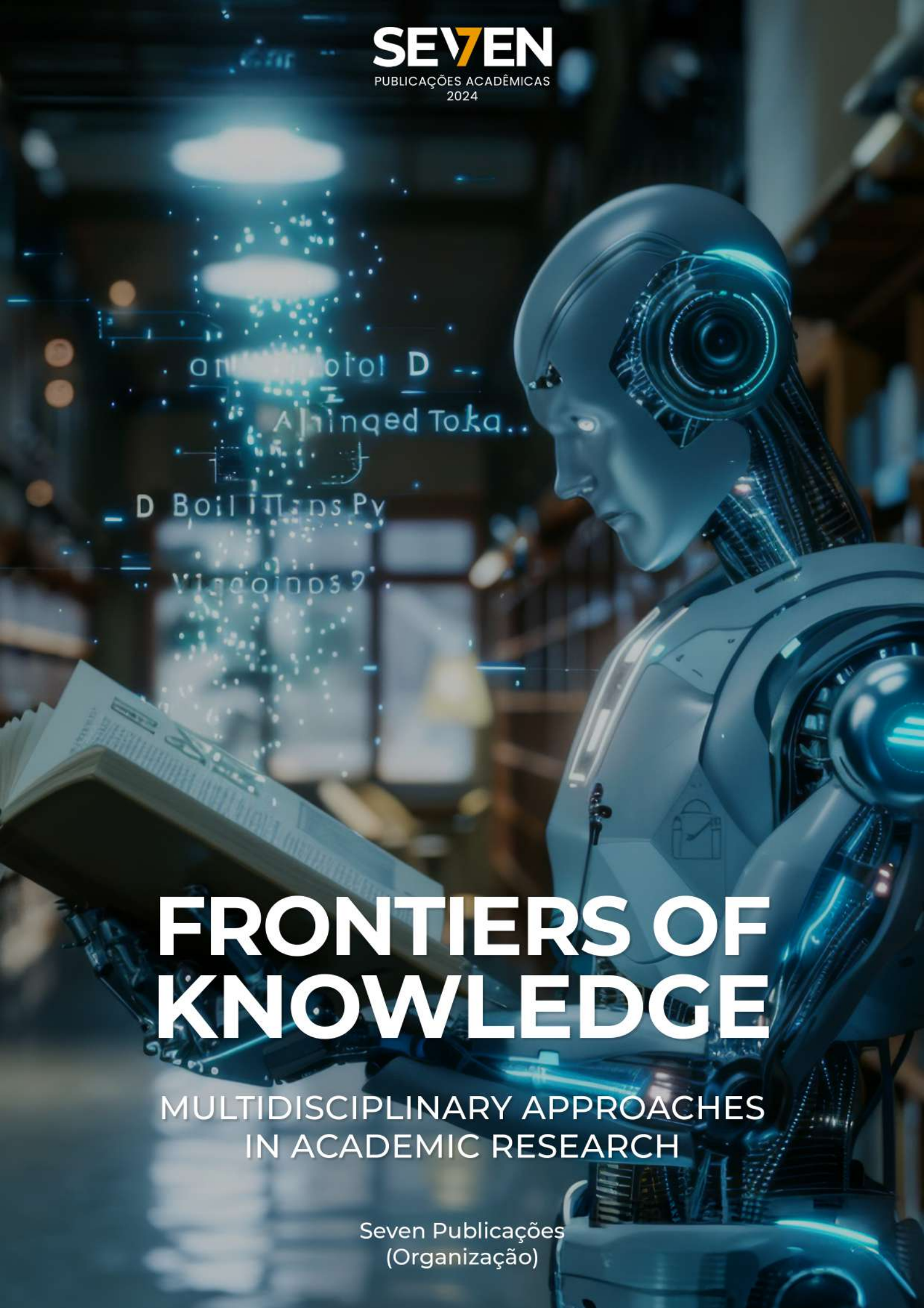

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On the agenda: The challenges for the preservation of school heritage

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ABSTRACT

The objective of this reflection is to present the research called "The digitization of the Institutional Collection as a possibility of Preserving the Memory of Professional and Technological Education" and to announce some of the possibilities identified in the use of technology for the preservation of institutional memory. Understanding that the conscious appropriation of the history of an institution makes it possible to signify and resignify its identity and social function, we seek to stimulate other actions in the context of preserving the history and memory of school institutions.

Keywords: History and Memory, History of EFA, Digital Collection, Digital Repository.

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INTRODUCTION[8]

This reflection presents the research called "The digitization of the Institutional Collection as a possibility of Preserving the Memory of Professional and Technological Education", approved by PROPESP[9] and developed at IFSUL/Campus Pelotas in the period 2022-2024. The investigation in question continued the studies that were carried out by the project "The Institutional Collection as a Space for the Preservation of the Memory of Professional and Technological Education", also approved by PROPESP and developed between the years 2021 and 2022, at the time aimed to survey, catalog and clean part of the documentation of the IFSUL/Pelotas Campus.

The project "The digitization of the Institutional Collection as a possibility of Preserving the Memory of Professional and Technological Education", approved in 2022 and renewed for another year in 2023, sought to digitize part of the institutional documentation of IFSul/Campus Pelotas with a focus on preserving the institutional memory of Professional and Technological Education. This proposition consolidated the creation of the Digital Repository History and Memory of Professional and Technological Education (HeMEPT), located on the Pelotas Campus page and available for public consultation at the electronic address: http://hemept.pelotas.ifsul.edu.br/hemept/.

The research developed here locates in the field of the history of education and analyzes in the documentation issues related to the consolidation of an identity for technical-professional education in the southern region of RS/Brazil. It contemplates the initial years of operation of the institution until the 1950s, considering the limit of human resources for the work of cleaning, organization, cataloging, digitization and finally availability in the digital repository. However, the relevance of such a project in the context of the preservation of institutional memory and in the promotion of research in the field of Education and History is highlighted.

Given the context of the creation of professional technical schools and the dissemination of an identity for technical courses in the early twentieth century, it is considered significant to understand the local particularities and their connections with the regional and national context, considering for this the access to the history of IFSUL/Campus Pelotas, which is among the first schools to offer professional education in the state of Rio Grande do Sul.

THE CHALLENGES FOR THE PRESERVATION OF SCHOOL HERITAGE

The study of the History of Brazilian Education is mainly anchored in the analysis of documents produced throughout history, in the different regions of the country (documents, books, magazines, periodicals, newspapers, photos, etc.) that record educational practices and the

[8] This production is part of the reflections carried out within the scope of the research project entitled "The digitization of the Institutional Collection as a possibility of Preserving the Memory of Professional and Technological Education", in the process of completion, promoted by IFSUL/ Campus Pelotas and with financial support from CNPQ and FAPERGS.
[9] The acronym PROPESP refers to the Dean of Research and Graduate Studies of IFSUL.

individuals involved in this process. Analyzing the remnants of each era in order to establish meanings is one of the great challenges of historiographical research.

However, access to documents or traces of the past is not always easy, as they are often not public knowledge, or have not gone through an appropriate archiving process. They are not properly indexed and cataloged, or they are stored inadequately, suffering from deterioration from their use, the action of time, temperature, humidity, physical, chemical and biological agents. Often, such documents are kept in geographically distant collections, making it impossible for students and researchers to access these historical sources.

Institutions such as libraries, museums, archives and documentation centers are initiatives that have been adopted and that intend to face the aforementioned challenges, through the safeguarding of documents that are cultural heritage. At the same time, digital repositories and collections are added to these initiatives.

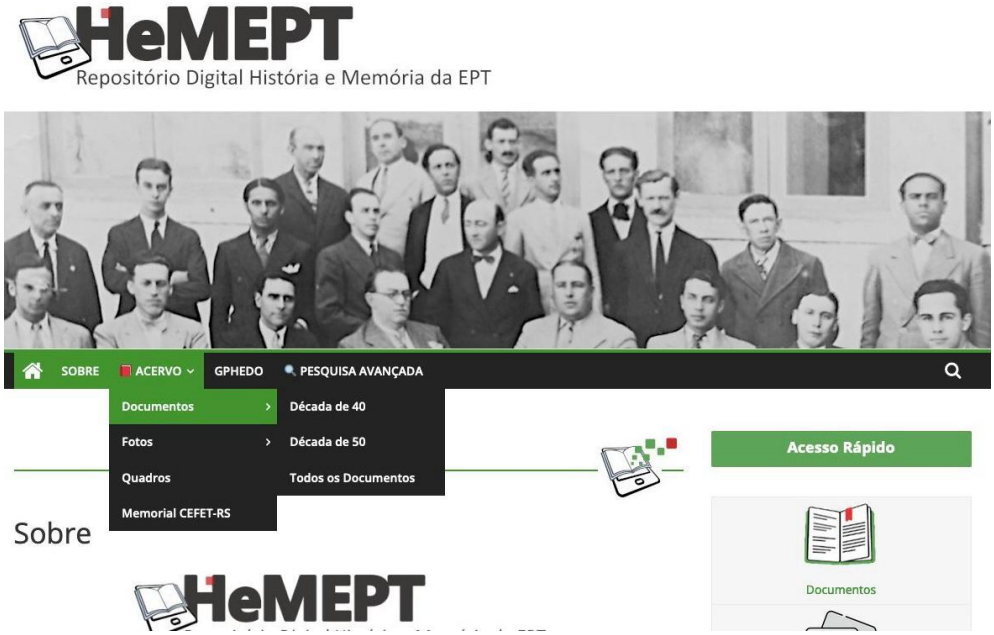
In order to join efforts to solve this problem, the dissemination and access to these documents, considering the advent of new Information and Communication Technologies (ICTs), the possibility of their digitalization arises, thus enabling their conservation, publicization and free and easy access to these contents through the Internet. In this context, with the resources of Information and Communication Technology (ICT) it is possible to convert elements of physical and material reality to digital reality, facilitating the access, diffusion and dissemination of information through the internet.

Certainly, one of the biggest challenges for those who work with historical collections is to make these materials reach the interested public. Digitization is one of the ways to facilitate and democratize access to these historical sources, but there are several challenges involved in this process to be overcome, both because of the technological resources involved, and in terms of access and visibility of these digitized materials on the Internet.

The digitization of school collections allows the preservation of heritage and its availability to researchers and interested parties from the general public, it is a strategy that publicizes the history of the institution and enables access in an easy and agile way. In addition, digitization allows the preservation of documents that are often subject to harmful weather and environmental conditions. By digitizing these documents, we consolidate a digital version that can withstand time unscathed.

Another benefit of digitization is that it allows for a better organization of the institution's history. With digitized documents, it is possible to carry out more accurate and detailed research, in addition to making access to information quick and practical, it is an efficient form of preservation, since technology can avoid handling the material and consequently its wear and deterioration.

Image 1 - HeMEPT homepage



Source: HeMEPT, 2024

In an attempt to illustrate the power of digitizing documents for the preservation of institutional memory, we use the illustration in image 1, on the opening page of HeMPET, which is available for public consultation on the Pelotas Campus page and at the address: http://hemept.pelotas.ifsul.edu.br/hemept/. The repository was created from the research project presented here and today democratizes access to the history of the school, as explained in the highlighted image, when entering the repository it is possible to access documents, photos and other records of the daily life of the school.

It cannot be denied that, at the very least, digital technology can provide excellent access to the intellectual content of digitized artifacts, safeguarding the originals from unnecessary manipulation, and delaying their deterioration. To prevent degradation caused by direct and constant access, valuable items are stored in secure archives, available to few researchers. This is frustrating because when documents are out of reach of the public, the task of keeping memory alive is not being properly fulfilled. Digital technology emerges as a possibility to break the compromise between preservation and access of opposites, these dimensions become cooperative. (VALLE; ARAÚJO, 2005, p. 132)

Digitization can expand the possibilities of analyzing the document that becomes available to a larger number of people, access to texts, images, documents and many others can be carried out in real time by a greater number of people, who can appropriate, reformat and return to cyberspace new information, the documents, which were once defined only as guardians of memory, they become emissaries of past events, with the possibility of resignification in the present. And this new function may earn them a place in the future (DODEBEI, 2011).

METHODOLOGICAL PROCEDURES

All the material, in the established cut, has already been properly sanitized and cataloged during the project "The Institutional Collection as a Space for the Preservation of the Memory of Professional and Technological Education", after this work, the digitization phase of the materials of the collection was carried out, which is still in progress. The materials located in the collection are divided into three types: books, photos and paintings.

The books are stored in cabinets and the paintings are wrapped in TNT or cardboard boxes. The photos cover a periodization that covers from 1930 to the 2000s, which are stored in 14 Styrofoam boxes for their better conservation, it should be noted that this article only addresses the initial periodization until the 1950s, as established in the project cited here.

Caring for materials during scanning is an important step and that is why all materials are handled with the use of gloves in an airy environment. The scanning stage is carried out on a table attached to a specific light and with the help of a cell phone. In the scanning, photos are obtained in jpg format, which need to be processed in the Notebloc or ClearScanner applications, which are obtained free of charge for Android and iOS systems that allow the conversion of jpeg to a PDF file.

The digitization of materials is a slow step, especially in relation to books, where the pages need to be handled with great care. The photos are stored separately and with an identification card, all on a cardboard wrapped in a sheet of tissue paper, the digitization includes the card and each photo individually.

Books need to be careful when handling because they are sensitive materials that can suffer page breaks, especially sheets that are, in some cases, made of fragile and thin paper. The digitization of books is time-consuming because it is done from the cover, front and back cover, in addition to all the front and back pages, which some books have approximately 900 pages. Thus, it was decided to digitize the first 50 pages of all the books and, only after this digitization process, will the other pages be digitized.

The paintings are placed on the white TNT fabric and the photos of the materials are taken, but some of these paintings are arranged in the corridors of the institution and the photos are taken at the place of origin.

The database is collected and stored on a drive, which contains all this information in an organized way. To date, it has been possible to identify 57 books, 1 box with 134 photos and 7 graduation pictures up to the year 1959.

The established survey corresponds to all the material that we have located in the institution so far, but it should be noted that we eventually receive the donation of new materials that are incorporated into the total amount of documents listed in the project "The digitization of the

Institutional Collection as a possibility of Preserving the Memory of Professional and Technological Education".

Thus, some books were received after the cataloging process, which were sanitized, cataloged, digitized and incorporated into the total amount of the survey carried out. These books were related to those exhibited in the Institutional Memorial, entitled 'Identification Book', 'Protocol Book' and 'Exam Book', the three were worked on and returned; we also received a 'Book of Teaching Methods' that was kept in a specific course at the institution. All the materials located bring the history of the institution to the current context and are relevant in preserving the memory of professional education.

FINAL CONSIDERATIONS

The context of the creation of professional technical schools and the dissemination of an identity for technical courses at the beginning of the twentieth century was a milestone for the development of education in the country. The history of education at IFSUL - Pelotas Campus portrays the changes that have been happening over time, so it is considered relevant to understand some of the local particularities, considering the access to documentation present in the Institutional Collection of Campus Pelotas.

Digitization brings multiple possibilities for the preservation of historical documents, preserves documents, books, photos and paintings, which bring to light the identity existence of the institution. It is also important to highlight that the digitization of collections in educational institutions can be a strategy for promoting access to information and social and cultural development, making the content available to a wider audience, including people who do not have physical access to the original materials, playing an important role in promoting access to information and the democratization of knowledge, The digitization of collections in educational institutions is an ongoing process.

The Project is important for the possibility of using the institution's future digital collection as a research tool, allowing access to historical materials, for study, research and development purposes, stimulating the production of new knowledge and the promotion of institutional culture. It is also noteworthy the use of metadata to organize the material allocated in the virtual environment, providing contextual details about a given document, helping in interpretation and playing an important role in long-term preservation, as metadata is an instrument to organize, describe and facilitate access to stored resources, enabling the provision of additional important information, that will allow the discovery, retrieval and understanding of these resources.

Finally, the facilitated access to institutional history can serve as a support for numerous researches at the local, national or international level and consequently contribute with new elements to the understanding of Brazilian professional education.

REFERENCES

1. Farge, A. (2009). *O sabor do arquivo*. Edusp.

2. Greenhalgh, R. D. (2011). Digitalização de obras raras: algumas considerações. *Perspectivas em Ciência da Informação*, *16*(3), 159–167. Disponível em: http://portaldeperiodicos.eci.ufmg.br/index.php/pci/article/view/866. Acesso em: 12 jan. 2019.

3. Instituto Federal Sul-rio-grandense (IFSUL). (2024). *Repositório Digital História e Memória da EPT- HeMEPT*. https://hemept.pelotas.ifsul.edu.br/hemept/

4. Bloch, M. (2002). *Apologia da história ou o ofício do historiador*. Jorge Zahar.

5. Candau, J. (2014). *Memória e Identidade*. Ed. Contexto.

6. Dodebei, V. L. (2011). Cultura digital: novo sentido e significado de documento para a memória social?. *DataGramaZero*, *12*(2). Disponível em: http://hdl.handle.net/20.500.11959/brapci/7335. Acesso em: 17 maio 2023.

7. Freire, P. (1982). *A Importância do Ato de Ler*. Cortez Editora.

8. Greenhalgh, R. D. (2011). Digitalização de obras raras: algumas considerações. *Perspectivas em Ciência da Informação*, *16*(3), 159–167. Disponível em: http://portaldeperiodicos.eci.ufmg.br/index.php/pci/article/view/866. Acesso em: 12 jan. 2019.

9. Le Goff, J. (2003). *História e Memória* (5ª ed.). Unicamp.

10. Lüdke, M., & André, M. E. D. A. (2014). *Pesquisa em Educação: Abordagens Qualitativas* (2ª ed.). EPU.

11. Meireles, C. M. S. (2007). *Das Artes e Officios à Educação Tecnológica: 90 anos de História*. Editora da UFPel.

12. Merlo, F., & Konrad, G. V. R. (2015). Documento, história e memória: a importância da preservação do patrimônio documental para o acesso à informação. *Informação & Informação*, *20*(1), 26–42. Disponível em: https://doi.org/10.5433/1981-8920.2015v20n1p26. Acesso em: 25 maio 2022.

13. Reifschneider, O. D. B. (2008). A importância do acesso às obras raras. *Revista Ibero-Americana de Ciência da Informação*, *1*(1), 67–76. Disponível em: https://doi.org/10.26512/RICI.V1.N1.2008.910. Acesso em: 12 jan. 2019.

14. Sayão, L. F. (2008). Bibliotecas digitais e suas utopias. *Ponto de Acesso*, *2*(2), 2–36. Disponível em: https://portalseer.ufba.br/index.php/revistaici/article/view/2661/2166. Acesso em: 13 nov. 2018.

15. Severino, A. J. (2002). *Metodologia do trabalho científico* (22ª ed.). Cortez Editora.

16. Roschild, A. B. (2021). *A Escola de Artes e Ofícios de Pelotas/RS e o Ensino-Técnico Profissional (1917-1930)* [Dissertação de Mestrado, Instituto Federal Sul-rio-grandense, Campus Pelotas].

17. Silva, S. C. A. (1998). *Algumas reflexões sobre preservação de acervos em arquivos e bibliotecas*. Academia Brasileira de Letras.

18. Valle, E., & Araújo, A. (2005). Digitalização de acervos, desafio para o futuro. *Arquivística, Arquivo Mineiro*. Disponível em: http://www.siaapm.cultura.mg.gov.br/acervo/rapm_pdf/Digitalizacao_de_acervos_desafios_para_o_futuro.PDF. Acesso em: 17 jun. 2024.

Business management in the digital age: The power of electronic contracts

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Abdo Dias da Silva Neto[1] and André Luis de Oliveira Silva[2]

ABSTRACT

The present study brings to light a focus directed to the uncertainties of information, one of the most complex issues in the new branch of Internet law. Its importance lies in the fact that, on the network, many of the facts and legal acts have international implications and, therefore, generate some problems that need urgent solution. These solutions are of interest to both the individual and the collective order, encompassing the interest of science as a set of knowledge in itself. The objective is to elucidate the unknown truth of the facts arising from electronic transactions, promoting a deeper and more comprehensive understanding of these interactions. In addition, it seeks to achieve a maturation of the current legal order, adapting it to the new realities imposed by technological and digital evolution. In this way, the study contributes to a more robust and effective legal scenario, capable of dealing with the contemporary challenges presented by the virtual environment.

Keywords: Management, Auditing, Business, Contracts, Internet, Virtual Contract.

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INTRODUCTION

The present study brings to light a focus on Brazilian e-commerce, which grew by about 27% in 2020, driven by the COVID-19 pandemic. Sales using the Internet reached the level of 87.4 billion reais in 2020, according to data from Ebit/Nielsen (EBIT/Nielsen, 2021). The pandemic has also accelerated the digitization of contracts around the world, forcing companies to quickly adapt their operations to the online environment. This move has not only driven the growth of e-commerce but has also highlighted the need for security and reliability in e-contracts. As reported by Johnson (2023), many companies that resisted digitalization were forced to adopt electronic contract technologies to maintain business continuity (Johnson, 2023)

The main concern of civil law, as a legal science, is to monitor and evolve the contractual tools of the new relationships and negotiations conquered by the commercial dynamics. It is known that information technology is a necessity for business, commercial and leisure relationships. Several facilities expand the range of possibilities in the internet world, such as car purchases, videoconferences, auctions, loan acquisition, among thousands of other business relationships.

In terms of Brazil, online purchases made by its consumers skyrocketed, with an average spend of 450 reais per person in 2023, which corresponds to an increase of 25% when compared to the previous year. At that time, consumers spent an average of 360 reais. One of the factors that leveraged internet sales was greater consumer confidence and improved delivery infrastructure (EBIT/Nielsen, 2021).

The objective of this article is initially to construct parameters for the analysis of the main legal aspects involving civil law and the internet, with emphasis on electronic contracts. The problem is considered vast due to the breadth of the commercial relationship itself, which includes numerous readings and views on the suggested theme; However, it is incumbent upon the investigator to delimit the universe of the phenomenon treated, without, however, intending to exhaust this theme that is still much discussed internationally, but with few objective and concrete definitions.

It should be noted that, even drastically reducing the field of study, some concepts of law often considered secondary cannot fail to be addressed, such as the various concepts of internet contract, the various types of electronic contract, digital signature, among others that generate importance for the integral understanding of the theme that will be directed to the study of modern contracts.

The value of e-commerce reaches significant levels of the economy and it is easy to predict that growth is continuous and very significant for developing countries like Brazil.

Through this intellectual vastness, it is imperative to emphasize the core of the problem: the involvement of legislation and contractual evolution in civil law.

From there the work begins. Having outlined a brief overview of what electronic commerce is in Brazil, we conclude that electronic commerce can no longer be ignored by the law, requiring legal scholars to take the necessary measures to seek a path aimed at the maturation of our legal system with regard to electronic contractual relations.

In view of this issue, we know that the electronic contract differs precisely because it is a contract entered into at a distance, outside the commercial establishment, and this characteristic is very important for our civil legislation. The increase in the number of electronic contracts is surprising. Such an advance stems directly from direct sales to the consumer, leading to the law immediately, not by tradition, but by necessity, to shelter this new branch that emerges so strongly within society, generating obligations and duties of all kinds.

Despite the benefits, the implementation of electronic contracts faces several challenges. Among them, the lack of standardization, cybersecurity concerns, and cultural resistance stand out. According to (Smith, 2022), the absence of a uniform regulatory framework across different jurisdictions hinders the broad and consistent adoption of electronic contracts, which can lead to complex legal disputes (Johnson, 2023).

It should also be remembered the evolution of computers and cell phones, of the communication network that, consequently, increase the relations arising from the electronic medium, bringing to light a new theme to be addressed by the Brazilian jurisdiction.

In fact, the popularization of the use of cell phones is recent and, therefore, it is necessary to know all the tools available in our legislation that are applicable to telematic contracts.

Even in the face of great advances, the intention to study this topic is based on the concern of solving the disagreements created in the digital world, as well as preventing them from occurring and suppressing the existing gaps in our legal system. Such problems are increasingly present in the daily life of Brazilians, since, with technological advancement, new legal relationships are constituted through the world wide web.

The use of the Internet today is no longer the privilege of only the upper classes of the population; everyone accesses the telematic world, whether through private or public computers, thus successively increasing the number of relationships generated by this means. The success of this new mechanism was immediate, and the ease of data exchange led to its own expansion to government areas and, consequently, to educational and research institutions.

The future of electronic contracts looks promising, with technological advancements such as blockchain and artificial intelligence (AI) promising to increase the security and efficiency of these agreements. According to research by (Brown, 2023), the use of blockchain can provide an additional layer of verification and immutability, while AI can help in analyzing large volumes of contract data to identify risks and opportunities (Johnson, 2023).

The proposed theme is part of a current and controversial context, since thousands of people are connected to the Internet making contracts without knowing at least what type of person they are contracting with. It should be noted that the act of hiring through the network, despite seeming so simple, has an incredible magnitude, taking into account that, being so accessible to certain people, it has already become a habit.

It is now up to us, based on the case in question, to study and deepen the issue so that in the future it will be possible to decide in the face of this new reality whether there is a need to create new rules or whether it is only necessary to make use of the rules already existing in our legal system.

In view of this problem, one has the opportunity to study contracts in depth, making a parallel with electronic contracts and their derivations, reasons that will sometimes lead to enter into pure concepts of informatics, as well as to understand how such contracts are created, the requirements that make them valid, their classifications and the legislation applicable to them.

Despite the benefits, the implementation of electronic contracts faces several challenges. Among them, the lack of standardization, cybersecurity concerns, and cultural resistance stand out. According to (Oliveira, 2020), the absence of a uniform regulatory framework in different jurisdictions hinders the broad and consistent adoption of electronic contracts, which can lead to complex legal disputes.

Finally, the importance of the work is due to the attempt to clarify some points related to the contractual theme and the identification of legal gaps, because, even if the country presents state-of-the-art technology, if the current legal norms and the control of their application are not really effective, the advancement will be of no use, since the telematic means, instead of helping humanity, it would become a problem for them.

THEORETICAL FRAMEWORK

BASIC CONCEPTS AND LIMITS OF CONTRACTING

The proposed theme addresses the attitudes of society in the contractual field, specifically in the electronic and virtual world. To this end, the concept of contract is essential, without, however, intending to analyze it. The concept of "Contract" presents divergences in the national doctrine; however, the one by Fran Martins (M. Fran, 2001, p. 62) is close to the most consensual among the authors, accepted with relative pacification and reads as follows: "the agreement of two or more people to constitute, regulate or extinguish a legal relationship of a patrimonial nature".

Initially, it should be noted that, in the context of a modern Rule of Law, the new Brazilian Civil Code has not innovated or modified anything that may be useful when it comes to buying and selling through the internet. Therefore, it is necessary to use analogy and principles for all work and

study on the rules to be used in a possible litigation, because, at no time, the "Old Civil Code of 1916" or the "New Civil Code of 2002" brought rules related to the electronic medium in particular.

We then start to pay attention to the principles. Principles are norms that contain broad, abstract, flexible statements, without a finished ending, susceptible to interpretation. The principles guide and solve problems, being used by the legislator for the creation of laws, by magistrates for the decision of litigation, by doctrinaires for the elaboration of theories and by lawyers for the defense of theses. The proposed theme requires the use of principles, but we will also take advantage of the rules. Rules are norms that contain restricted, concrete, rigid, complete statements, developed to regulate behaviors, having immediate and incisive application on the factual reality presented.

The illustrious scholar Alexandre de Moraes <LINK> [1] teaches that probity is directly and intimately linked to the principle of morality, and probity, in common language, is synonymous with: honesty, integrity of character, honesty, rectitude, etc.

It is very logical and sensible to use the influence of Public Constitutional Law on Private Contract Law to compensate for inequalities through judicial assistance. Such a reason is justified in order to avenge the objectives of our Magna Carta. Articles 3 and 5 of the Federal Constitution of Brazil explain the social function of private property, as can be noted:

> Art. 3 The fundamental objectives of the Federative Republic of Brazil are: I – to build a free, fair and solidary society;
> Article 5 [...]
> XXII – the right to property is guaranteed;
> XXIII – the property shall serve its social function;

Doctrinally, Maria Helena Diniz <LINK> [2] puts on the screen the freedom to contract, the autonomy of will, explains that citizens can contract in the way that best suits them, through an agreement of wills, the discipline of their interests, giving rise to effects protected by the legal order. Regarding the limitations, it recalls that the principle of sociality as a form of contractual action is not absolute, as it is limited by the social function of the contract, which serves the common good and social purposes, as well as by the supremacy of public order that subordinates the contracting parties to the collective interest.

It is reinforced that, although there is a specific legislation, the "social function of the contract" accentuates the guideline of "sociability of the law" in fact, it is addressed to the interpreter in the application of contracts.

Mário Aguiar Moura <LINK> [3] talks about the importance of the contract, always emphasizing individual and collective interests such as the possibility of problems if both are confronted.

> […] The contract is in a position to provide relevant services to social progress, provided that the collective interest is based on the individual wills in confrontation through rules of public

order, which cannot be set aside by the will of both or any of the contracting parties, with the greater purpose of avoiding the predominance of the economically strong over the economically weak.

THE PRINCIPLES THAT GOVERN ELECTRONIC CONTRACTS

As there is a clear need to use the relevant principles, we will now expose some applicable principles in contract law:

a) Principle of autonomy of will – It is composed of the power of the parties to freely stipulate, as it best suits them, by agreement of wills, the discipline of their interests; it is the possibility of contracting and adhering to the contract that is deemed relevant;

b) **Principle of binding convention** – better known as pacta sunt servanda, here the parties must comply with what was contracted, without the possibility of changes, except if there is mutual agreement to do so or if it is a special or extraordinary case, such as in the case of an excuse for fortuitous events or force majeure, or even in judicial reviews for various reasons;

c) **Principle of consensualism** – Almost always the simple agreement of wills is sufficient to validate a contract; however, there are cases in which the law provides for the fulfillment of certain formalities and solemnities for the full effectiveness of the contract;

d) **Principle of relativity of the effects of the contract** – this principle states that the contract only generates effect between the contracting parties, not reaching third parties, whether benefiting or harming;

e) **Principle of good faith** – also as a general principle, this principle implies that the parties must act with reciprocal loyalty and trust, helping each other in the formation and execution of the contract; thus, in the interpretation of the contract, the real intention of the parties to the detriment of the literalness of the contracted text must be sought.

In the specific case of internet contracts, these are also governing principles that will directly influence the resolution of problems in the virtual field:

(a) **Principle of functional equivalence between legal acts produced by electronic means and legal acts produced by traditional means** – here it is verified that there is a prohibition of any differentiation between classic contracts with immediately representative tangible physical support (paper contract) and internet contracts with mediately representative intangible virtual support (electronic); therefore, it is impossible for the virtual contract to be considered invalid because it was entered into electronically;

(b) **Principle of the unalterability of the existing law on obligations and contracts** – here it is also possible to feel the force that equalizes virtual and tangible contracts. The

electronic support is only a vehicle for the constitution of contracts; that is, the obligations originated in the virtual environment do not need, in order to be valid, a change in the current contractual law;

c) **Principle of identification** – in order to avoid future conflicts and inquiries, it is necessary to pay attention to the existence of proper identification of the parties who enter into a contract over the internet, so that both know who they are dealing with, which can be done by means of a digital signature, among other possibilities;

d) **Principle of verification** – finally, all electronic documents related to the agreement must be stored so as not to be the object of an allegation of their non-existence and to enable any possible future verification, thus preserving the proof of the contractual conclusion.

In view of the above, electronic contracts are based on the common principles of contracts. Based on this information, it is concluded that its subjective requirements for validity are the same as those of common contracts. Thus, it is necessary that there be two or more people freely expressed will and the civil capacity for the act, for the act to be validly completed.

The same idea arises when commenting on the objective requirements of validity, such as the lawfulness of the object, its economic value, the physical and legal possibility of its accessibility.

THE SECURITY OF AN ELECTRONIC CONTRACT

A question naturally arises about the guarantees that the contractor will have that the contract will be terminated by the other party, since in the virtual relationship there may be no documentary evidence, and without it it becomes immensely difficult to comply with the agreement.

It is logical that the contracting parties in the virtual electronic environment, as in the physical environment, have the need to wait and demand from the other party probity and good faith in the contracts; Even so, today the concept of document must be expanded so that it equally encompasses the electronic document, always bearing in mind that the latter is not necessarily tied to the medium in which it was created and that its materialization is simple.

With the intention of further increasing security, the encrypted digital signature comes to the fore. As already mentioned, the electronic contract is marked by being made without contact between the parties, making this an inherent characteristic of them. The parties use different computers, connected from the most diverse parts of the world, which undoubtedly generates some insecurity, since the consumer may end up being deceived by a criminal.

The internet contract is safe and undeniable that it has several advantages, because in addition to reducing administrative costs, it is fast, which explains the strong growth in recent years around

the world. This modality is generally used for the purchase of any type of goods and for contracting services, financial transactions through internet banking, among many other facilities.

It is of essential importance that contracts are well described, since the parties are not face to face to clarify points that may not be well understood. Thus, we have that the interpretation of the electronic contract is something special to study. The Civil Code, for example, in its article 423, mentions that the adhesion contract must be interpreted in a more favorable way to the adherent. In the consumer system, the Consumer Protection Code (CDC), in its article 47, understood concomitantly with article 54, already uses this interpretation in ambiguous and contradictory clauses, due to the vulnerability and hyposufficiency of consumers in many cases.

The consumer contractor will continue in the electronic contract holding his rights, because in most cases there is a huge imbalance of forces of the contractors due to the needs of the contractor vis-à-vis the contractor, formalizing pre-established clauses.

THE BIRTH OF THE ELECTRONIC CONTRACT

Attention should be focused on the date of formation of the contract. This term is essential, as it is from there that the duties and rights arise for the contracting parties, executing the agreed business without the unilateral possibility of retraction and with the bond of contractual liability that comes to be created. The contract is "born" when the proposal is accepted through a directed declaration.

Normally, in conventional contracts with parties present, the agreement is confirmed when the oblate accepts the proposal, since the presence of the parties allows such deliberation.

Therefore, under the terms of the proposed theme – Electronic Contracts – the sending of the electronic message confirming the acceptance of what is proposed will be applied as a legal moment of the perfection of the contract, thus becoming a perfect legal act.

PLACE OF EXECUTION OF THE VIRTUAL CONTRACT AND TERRITORIAL JURISDICTION

Another concern that should be taken when it comes to electronic contracts is regarding the determination of the place where the contract is concluded. Such observation is essential for the resolution of problems arising from the definition of where the injured party may seek the legal means to resolve the impasses arising from the fulfillment of the contract, as well as the applicable law, which may often result in a question of law.

From the above reading, it is concluded that the authority will be Brazilian whenever the defendant, whatever its nationality, is domiciled in Brazil, when the obligation has to be fulfilled in Brazil, even if the proponent resides abroad, and in cases involving real estate located in Brazil, as

well as when the demand arises from a fact or act that occurred in Brazil. Such exceptions are in the form of clearly protecting the consumer residing in Brazil. If these exceptions are overcome, the competent court will be that of the country where the contract was constituted, thus excluding the jurisdiction of the Brazilian courts.

CLASSIFICATION OF THE ELECTRONIC CONTRACT

The search for the organization and the need to identify electronic contracts has led the doctrine to classify virtual contracts in different ways. It is important to highlight the most common in the legal environment.

Interactive Electronic Contracts

Interactive electronic contracts are used in greater numbers in the virtual field, making it the most peculiar. Its shape is the most typical, fitting fully into what has been exposed so far.

It is an interactivity between an Internet user and a system equipped with specific accessible information, created and made available by a company or even by another person who may not even be connected, being aware of the hiring later.

These contracts happen billions of times a day around the world, in a simple person/program interaction, where hiring interest is demonstrated (EBIT/Nielsen, 2021).

It should be noted that the application system with which the communication takes place is nothing more than a computer program with the function of accessing a specific database. Such a program is usually endowed with functionalities capable of directing the Internet user to services, consumer goods, products, forms, etc.

A critical point that must be differentiated is the fact that these contracts have as a characteristic a large load of generality of clauses, which cannot be confused with the infamous adhesion contracts.

Adhesion contracts naturally have clauses that are pre-established by one of the parties, without these clauses being able to be modified or at least discussed. Most of the time, such contracts are delivered in written form, where only necessary data is completed, such as name, values and locations.

What happens in Interactive Electronic Contracts, on the other hand, is the intrinsic affinity with the general conditions of the contracts. Here, the conditions to which interactive contracts are submitted, even with the acceptance of both parties tacitly or expressly, and with clauses constructed previously, differ from the adhesion contract because they do not have a rigidity such as the latter. However, a form of interactive electronic contract can become an adhesion contract, everything will depend on the softness and the possibilities of making changes to them.

In view of this form of classification, the contracting party interacts with a system to which it knows who its owner is, thus causing the will to be expressed, generating the contractual bond. Therefore, the computer interconnected to the network, used in this way, acts as an auxiliary in the process of forming the will.

Intersystemic Electronic Contracts

These are characterized when the computer is used as a convergent point of pre-existing wills, that is, the parties synthetically direct the wills resulting from prior negotiation, without the equipment intervening in the field of will, since it was already pre-existing.

Therefore, it is observed that the computer is only a tool that enables the parties to expose their wills in carrying out a valid legal transaction.

As should be noted, in the present case, the will was born when the systems were "predestined", because there the volitional manifestation of the parties covered by the intersystemic contracts occurred when the systems were programmed for the consummation of each of the electronic communications.

Technically, in this type of electronic contracting, the use of Electronic Data Interchange (EDI) stands out, which allows electronic dialogue between different application systems through the use of "standard documents" or "EDF standards".

In fact, this form of contracting is characterized by being carried out between legal entities and is notably aimed at wholesale commercial relationships. An EDI operation occurs, for example, when an enterprise participates with a supplier's sales system in order to purchase a product. In this understanding, electronic purchase order documents and all the logistics involved are exchanged, for example (EBIT/Nielsen, 2021).

In this contractual form, the use of the computer is a simple means of communication, the main contract is entered into in a traditional way and, in it, the general rules of operation of subsequent occurrences made through the use of the computer are constituted, which may constitute other contracts called "derivative".

Interpersonal Electronic Contracts

Contracts solemnized by computer when it is used as a direct means of communication between the parties, that is, there is the simultaneous will of both parties at that exact moment. The interaction is not done by any program or computer system, since here the will is not pre-established. Human interaction is the great characteristic of this contractual form, with the computer being only the communication tool.

This type of contract can be divided into two different categories, depending on whether or not the declaration of one party and its reception by the other are simultaneous.

The first classification is due to interpersonal electronic contracts that have simultaneity in the celebration in real time in the virtual world. Contracts are signed by parties that are at the same time linked to the network, expressing the declaration of intent and that this declaration is received by the other at the same time it is declared or in a short period of time.

This article is very important, as it has extended the scope of probabilities of having agreement between those present at the disposal "or by means of similar communication".

With this wording, any means of contracting that resembles the provisions of the law will not need analogy or new legal wording to be considered as a contract between those present.

Contracts in which the protest and the reception of the will do not occur simultaneously, but for which there is a space of time between the declaration of one party and the reception of it by the other party, are non-simultaneous interpersonal electronic contracts.

In the context of this research, it is observed as non-simultaneous contracts those entered into via e-mail, which, as can be inferred from the name itself, is equivalent to a common correspondence.

If the parties exchange e-mails instantly, it is a matter of simultaneous operations, as long as both are connected to their computers at the same time; However, if there is a certain period between the exchange of messages, the contract should not be classified as simultaneous.

A second school of thought understands that, even if communication via e-mail is very light, it cannot be evaluated as instantaneous. This is due to the fact that, in order to have access to the message sent by e-mail, it is imperative to have a new influence with the computer.

In fact, for those who follow this current, it is imperative that there is a new action so that the possibility of accessing the content of the message received is born, which removes the instantaneity of communication.

METHODOLOGY

The methodology adopted in this study allowed a comprehensive and detailed analysis of the use of electronic contracts in business management. The combination of literature review, document analysis, case studies, interviews and content analysis provided a robust and multidimensional approach, essential to understand the complexities and implications of electronic contracts in the business environment.

This study followed a qualitative methodological approach, based on a literature and documentary review, aiming to understand the application and impact of electronic contracts on business management. The methodology was structured in the following stages:

The first stage consisted of an extensive review of the existing literature on electronic contracts and their application in business management. Relevant scientific articles, books, theses and dissertations were selected, available in academic databases such as Scielo, Google Scholar and CAPES journals. The selection of sources was based on relevance, timeliness and contribution to the understanding of the theme.

The document analysis was conducted based on legal documents, guidelines, rules and regulations related to electronic contracts and business management. Documents such as the Brazilian legislation on electronic contracts, case reports and corporate policies for contract management in Brazilian companies were examined.

The collected data were analyzed qualitatively using the content analysis technique. This technique allowed the identification of recurring themes and emerging categories, which were organized and discussed based on the theoretical framework. Content analysis facilitated the triangulation of the data, ensuring greater validity and reliability of the results.

CONCLUSION

It is clear that the Civil Code should be used together with the Consumer Code, with the parties in the electronic environment being better protected by the communion of laws.

Even with great efforts, the new articles created in the New Civil Code did not innovate specifically regarding the Purchase and Sale Agreement through the Internet, E-Commerce and even electronic law. It is concluded that the applicator of the law should, on a case-by-case basis or even in theory, make analogies and guesses about the thinking of the new legislator.

This is the problem of Civil Contract Law highlighted in this monograph. Is it appropriate to have to do guessing? Will the application of the analogy be 100% effective? The obvious leads to negative answers, as it is common for human beings to make mistakes, which directly affects the legal certainty of the Rule of Law (EBIT/Nielsen, 2021).

We live in times of innovation, and the moment to regulate electronic contracts was with the creation of the New Civil Code. It is also not a lack of legislation that will prevent the growth and expansion of the reality of the electronic world; However, there will be a delay in the problems generated by this growth.

Finally, it should be noted that this evolution reflects the contemporary way of life in many aspects, not only in the field of virtual commerce, hence the importance of organizing national legislation. If this action is delayed, the problems will grow exponentially. It is important to remember that today we can thank the thinkers who work to improve the situation, creating specific doctrines and jurisprudence, preparing a field for commerce to grow healthy.

REFERENCES

1. Albertin, A. L. (2004). *Comércio eletrônico*. Editora Atlas.

2. Andrade, R. A. de. (2004). *Contrato eletrônico*. Editora Manole.

3. Aoki, E. (1996). Comércio eletrônico – modalidades contratuais. In *Anais do 10 Seminário Internacional de Direito de Informática e Telecomunicação* (dez.). Associação Brasileira de Direito de Informática e Telecomunicações.

4. Barbagalo, E. B. (2001). *Contratos eletrônicos*. Saraiva.

5. Bessone, D. (2001). *Dicionário jurídico brasileiro*. Del Rey.

6. Blum, R. O. (2001). *Direito eletrônico – a internet e os tribunais*. EDIPRO.

7. Brandini, E. (2000). Formação e eficácia probatória dos contratos por computador. In *O comércio eletrônico, Anais do 11° Seminário Internacional de Direito de Informática e Telecomunicações*.

8. Brasil. (1990). Lei nº 8.078 de 11 de setembro de 1990. Dispõe sobre a proteção do consumidor e dá outras providências. Disponível em: https://www.planalto.gov.br. Acesso em: 29 jul. 2024.

9. Brasil. (2002). Lei nº 10.406 de 10 de janeiro de 2002. Lei de introdução ao Código Civil. Disponível em: https://www.planalto.gov.br. Acesso em: 29 jul. 2024.

10. Bruno, M. G. da S. (2001). Aspectos jurídicos dos contratos eletrônicos. *Jus Navigandi*, 5(51), out.

11. Comparato, F. K. (2004). *Manual de direitos do consumidor*. Editora Atlas.

12. Dicweb. (2003). *Dicionário de informática*. Disponível em: http://www.dicweb.com/. Acesso em: 29 jul. 2024.

13. Ebit/Nielsen. (2021). *Webshoppers 44ª edição: Relatório de E-commerce no Brasil*. Disponível em: https://www.ebit.com.br/webshoppers. Acesso em: 19 jul. 2024.

14. Filomeno, J. G. B. (2004). *Manual de direitos do consumidor*. Editora Atlas.

15. Glanz, S. (2004). Contrato eletrônico. In R. A. de Andrade (Ed.), *Contrato eletrônico* (p. 29). Editora Manole.

16. Green, H. (2021). The evolution of e-contracts in a post-pandemic world. *Journal of Digital Law*. Disponível em: https://journaldigitallaw.org. Acesso em: 19 jul. 2024.

17. Johnson, M. (2023). The digital transformation of contract management: Lessons from the COVID-19 pandemic. *Journal of Business and Technology*.

18. Lima Neto, J. H. B. M. (1998). Aspectos jurídicos do documento eletrônico. *Jus Navigandi*, 2(25), jun.

19. Mendes, R. (2019). Blockchain technology in legal contracts: Opportunities and challenges. *Revista Brasileira de Direito Digital*. Disponível em: https://rbdigital.org. Acesso em: 19 jul. 2024.

20. Oliveira, P. (2020). Cybersecurity and electronic contracts: Ensuring integrity in digital transactions. *International Journal of Cyber Law*. Disponível em: https://ijcyberlaw.org. Acesso em: 19 jul. 2024.

21. Pinto, A. L. de T., Windt, M. C. V. dos S., & Céspedes, L. (2008). *Código civil* (59ª ed.). Saraiva.

22. Sampaio, R. P., & Souza, C. A. P. de. (n.d.). Contratos eletrônicos – um novo direito para a sociedade digital?

23. Silva, J. (2022). Artificial intelligence in contract management: A new frontier. *TechLaw Review*. Disponível em: https://techlawreview.org. Acesso em: 19 jul. 2024.

Sustainable vegetable garden in the school environment: A STS approach in elementary school

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ABSTRACT
We will present here the results of a research that aimed to ascertain the pedagogical potential of an educational product linked to the construction of a sustainable vegetable garden with students of the 5th year of Elementary School. This educational product was structured from a STS (Science, Technology and Society) approach in order to develop learning and skills capable of expanding the students' repertoires about Science, Technology and, mainly, about its implications in our society and environment. Our study is qualitative and as a data collection instrument we used a field diary. The data revealed that pedagogical actions – such as those of school gardens – supported by a STS approach contribute to the formation of students who are more critical about food and healthy processes related to human health.

Keywords: Organic food, Science, Technology and Society, Elementary School of the Early Years, School Garden.

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INTRODUCTION

Throughout history, science and technology have become essential to human development; both are present in all spaces of life and are part of people's coexistence (Leal, 2010). Technology has been latent since the Prehistoric periods, in which the individual sought to settle in certain places to manually build his first vegetable gardens to acquire food. Thus, we observe that from a very early age the individual had the need to operationalize certain knowledge/knowledge (science[4]), build data artifacts (technologies) and, thus, promote better conditions of adaptability for their existence; In this process of increase, agriculture proved to be a technological construct full of scientific knowledge undertaken by the subjects so that they could meet their food and nutritional needs, thus helping them to move away from nomadic life, predatory-extractive harvesting and hunting as exclusive food sources. In view of this, we can emphasize that individuals at that time were already developing scientific and technological knowledge to support their own livelihood.

In modern times, scientific and technological knowledge has increasingly undergone innovations in society and one of them, to stay in the field of the food issue, was the replacement of manual work for mechanical work, seeking to meet the demand for food productivity, due to population growth. With this and as an alternative to the expansion of agricultural production, we had an excessive increase in the use of pesticides in the search for greater productivity and profitability of food production. Thus, with the indiscriminate use of pesticides by farmers, we have (1) a vertiginous increase in health problems in living beings and (2) the environment increasingly impacted.

In this context, the STS (Science, Technology and Society) approach has been inserted in school and educational spaces with the intention of provoking in individuals, in a critical way, the development of knowledge that questions this socio-environmental panorama correlated to the processes of transformation given by Science and Technology in humanity. Thus, one of the ways to provide the STS approach in school is through the insertion of new pedagogical approaches, thus providing students with a more critical look at the technological and environmental issues of their reality. In view of this approach, it made possible, through scientific and technological knowledge, the implementation of an organic-school garden at the Nilza de Oliveira Pipino Municipal School, located in the municipality of Formosa do Oeste-PR.

[4]Here, we assume a broader notion of science, such as that described by the authors Felipe Fontana and André da Paixão Gomes, in the article entitled "Black culture and African scientific legacy for a more dynamic teaching of the natural sciences"; For them: "[...] Scientific thought and science are commonly regarded as incontestable and irrefutable truths, a type of systematic knowledge – built through a rigorous and tested method of investigation and analysis – aimed at understanding the reality that surrounds individuals in order to promote their transformation and a consequent greater adaptation of them to their environment. Now, if we use this metric as an interpretative lens and observe other societies, we will notice that numerous social and human groupings – alien to the Eurocentric and Western axis of humanity – produce a relevant scientific thought that, in turn, is full of specificities, contributions and meanings. In other words, considering this view, we observe that Humanity has not produced a single legitimate scientific thought – as educational institutions would have us believe – but rather an amplified and polyphonic set of ideas that have attempted to transform the world and promote a greater adaptation of individuals to their environments" (Fontana, 2018, p. 7).

Through partnerships made with the City Hall and the Department of Education and Culture of Formosa do Oeste-PR, we raised the subsidies for the implementation of an organic garden. In this direction and assisted by technicians specialized in each function, we provide opportunities – with the construction of flowerbeds, with the fertilization of the land, with the installation of the rainwater harvesting system and with the installation of sprinklers for irrigation – the possibility of promoting in the students, in a dialogical and operationalized way, the latent link between scientific knowledge, technological artifacts and the imperative of food subsidies necessary for the existence of the subjects of our society.

The research underlying[5] this article was based on the action research methodology, safeguarding a qualitative approach. According to Gil (2016), action research is characterized by its flexibility and involves the action of the researcher and groups of interested parties in the most diverse moments of pedagogical action. There is a constant back and forth between the phases, which is determined by the dynamics of the relationship between the researchers and the researched situation. Among this approach, the research aimed to investigate the pedagogical potential of an educational product for the construction of a sustainable garden in a class of the 5th year of Elementary School. To make this possible, we listed specific objective data, such as: 1) building a school garden; 2) implement the rainwater harvesting system; 3) make a composter; 4) provide students with the practice of planting in the school garden; 5) subsidize students through lectures with professionals, Emater technicians and Nutritionists; 6) address content related to healthy foods, through a STS approach; 7) sensitize students and the school community about maintaining healthy habits.

THEORETICAL FOUNDATION

THE STS APPROACH IN SCIENCE TEACHING

According to Bonfim and Guimarães (2015), the purpose of the STS approach in the teaching of Science is to provide a scientific view through Science and Technology, allowing the teacher to develop content in a way that can contribute to the formation of the student for the exercise of citizenship. In this reality, the school has an important role in disseminating knowledge and seeking to sensitize students to environmental issues with pedagogical activities that are included in the school curriculum, working with the transversality between disciplines directed to environmental issues (Silva, 2017).

[5] The aforementioned work is called "SUSTAINABLE VEGETABLE GARDEN IN THE SCHOOL ENVIRONMENT: A CTS APPROACH IN ELEMENTARY EDUCATION". This research linked to the Graduate Program in the National Network for the Teaching of Environmental Sciences (PROFCIAMB-Associada UEM) is available at: <https://dci.uem.br/profciamb/publicacoes/dissertacoes>. Accessed on: 08/16/2024.

Pinheiro, Silveira and Bazzo (2007) mention that the STS approach began around the 1970s as a result of great economic and technological development, evidencing its insertion in school curricula in several countries, with the aim of developing scientific-technological literacy in citizens. The same authors also state that the STS approach inserted in education aims to provide students with a critical view and a questioning posture in the face of the existing problems of their reality. Thus, teaching is promoted capable of developing students' interest in the search for subsidies aimed at solving problems intrinsic to their daily lives.

Miranda (2013) points out that the STS approach is based on the Industrial Revolution. During this period, society understood that technology controlled people's lives and also believed that to have a better quality of life it would have to depend exclusively on it. According to Santos and Mortimer (2002), the STS approach can also be worked with several disciplines, especially in multidisciplinary activities, enabling the student to better understand and, through more complex analyses, seek solutions to environmental problems. Bazzo (2010) adds that there is a correlation between the knowledge of Science and Technology with the practice of citizenship, thus encouraging students to be more participative in the occurrence of eventual changes in the technological process. In Brazil, the National Curriculum Parameters (PCN) were elaborated, which, in turn, bring a STS approach; According to this document, we see that in the context of general pedagogy:

> [...] the discussions about the relations between education and society are decisive for the emergence of progressive tendencies, which in Brazil were organized into important currents, such as Liberating Education and the Critical-Social Pedagogy of Contents. These were currents that influenced the teaching of Science in parallel with the STS trend. A common feature of these tendencies was the importance given to socially relevant content and to the processes of group discussion. If, on the one hand, there was a renewal of the criteria for choosing content, it was not verified in relation to the teaching/learning methods, as the belief in the method of rediscovery that characterized the area since the 60s still persisted (Brasil, 1997, p. 20).

The PCN suggest that teachers work on pedagogical content, such as teamwork, the insertion of scientific research and the elaboration of hypotheses in the Natural Sciences related to STS; making the student have an approximation and involvement with scientific and technological knowledge in their learning process. The PCN also mention that from the 1970s onwards, due to the various questions coming from the population about science and technology, it is recommended to insert content related to the STS approach in various teaching disciplines:

> This model has deserved criticism that points to the need to reorient investigations beyond the students' preconceptions. It does not take into account that the construction of scientific knowledge has demands related to human values, to the construction of a vision of Science and its relations with Technology and Society, and to the role of the methods of the different sciences (Brasil, 1997, p. 21).

By studying aspects of the STS approach, students can understand the importance of viewing specific content in its multiple dimensions, which facilitates the formation of a participatory citizen in society, improving their decision-making capacity. Would it be convenient to explain the concept of food, without addressing the damage to health and the environment? And what about the political aspects involved in food production, without questioning the exaggerated consumption of ultra-processed foods? We believe that, for both questions, the answer is no. Herein lies the defense we make of the STS approach.

THE SCHOOL AS A SPACE FOR HEALTH PROMOTION

Insufficient consumption of fruits and vegetables increases the risk of chronic non-communicable diseases, such as cardiovascular diseases and some types of cancer (which are among the ten risk factors that cause the most deaths and diseases worldwide (WHO, 2002). The consumption of healthy foods is essential in the school environment. According to Kassaoka and Raimundo (2017), acquiring healthy habits in childhood and adolescence offers good foundations for maintaining these habits in adult life. For Bodah, healthy eating is a growing one:

> [...] concern because the world population continues to grow and demand more quality food, through effective and sustainable methods. Thus, agroecology comes in as a very important alternative in organic and sustainable food production, mainly due to the fact that it is devoid of the use of pesticides or agricultural chemicals (Bodah, 2010, p. 43).

In this context, the school has a primary role in disseminating knowledge linked to the formation of citizens with healthy eating practices (Freitas, 2007). In this way, in the school environment, students are encouraged to acquire healthy habits in their diet (introducing a greater amount of fruits and vegetables in lunches, for example). In this sense, school meals are essential during the school period and must be well planned, using nutritious and diverse foods in their preparation; each stage of their development is carefully done so that students receive a healthy, balanced and adequate diet (Basaglia; Marques; Benatti, 2015). Kassaoka and Raimundo (2017) report that one of the ideal ways to ensure healthy eating at school is through lunches, which should be composed of organic foods and avoiding processed foods.

ORGANIC-SCHOOL GARDENS IN PEDAGOGICAL ACTIVITIES IN THE TEACHING OF SCIENCE IN THE EARLY YEARS OF ELEMENTARY SCHOOL

The consumption of organic food is one of the bases for a healthy diet. Knowing this, it is essential that the teacher develops didactic activities addressing content about the importance of organic food for health and the environment, thus enabling the improvement of knowledge. For Veiga (1994), pedagogical practice is related to social practice; They are guided by objectives, purposes and

knowledge that enable the teacher to work on content that involves theory and practice – inside and outside the classroom – associating the subject with the real context of the student. Thus, the didactic-pedagogical practices for Science Teaching achieve didactic content, thus enabling students and teachers to actually interact in the construction of concepts and skills.

A study developed at the Padre Mario Castagna School in Porto Velho-RO led to the implementation of a vegetable garden and the application of didactic-pedagogical activities, in which the consumption of pesticide-free food produced in the school garden was associated with the health benefits of the students, obtained through a healthy diet (Eno; Luna; Lima, 2015). Fernandes, *et al.* (2013) in Uberlândia-MG, developed the implementation of a school garden for Early Childhood Education students. Cypriano, *et al.* (2013), at the Cônego José Ermelino de Souza State School in Araponga-MG, implemented a vegetable garden that was used as a tool for the development of pedagogical activities. In this way, the pedagogical actions worked by the teacher in the school environment provided students with mastery in the execution of the proposed didactic activities, in an interactive, participatory way, valuing the students' knowledge effectively in the performance of their teaching profession (Silva; Oliveira, 2009).

METHODOLOGY

LOCUS OF RESEARCH AND ITS SUBJECTS

The study linked to this article was developed in the urban area of Formosa do Oeste-PR, which, in turn, is located in the West of Paraná (IPARDES, 2018). In the area of Education in 2015, students in the initial years of Elementary School in the Public Network of the Municipality of Formosa do Oeste obtained an average score of 5.8 in the IDEB. For students in the final years, this score was 4.8 (IBGE, 2017). In the city, we established a partnership with the Nilza de Oliveira Pipino Municipal School to consolidate the development of our work. The subjects participating in this study were twenty-four (24) students from the 5th year of Elementary School of the aforementioned school with the age group between ten (10) and eleven (11) years. Of this total number of students, eighteen (18) students were from the urban area and six (06) students from the rural area.

METHODOLOGICAL ASPECTS

The research was based on the methodology called *action research* (qualitative approach). Our methodological aspects related to action research are based on the studies developed by Thiollent (1986), Fonseca (2002), Tripp (2005), Baldissera (2001) and Engel (2000). In a representative way, Thiollent (1986) states that *action research* is characterized by the actions of the researcher and the people involved in the face of the object studied, thus seeking possible solutions to mitigate

situational problems. It proposes a collective and participatory work during the development of each stage, allowing for a visible interaction between the members of the research in the midst of the investigated situation. Furthermore, he describes that this methodology can be seen as a research method or strategy, which provides those involved with the insertion of practical-collective activities based on "techniques of recording, processing and exposure of results".

DATA COLLECTION INSTRUMENTS

The data collected in the study were obtained during its development through theoretical approaches in the classroom, through interviews, field diary (daily notes of activities with students at the end of class), video recording and texts written by the students. Also, through practical classes developed in the school organic garden. We emphasize that the records referred to the observations made by the researchers during the process of developing the pedagogical actions. Thus, the research was duly approved by the "Ethics Committee" for its implementation (mediated by Informed Consent Forms for Minors).

RESEARCH ACTIONS AND DATA COLLECTION

The research was developed in three stages: In the first we sought partnerships, through a meeting, with the mayor of the municipality and with the municipal secretary of education and culture to request financial support for the implementation of a school garden. At this stage, we also made contact with the principal and the pedagogical coordinator of the selected school in order to define the place where we would implement the garden. In the second stage, we started the construction of the school garden in which the City Hall supported us financially. The land where the garden was implanted had a steep slope, and there was a need for grounding to minimize it. In the garden, paths were implemented on the sidewalks with concrete blocks around the flowerbeds and black "shading" screens were placed. In the construction of the rainwater harvesting system, it was necessary to acquire a 2000-liter water tank, PVC pipes, zinc gutters, sphere register to control the flow of water, sprinklers for irrigation in the garden (inputs that were already in the school to adapt the system). A compost bin was made, digging a rectangular hole in the ground near the vegetable garden. To obtain organic compost, we use leaves, grasses, sawdust and raw food scraps covered with umbrellas or tarpaulins to prevent the proliferation of insects.

In the third stage, weekly meetings were held for the implementation of pedagogical actions with the 5th grade "A" class in the classroom with the morning Science teacher. These actions were divided into ten (10) meetings, described in Table 01.

Table 01. Pedagogical actions at school.

MEETING	PEDAGOGICAL ACTION	H. CLASS	DESCRIPTION
1th	Development of practical activities under the guidance of Emater's technician.	02	Discussion about organic planting, rainwater harvesting system and composting in the garden with the Emater technician; then, planting of vegetable seedlings under the guidance of the Emater technician. In fertilizing the beds, we use dry animal fertilizers.
2nd	Emater Lecture: "Types of gardens, care and benefits to obtain organic food".	02	Lecture entitled "Organic home garden", given by the technician from Emater.
3th	Lecture with a nutritionist on "Organic food and its benefits".	02	Lecture "Organic Food" with a nutritionist from the City Hall.
4th	Visit to an organic food producer in the municipality.	03	Formulation of three questions about organic cultivation to be asked during the visit to the rural organic producer in the Santa Terezinha Community of Formosa do Oeste. Afterwards, we went towards the rural producer's property. During the visit, she guided the students by showing her organic garden and the types of plants there. At this point, the students asked the questions formulated before.
5th	Class: composting, "Preparation and its benefits for the environment".	01	Science class on the theme "Composting".
6th	Preparation of organic fertilizer by the students.	02	Practical class "Demonstration of how to make an organic compost in a composter".
7th	Application of the didactic game "Food Bingo".	02	Didactic game "Food Bingo" (process no. 4422/2008-DEX).
8th	On-site visit to Sanepar to learn about the treatment process and the physical-chemical controls and the logistics of water distribution.	03	Practical class with the theme "Water". Then, under the guidance of the Science teacher, we went to the Paraná Sanitation Company in the municipality of Formosa do Oeste-PR. On the occasion, the Sanepar technician began with a lecture in the courtyard of the place. The students observed, at Sanepar, all the water treatment processes and their physical-chemical controls performed by the technician in charge. Later, we returned to the classroom and the researcher requested the elaboration of a text reporting the visit made.
9th	Definition and distribution of didactic activities to be developed by groups of students.	02	Practical contact of students with different vegetables, herbs and greens. The class was divided into groups and, in the computer room, each group researched the plant selected by him. Then, a debate was held to choose the name of the garden entitled "Green Space".
10th	Harvest and presentation in the schoolyard about "organic food" to the school community and the parents of the students.	03	Writing an essay about the activities carried out to build the garden. Then, we harvest and exhibit the harvested vegetables, herbs and vegetables. At the end, we presented it in the courtyard and to the whole school – with multimedia – the process of implementing the garden.

Source: authorship.

Our pedagogical actions employed procedures closely linked to the methodological assumptions of "action research". In this process, we observed the development of sustainable

attitudes and behaviors to the exercise of citizenship, to Environmental Education, as well as the development of critical thinking and the understanding of aspects that encompass many environmental issues. We'll see this better in our results.

Image 01. Photographic records that identify the pedagogical actions described in "Table 01" – we have in the assembly: 1) the school garden built and its cistern installed; 2) students eating vegetables from the garden; 3) exhibition of the plants collide in the garden for the school community; 4) technical visit to the organic garden of the Santa Terezinha Community; 5) construction of the composter; 6) observation and research on vegetables, herbs and greens; 7) lectures with the Emater technician; 8) harvest in the "Green Space" school garden.

Source: authorship.

RESULTS AND DISCUSSIONS

PARTNERSHIPS FOR THE IMPLEMENTATION OF THE GARDEN

In the meeting held with the Municipal Mayor of Formosa do Oeste-PR, it was agreed to his partnership with the project to implement an organic garden in the school space. The mayor was responsible for the financial resources and the manpower necessary for the execution of the project (construction of the vegetable garden, rainwater harvesting and other materials). It was also agreed with the Municipal Department of Education and Culture of Formosa do Oeste-PR the location of the implementation of the school garden and the permission for the development of a didactic-pedagogical-environmental project with the class of the 5th grade "A" of the Elementary School of the Municipal School Nilza de Oliveira Pipino. The vegetable garden was built behind the school in a total area of 77.0 m2, containing five (05) beds of 8.0 m2/each and a sidewalk with blocks around them to enable people's mobility. Sprinklers were installed to irrigate the plants and shade screens to protect the plants from the most intense sun rays. The contents addressed with the students were

taught according to the curricular programmatic needs, which are: 1) food; 2) food production and its technologies; and 3) environment (BNCC 2017, Early Years of Elementary School, Science subject).

EVALUATION OF PEDAGOGICAL ACTIONS WITH A CTS APPROACH

First meeting

In the first meeting, at the beginning of the class, the students participated in a discussion in the school court, next to the vegetable garden, with the technician of the Technical Assistance and Rural Extension Company of the State of Paraná – Emater-PR. At this time, the following contents were developed with the students: 1) organic garden at school; 2) the generation of organic waste and alternatives to composting; 3) the rainwater harvesting system and water saving; 4) vegetable planting techniques. Then, the students planted their own vegetable seedling and had direct contact with the soil, thus assimilating techniques for preparing the holes with correct spacing between the seedlings. Within the Teaching of Natural Sciences, we know how important it is to link the practical dimension to the teaching and learning process in the search for a greater educational use of students about the specific knowledge offered to them[6]. In this sense, the content previously conveyed by the Emater professional gained greater dialogue, fixation and representativeness. Thus, the BNCC (2017) proposes to the early years of Elementary School, through the Teaching of Natural Sciences, that students can arouse a greater interest in understanding the "natural and technological world", allowing the student to build knowledge that allows them to distinguish and also to understand the events of their reality (simple and complex).

The students were participative and attentive in all stages of the planting process; showing a lot of enthusiasm for being a different class and for providing a correlation between theory and practice. This enthusiasm is interesting, after all, it shows a pleasure in relation to the learning process[7]; added to this, the fact that the students understood how certain "more specific knowledge", in this case organized within the Natural Sciences, is converted into techniques and technologies linked to the transformation of human life, giving individuals greater food adaptability and preservation of natural resources.

We verified recurrent interactivity among students and a lot of emotion in the development of the activity. During the execution of the planting, some comments emerged, such as: 1) "I am enjoying planting the vegetable seedlings"; 2) "I had never planted a vegetable"; 3) "I don't want to stop planting anymore"; and 4) "I'm enjoying it a lot". Observing students in a position of subjects of

[6]In the study by Costa and Batista (2017), it was found that practical activities, in addition to being educational, stimulate the student's creativity in their learning. In addition, the teacher becomes a stimulator and participant in this process, thus making the student's teaching and learning more effective.

[7] Fonseca (2008) mentions that, for the student to achieve success in his learning, there needs to be this interaction between the teacher and the student at school, thus providing a bond of affection.

research and knowledge is important, as it annuls in them the position of passivity intrinsic to the traditional educational process with which the school system is too accustomed (and the school public as well). Far from it, they cease to behave as univocal receptacles of knowledge; that is, as blank slates that only receive information and have the obligation to retain it. On the contrary, in this modulation of teaching and learning, they are actors in the process and, by participating in a practical and dynamic way, they assume a posture of researchers and, consequently, of builders of knowledge: "Action research is a valuable instrument that teachers can use to improve the teaching-learning process, at least in the environment in which they work directly" (Rocha, 2012).

Second meeting

In the second meeting, the Emater technician taught content linked to organic planting and its advantages for health and the environment. In this second activity, the following contents were published: 1) what is an organic garden; 2) where can we build a domestic, business and/or institutional organic garden; 3) what are the types of chemical and organic fertilizers; and 4) what are the benefits of implementing an organic garden. In this sense, the BNCC (2017) suggests that scientific knowledge be conveyed to students in the teaching of Natural Sciences and provides opportunities for the development of the awakening of curiosity, observation and logical reasoning.

It was reported that the planting of organic fertilizers can be done in any space, using organic fertilizers and without pesticides. In this activity, the students interacted with the speaker, participating intensely with questions about their daily food, as well as being very interested in building a home garden and knowing the advantages of producing pesticide-free food. They also understood the benefits of these foods for human health, as well as questioned about which organic edible plants could be planted and purchased in the local markets of the municipality for a healthier diet. In general, we found that the students had an apprehension of the knowledge addressed, an indication of this were the questions they raised. Below, we list some of them: (i) "How do I build a vegetable garden in my house?"; (ii) "What types of organic fertilizers can I use in my garden?"; (iii) "What types of plants (vegetables) can I plant in my garden?"; (iv) "What organic plants can I buy at the market for me to eat?"; (v) "Will the planting of vegetables from the garden be for school?".

All these questions, recorded in our field diary, aroused a lot of enthusiasm in us, after all, they show how comfortable the students felt to carry out questions, which, in turn, is the driving force for the construction of a teaching and learning process anchored in the constitution of criticality and autonomy.

It was observed in the lecture that the students paid close attention to the content spoken by the Emater technician and showed interest in acquiring new technological and scientific knowledge related to organic planting. This action allowed the students to build a broad view of the contents

learned and, more than that – as we can see in the questions asked – the need to link them to their daily lives and their realities. Linking technical and scientific knowledge in a critical way to the lives of individuals is one of the mottos of the STS approach that, in this action, we had the opportunity to make available. In agreement with Oliveira and Messeder (2017, p. 22), we note that: "Bringing a STS approach to the daily lives of children in the early years of Elementary School, in the context of the school garden, means valuing human aspects".

Third meeting

In the third meeting, with the knowledge already obtained previously – which facilitated the approach of new information about organic – we received a nutritionist who, in turn, made a presentation related to the advantages of consuming food without pesticides and that use organic fertilization for the best development of the crop, thus providing food with high nutritional value, after all, they were produced in a rich and balanced soil. At this time, the following contents were addressed: 1) organic foods; 2) health benefits of organic food; 3) food more contaminated by pesticides according to Anvisa; 4) the possible diseases that can occur with conventional food. In this way, according to the nutritionist, the consumption of organic products avoids health problems. Based on data studies, she said that research has shown that the toxic residues that remain in the food ordinarily planted by most farmers can cause various diseases, such as: 1) allergic and respiratory reactions; 2) hormonal disorders; 3) neurological problems; and 4) cancer. These diseases could arise when consuming conventional foods with an excess of pesticides and, in relation to this, students should be careful. We can notice that the students showed a strong apprehension and great interest in the knowledge acquired, according to the questions formulated by one of them, which we list below: a) "Which foods contain the highest amounts of pesticides?"; b) "What type of disease is most frequent when we eat food with pesticides?". Nutritionist's answer: "The foods that contain the highest amounts of pesticides are: peppers, tomatoes and strawberries, according to Anvisa's research. And the main most frequent disease, when we consume foods with pesticides excessively, is cancer. In fact, many farmers who have direct contact with pesticides end up being affected by some oncological disease".

Then, the nutritionist started a discussion with the students about the harm that foods with pesticides cause to people's health, of which one of the alternatives to alleviate this disease is the consumption of organic foods in our meals. These questions demonstrate the concern of the participating student in identifying and consuming foods that have lower amounts of pesticides, thus avoiding future diseases.

Fourth meeting

In the fourth meeting, the students were enthusiastic about the visit made to a rural producer, after all, they could see that they do not need to go far from school to verify that there were people/farmers in the community who produced good quality food, without pesticides and with environmental responsibility, thus preserving the environment. Added to this, the fact that leaving school and getting to know the surroundings of the city was a totally different and enriching experience for most of the participating students. In this action, we found that the farmer transmitted, to the student, the following contents**:** 1) organic planting; 2) preparation of seedlings for planting; 3) how seedlings are transplanted in beds; and 4) Sprinkler irrigation and the number of times they are turned on per day. In general terms, we realized that the students were unaware that there were people who grew organic food in the rural area of the municipality. In addition to getting to know the dynamics of an organic garden in practice, they were able to feel nature more closely and how much it was possible to grow food in a natural way, without synthetic pesticides. The students checked "how much experience" the producer had accumulated with the cultivation of her organic garden. They also explored the garden, observing the types of plants that were being grown. In this exploration, they learned to identify which plants could not be used as food – "bush" –; however, they were informed that they had an often positive purpose in the organic garden (scaring away diseases, pests and insects, for example, to the detriment of the use of pesticides and chemical-inorganic pesticides).

The students had the opportunity to verify in person what an extensive organic garden built on a flat land was, and, consequently, with resources used for its maintenance. In the process, they were surprised by the presence of a huge amphibian, which was inside the seedling nursery. They were able to visualize their physical and motor characteristics. According to Silva (2016), the importance of developing didactic activities outside the classroom is linked to the possibility of undertaking new interactions between the content studied and its reality, thus being able to contribute in a significant – and in this case surprising – way to the teaching and learning process of the student.

In this activity, it provided an opportunity for the students to integrate with a relevant and necessary economic-social process on which we are currently very dependent: the production of food on a large scale for human consumption. Now, with this visit, the students saw how scientific knowledge was used by individuals in the forging of new technologies linked to their adaptability to the world (use of scientific-technological knowledge for the production of a larger quantity of food, specifically here, the making of vegetable gardens is configured as an example of this). In this case, they saw that not all scientific knowledge – converted into technologies that cause changes in nature in order to promote greater adaptation of human beings – is harmful; on the contrary, after all, in the garden visited, nature is explored and, at the same time, its preservation is carried out. It was explicit

to the students that the problem is not scientific knowledge and the new technologies that emerge from it, but rather the way in which individuals direct their efforts to promote the adaptability of human beings. The questions prepared in advance by the students in the classroom were used to interview the producer during the visit. Eight questions were selected to be asked: (i) "What kind of vegetables do you grow"?; (ii) "Is it necessary to water with the irrigator?"; (iii) "How many times do you have to throw water on lettuce?"; (iv) "How long does it take to grow lettuce?"; (v) "What plants do you recommend planting in backyards?"; (vi) "What poisons are applied to plants in the garden?"; (vii) "What kind of fertilizer do you use?"; (viii) "What is your greatest difficulty in your plantation?"

In this meeting, we noticed that the students had a different contact with large-scale organic production. In this way, they were able to learn about other types of organic food and the irrigation system – made by larger sprinklers. Unlike the school garden, the plantation visited was irrigated through a water collection system from a spring on the property. We also observed that the students were able to visualize other spaces for growing organic gardens and, as a result, there was a greater contact with organic food in different environments. Added to this, the ratification of the importance, for human health, of consuming food free of pesticides. For Terso and Leite (2013), the organic garden is linked to the construction and maintenance of sustainable development, without aggression to the environment and, at the same time, providing a better quality of life resulting from the consumption of products that act in the prevention of diseases.

Fifth meeting

A class on composting was given. In this action, we convey the following contents: 1) what composting is; 2) what types of composting and how to prepare a composter; 3) benefits of composting; and 4) care with the composting process. Related to this, our BNCC (2017) highlights that it is necessary to encourage educational alternatives engaged in the acquisition of scientific knowledge that allow for awareness, providing a more harmonious environment. The teacher began the meeting by mentioning the importance of students knowing the composting process, its maintenance, the transformation of waste deposited there into organic fertilizers and its benefits for the environment. After the lecture, some comments from the students were raised: 1) "I didn't know that the remains of fruits and vegetables could become organic fertilizer"; 2) "Now I know how many meters I can make the compost bin in the soil"; 3) "I'm going to ask my parents to make a composter at home"; 4) "When I make the compost I will cut the bigger husks"; 5) "I'm going to separate fruit and vegetable peels at home". The composting process acts on the recovery of nutrients through organic waste in the soil, which, in turn, is transformed into organic compounds and is used as fertilizers. This is one of the ways to contribute to the environment, recycling organic waste that was previously discarded (Terso; Leite, 2013).

Sixth meeting

We discuss the procedures for preparing a home composter. Thus, we showed that this process involved choosing an appropriate type of material (raw vegetable remains, fruit peels, sawdust and grasses) for its deposition in an appropriate container. We also inform the necessary care to carry out this process, such as: 1) the periodic turning of solid waste, seeking to provide aeration; 2) periodicity for obtaining it; and 3) guidance regarding the use of organic compost. Thus, the contents taught were: i) how to prepare the organic compost; ii) which organic waste is suitable for the decomposition process; iii) how to do the daily maintenance of the composter; and iv) presentation of the preparation of the compost in the plastic box in the classroom. The presentation of the procedures for the preparation of the composter was made in an expository way; In this way, we present the organic compost in different stages of decomposition, highlighting its characteristics and the care for its maintenance.

We also highlight the environmental benefits of this practice. Subsequently, the students took the remains of raw organic food to the composter in the soil of the garden. Santos, *et al.* (2014) emphasize the importance of the composting process for the construction of more interdisciplinary knowledge offered to students, enabling them to acquire new meanings in relation to sustainable practices – in the school environment and outside it. It was noted – in our field diary – that the students participated in all the moments intrinsic to this pedagogical action: from the construction and maintenance of the organic compost in the composter, to its transformation into a sustainable fertilizer for the school garden.

Seventh meeting

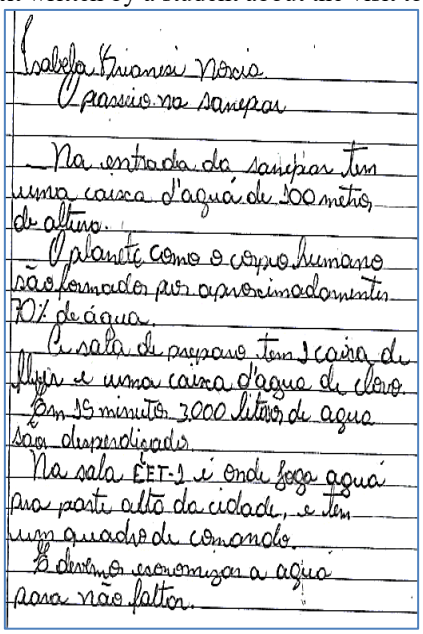
In the seventh meeting, the students participated in the didactic game "Food Bingo". Each student received a card along with the E.V.A. markers. Soon after, we drew a number where there was a question that was addressed to the student of the time. This action made it possible – playfully and playfully – for the students to come into contact with theoretical knowledge related to the nutritional values present in various foods. Silva *et al.* (2013) mention that the realization of didactic games in the school environment – especially with those related to the content "food" – encourages the student to have a healthy diet, thus providing several benefits in the choice of more nutritious foods. The students participated in the game with great intensity: they gave their opinions, debated and argued about the theme. For Cabrera and Salvi (2005), the didactic game is very useful to complement, pleasurably, the student's learning. The fact of learning and teaching through play enriches worldviews and the possibilities of relationships, companionship, socialization, competitiveness and exchange of experiences. According to Oliveira, Costa and Takahama (2013), the game brings numerous contributions to learning, after all, the child learns in a more natural way.

Eighth meeting

In the eighth meeting, the students visited the Sanitation Company of Paraná – SANEPAR of Formosa do Oeste-PR. There, they learned about the water treatment process. There was student participation at all times of the visit; Most of them were surprised, after all, they did not know the operating process of a distributor of this size and, consequently, the sanitation and water treatment consumed daily by them. Thus, they had the opportunity to question the technical speaker about the performance of daily physical-chemical analyses and the maintenance of the machines. During the visit, the students positioned themselves as active and critical subjects in the face of the scientific and technological knowledge acquired at the site, which, in turn, were: 1) the conscious consumption of water; 2) demonstration of the steps and procedures of water analysis in the laboratory; 3) rainwater harvesting; and 4) visitation in the engine room, where students observed and received explanations of the pumping process of water distribution in the municipality.

In the classroom, the students were able to report the knowledge obtained at SANEPAR in an essay requested by the educator; they were very confident in the elaboration of the texts. As an example, we noticed in the text of Figure 01 that the students paid significant attention to the actions related to the visit to SANEPAR. Thus, the students' reports show that the activity was positive, motivating and allowed the understanding of theoretical and practical concepts involved in the process of water treatment and supply, and which are in situations present in the municipality. Freitas and Nuances (2015) emphasize that educational practices carried out with the participation of students outside schools are of great importance in the development of sustainable activities, allowing them to become aware of the local reality that surrounds them, thus forging attitudes aimed at the "rational use of water", for example, in their municipality of origin.

Figure 01. Text written by a student about the visit to SANEPAR.[8]



Isabella Brianesi Moraes
Passeio na sanepar

Na entrada da sanepar tem uma caixa d'agua de 100 metros de altura.
O planeta como o corpo humano são formados por aproximadamente 70% de água.
Na sala de espera tem 1 caixa de vidro e uma caixa d'agua de cloro.
Em 15 minutos 3000 litros de agua são desperdiçados.
Na sala ETE-1 é onde faz agua para parte alta da cidade, e tem um quadro de comando.
Devemos economizar a agua para não faltar.

Source: authorship.

Ninth Enagainst

On this occasion, we defined teams and each one of them was responsible for researching the chosen vegetable and/or greenery to then plant it. During this action, we carried out research on each selected vegetable and/or vegetable, among them, we had chicory, tomato, lettuce, cabbage, radish, parsley and chives. The students were enthusiastic and interested in carrying out these activities. The linked contents were: 1) variety of vegetables; 2) characteristics of vegetables; 3) nutritional values present in vegetables; and 4) benefits of eating vegetables. Barbosa *et al.* (2016) emphasize that the acquisition of food-nutritional knowledge by the student is necessary; in addition, this process must occur in order to give rise to possible changes in their nutritional behavior, thus enabling the prevention of certain diseases considered chronic. After this first stage of research, we planted the respective seedlings in recyclable milk carton models. According to Silva and Muniz (2012), by producing models in schools, we can stimulate students to better learning (a positive way of understanding the sociocultural, environmental, spatial and geographical context in which they are inserted). In addition, encouraging group work allows students levels of interaction between them; in an enriching way for their learning, they jointly seek knowledge for the development of their study, in which everyone learns and teaches at the same time (Riess, 2010).

[8] It is important to highlight that, in the dissertation already referenced that served as a subsidy to this article, we have a greater and more detailed number of images, figures, reports, transcriptions, comments and productions resulting from the research process presented in this article.

Tenth meeting

At the beginning of this meeting, the students placed the sign with the name – collectively chosen – of the garden: "Green Space". As it is a collective moment of evaluation, new specific content was not necessarily broadcast. Thus, we seek to apprehend and evaluate the knowledge acquired/assimilated so far by the students in the midst of the nine activities previously developed. Then, and once again, the students prepared a brief essay on the construction trajectory of the "Green Space" hour, thus demonstrating an understanding of (i) the educational process carried out and (ii) the interventions made – planting in the garden, the visit to the organic producer, the lectures on the garden, nutrition and composting, the visits to SANEPAR, internet searches, etc. This evaluative methodology, of a more traditional nature – textual production to measure assimilated knowledge – was employed without constraints, after all, until that moment, we prioritized practical, playful and enjoyable teaching and learning processes far removed from traditional models (in fact, as we know, students need to come into contact holistically with different forms, methodologies and approaches to teaching and learning). With this way of measuring knowledge – textual production – in addition to the need to evaluate their knowledge related to our actions, we also stimulate important dimensions in students, such as: 1) writing skills, textual form and Portuguese language; 2) concentration; 3) organization of ideas; and 4) ability to synthesize. Considering that the LDB of 1996 and the BNCC for Science Teaching of 2017 require greater diversification in the forms Evaluating is a complex and difficult process; in this sense, Silva, Matos and Almeida (2014) present some considerations about evaluation by stating that educators are the main mediators in the elaboration of the concept of evaluation in the minds of students, also including society as a whole. Next, we selected four (4) transcriptions of texts produced by the students:

> Student 1: "Our garden is homemade and is made in a well-kept garden at the school made by our own manure known as fertilizer it helps the vegetables grow beautiful, healthy and faster. I learned that in a bed several vegetables or fruits are planted and my teacher taught me how to make fertilizer. And the waters that water the vegetables, fruits, etc. The box has to have about 2 liters of water and that's what I learned."[9]
>
> Student 2: "Green space is the name we gave to the fifth grade garden There in the garden we planted lettuce, chicory, and the teacher planted chives, tomatoes, pumpkins, cucumbers,

[9] This student ratified in his speech the importance of collecting rainwater to irrigate the vegetable garden and also the benefits of organic fertilization. It is noteworthy that he offers information about his participation in the preparation of compost, thus stating that organic fertilizer is important for the maintenance of the plant. This student clearly absorbed certain technical-scientific knowledge for the making of organic gardens and the description he makes of the activities shows this. The use of organic fertilizers, compost and collected water are essential for the construction of this technology (vegetable garden). Having this perception inscribed in the minds of students helps them to compose representations of how what the individual transforms is engendered with knowledge and, through this transformation, he promotes a more comfortable/adapted life (in the case of organic gardens, we promote greater food security, preservation of the environment and quality of life linked to better health). Thus, we can affirm that this way of connecting knowledge, as we have already observed, is a necessity for educators, especially those of Natural Sciences, concerned with promoting a teaching and learning process anchored in the STS perspective: "In this perspective, we consider the importance of teaching Science to make students scientifically and technologically literate, through educational actions planned to achieve this goal" (Bonfim; Guimarães, 2015, p. 3736).

tomatoes, we started the garden on October 9th, from time to time without a country school class we went to see the garden we harvested on November 27th we harvested lettuce, Almeirão, that and the teacher harvested the rest of the vegetables and we did a lecture and each group talked about a vegetable that was in the garden and we made a model and on the last day of school in the field the teacher will have a picnic on the farm".[10]

Student 3: "In our school we have a vegetable garden called Espaço Verde. In it you have: Lettuce, chicory, cabbage, cabbage, parsley, pumpkin, cucumber and chives. It is a project of the School in the countryside. On this day we visited several places such as farms, a visit to Sanepar, our school garden. We students plant the vegetables and then harvest the vegetables. On the first day of the project we had a lecture with Valmir. We also had a lecture with Josiane and then we did a food bingo competing for gifts such as pencils and erasers. When our garden was finished, it became very green and beautiful. The vegetables were very large and ripe, ready to be harvested. We composted with food scraps and saw dust. The beds of our vegetable garden were made with wooden boards. We students made a presentation to the school and family members about the benefits of various types of vegetables. In our classroom we made a model about our 'school garden' and then presented our model to the school. In the Espaço Verde vegetable garden there is a water tank pump that filtered rainwater and irrigated our vegetable garden. We put our compost in the compost bin we made and it is almost ready. In short, our Green Space garden is being a success".[11]

Student 4: "This year the School in the countryside showed us how important it is to grow products in a home garden, such as: lettuce, chicory, pumpkin, cabbage and many other vegetables. The most beautiful products we see in the markets are those that have more pesticides, this is very sad, because it harms people's health, bringing cancer and other diseases. In our school we made a garden to eat products without poison. Our class collaborated with everything. I replanted the lettuce seedling. The flowerbeds were very beautiful. On the day we went to the farm we learned about very cool things like planting seedlings! There were several trays with seeds planted, these seeds stayed in the greenhouse for a few days, then they were planted in the beds with manure and prepared soil. It was an educational and interesting tour. With this project I learned how to grow our own food and take better care of our health. The vegetables were watered at least twice a day. And when they got big, they were sold to be consumed, completely free of poisons."[12]

In general, the texts were produced within the classroom and had exclusive ideas of the students, that is, according to their interpretation of the project. In an evaluative way and considering all the statements analyzed, we found that most of them identified: 1) the difference between organic and conventional products, consequently, the benefits linked to the consumption of organic products to the detriment of foods with pesticides; 2) the saving of water related to the capture made through rain; 3) the potential of making a composter; 4) contact with the environment as something relevant;

[10] Also supported by an essentially descriptive speech, he recalled his participation in all stages of the project and was enthusiastic about making the models and presenting the research on the selected vegetables to the entire school community. As we have already observed, these levels of satisfaction and affectivity linked to the actions developed within the schools are essential for the school success of the students, as it confers pleasure to the teaching and learning process.

[11] Student 3 showed effective participation in all stages of the project and showed great satisfaction with the result in the garden. He showed a broad view of the process linked to the making of the garden, thus evidencing mastery in relation to the knowledge absorbed and its link with the construction of a specific technology, in this case, the garden, which can positively interfere in the existence of individuals. Thus, this student offers us information that supports the perception that the vision expressed in his speech is anchored in a STS perspective linked to the teaching and learning process.

[12] This student demonstrated the importance of growing organic gardens and consuming food without pesticides, emphasizing the benefits they bring to health. He also highlighted the need to work with the land, understanding the difference between growing organic food and conventional food. This type of perception demonstrates that the content has been assimilated by the student, making him consider the consumption of food in a more conscious way. Conscious consumption, as we have already discussed, is also one of the mottos linked to teaching based on a STS perspective that, here, we have already had the opportunity to debate.

5) the handling of tools connected to the treatment of the soil, that is, the use of a set of technologies and techniques linked to the preparation of the school garden; 6) appreciation and affection for the actions developed; 7) the need to preserve the environment; 8) the use of recyclable materials for the production of models; 9) group collaboration for the development of activities; 10) the participation, even if indirect, of the family while they took organic food to their homes; 11) the collaborative work with the Emater technician, the Sanepar professional, the organic farmer and the nutritionist; and 12) the link between a significant range of knowledge and the production of a given technology (the school garden) capable of transforming the reality of individuals, promoting their greater adaptability and quality of life (modulation of teaching and learning linked to the Teaching of Natural Sciences, broadly anchored in the perspective of STS)[13].

FINAL CONSIDERATIONS

Our research was based on the construction of a school garden which, in turn, served as a reference for the elaboration of an educational product[14]. We observed that the pedagogical actions constituted helped, together with the students, in the processes of: 1) assimilation of scientific, technological and sociocultural concepts related to the theme of vegetable gardens, food, human health and organic products; 2) expansion of the autonomy and criticality of the students; 3) approximation and affection of students in relation to the school environment; 4) construction of a feeling of collectivity and group work.

In an interdisciplinary way, the research developed and reported here engendered in its execution different fields of knowledge: i) Portuguese Language (when the students carried out their textual productions); ii) Informatics (in the activities in which the students developed their research on the internet in a way guided by the educator); iii) Environmental Education and/or Environmental Sciences (in different actions in which debates on the environment, environmental issues and environmental preservation were raised); iv) Natural Sciences (throughout the journey taken by us, issues related to human health, water resources, soil chemical processes, planting and plant

[13] We must highlight that the students had the opportunity to taste the vegetables harvested in the school garden in their lunches. The students were excited to consume the very food they had planted and harvested. The joy of consuming vegetables in school lunches as if it were a reward for the work developed was evident. According to Terso and Leite (2013), school meals have made positive advances in relation to the use of organic foods, which were gradually inserted into the students' daily meals with varieties of vegetables and also fruits, seeking to provide a better quality in their school meals.

[14] Our educational product – the manual called "Manual for schools: how to build a sustainable garden" – was developed with the intention of guiding the construction of an organic-sustainable school hour. It has instructions for the implementation of a rainwater harvesting system and the making of a composter in the soil. The basis for the making of this product is anchored in the experience and results reported in this article. This educational construct is available at: <https://oercommons.org/courses/manual-para-as-escolas-como-construir-uma-horta-sustent%C3%A1vel>. And it was accessed on: 08/17/2024.

development emerged); 5) Geography and Art (specifically when the student developed models and, there, spatiality, artistic and geographical knowledge were used).

For us and considering the results exposed, the students were able to perceive themselves as members, interconnected and transforming agents of the environment and the space in which they are inserted. Proof of this was the evidenced knowledge that the students had about the most latent environmental problems; They often knew how to conceptualize and contextualize data terms/concepts articulated with the subject. The theme of organic food inserted in the form of didactic-pedagogical activities in the school can provide students with positive attitudes and consumption habits. In this way, we still believe in the school space as a privileged locus to educate; or rather, to educate themselves environmentally, critically, scientifically, technologically and socially. We cansay that our actions showed satisfactory results in relation to the previously established objectives.

The construction of the school garden proved to be an effective strategy to integrate scientific, technological and social knowledge in the context of Elementary Education in the Early Years and, in this context, the constitution of educational strategies coordinated with action research is indispensable (as we have tried to demonstrate). The pedagogical actions developed contributed significantly to the formation of more aware and critical students, capable of understanding the implications of food production methods for human health and the environment. Through our practical and interdisciplinary activities correlated to the methodology of action research, students have not only acquired technical skills related to organic cultivation and sustainability, but have also developed a sense of scientific-technological, environmental and social responsibility.

The involvement of the school community and the partnerships established reinforced the collective character of the project, promoting collaboration and teamwork (which, as we have seen, also slipped and engendered among the children in the class participating in the research). The results of the research indicate that the school garden, supported by the STS approach, is a powerful tool for the education of students, preparing them to face contemporary challenges related to healthy eating, environmental preservation and the conscious use of given technologies. According to our perception, the reported experience/research evidences the central role of the school in promoting educational practices that dialogue directly with the reality of the students and with the most evident desires for transformation – especially the environmental, food, educational and public health – that we currently need to collectively face and build in our society.

REFERENCES

1. Baldissera, A. (2001). Pesquisa-ação: uma metodologia do "conhecer" e do "agir" coletivo. *Sociedade em Debates*, 7(2), 5-25. Disponível em: http://revista.ucpel.edu.br/index.php/rsd/article/viewFile/570/510. Acesso em: 25 de abr. 2018.

2. Barbosa, L. B., Vasconcelos, S. M. L., Correia, L. O. Dos S., & Ferreira, C. F. (2016). Estudos de avaliação do conhecimento nutricional de adultos. *Ciência & Saúde Coletiva*, 21(2). UFA, Maceió. Disponível em: http://www.scielo.br/pdf/csc/v21n2/1413-8123-csc-21-02-0449.pdf. Acesso em: 11 dez. 2018.

3. Basaglia, P., Marques, A., & Benatti, L. (2015). Aceitação da merenda escolar entre alunos da Rede Estadual de Ensino da cidade de Amparo, SP. *Saúde em Foco*, 7. ed. Disponível em: http://unifia.edu.br/revista_eletronica/revistas/saúde_foco/artigos/ano2015/aceitação_merenda.pdf. Acesso em: 22 de fev. 2018.

4. Bazzo, W. A. (2010). *Ciência, tecnologia e sociedade e o contexto da educação tecnológica* (2ª ed.). Florianópolis: UFSC.

5. Bodah, E. T. (2010). *Conversas entre Educadoras: do dia a dia à utopia*. Projeto Passo Fundo.

6. Brasil. (2017). *BNCC*. Disponível em: http://basenacionalcomum.mec.gov.br/images/BNCC_EI_EF_110518_versaofinal_site.pdf. Acesso em: 17 de out. 2018.

7. Brasil. (2005). *LDB*. Brasília. Disponível em: https://www2.senado.leg.br/bdsf/bitstream/handle/id/70320/65.pdf. Acesso em: 17 de out. 2018.

8. Brasil. Ministério da Agricultura, Pecuária e Abastecimento (MAPA). (2016). Disponível em: http://www.agricultura.gov.br/assuntos/sustentabilidade/organicos. Acesso em: 18 de mar. 2018.

9. Brasil. (1998). *Parâmetros Curriculares Nacionais: Ciências Naturais Secretaria de Educação Fundamental*. Brasília: MEC SEF, p. 30. Disponível em: http://portal.mec.gov.br/sed/arquivos/pdf/ciências.pdf. Acesso em: 31 de jul. 2017.

10. Bonfim, H. C., & Guimarães, O. M. (2015). A abordagem CTS no ensino de ciências nos anos iniciais do ensino fundamental: um caminho para a cidadania. In *XII Congresso Nacional de Educação e V Seminário Internacional sobre profissionalização docente – Cátedra Unesco PUC*. Disponível em: http://educere.bruc.com.br/arquivo/pdf2015/19862_8324.pdf. Acesso em: 28 de dez. 2018.

11. Cabrera, W. B., & Salvi, R. (2005). A ludicidade no ensino médio: Aspirações de pesquisa numa perspectiva construtivista. In *ENPEC, 5. Atas*.

12. Costa, G. R., & Batista, K. M. (2017). A importância das atividades práticas nas aulas de ciências nas turmas do Ensino Fundamental. *REVASF*, 7(12), 06-20. Disponível em: http://www.periodicos.univasf.edu.br/index.php/revasf/article/download/20/28. Acesso em: 24 de nov. 2018.

13. Cypriano, R. J., Zito, A. F., Fontes, M. do. C., & Silva, A. P. da. (2013). Horta escolar: um laboratório vivo. Disponível em: http://www.revistaea.org/artigo.php?idartigo=1400. Acesso em: 26 de abr. 2018.

14. Engel, G. I. (2000). Pesquisa-ação. *Educar*, Curitiba, 16, 181-191. Editora UFPR. Disponível em: http://www.educaremrevista.ufpr.br/arquivos_16/irineu_engel.pdf. Acesso em: 25 de abr. 2018.

15. Eno, E. G. de. J., Luna, R. R. de, & Lima, R. A. (2015). Horta na escola: incentivo ao cultivo e a interação com o meio ambiente. *Revista eletrônica em Gestão, Educação e Tecnologia Ambiental*, 19(1), 248-253. Revista do Centro de Ciências Naturais e Exatas, UFSM. Disponível em: https://periódicos.ufsm.br/reget/article/viewFile/19538/pdf. Acesso em: 14 de abr. 2018.

16. Fernandes, M. O., Silva, N. S., Martins, R. K., Defensor, M. O., & Borsato, J. M. L. S. (2013). Horta na escola: incentivando hábitos saudáveis de alimentação em uma escola de Uberlândia – MG. *Em Extensão*, 12(2), 75-83.

17. Fonseca, J. J. S. da. (2002). *Apostila de metodologia da pesquisa científica*. Universidade Estadual do Ceará.

18. Fonseca, T. de. M. (2008). *Ensinar - Aprender: Pensando a prática pedagógica* (42f.). Material Didático (PDE) – SEED, Programa de Desenvolvimento Educacional, Ponta Grossa. Disponível em: http://www.diaadiaeducacao.pr.gov.br/portals/pde/arquivos/1782-6.pdf. Acesso em: 26 nov. 2018.

19. Fontana, F., & Gomes, A. da P. (2018). Cultura negra e legado científico africano para um ensino mais dinâmico das ciências naturais: apontamentos teórico-metodológicos. *Revista Sociologia, Política e Cidadania*, 1(1). Disponível em: http://www.ojs.funepe.edu.br/index.php/sociologia/issue/view/14. Acesso em: 26 de out. 2018.

20. Freitas, D. (2007). *Tecendo redes: conexão entre saberes para a educação*. Rio de Janeiro: Editora E-paper.

21. Freitas, N. T. S., & Nuances, M. G. D. A. (2015). Educação ambiental e água: concepções e práticas educativas em escolas municipais. *Estudos sobre Educação*, 26(1), 234-253. Disponível em: http://revista.fct.unesp.br/index.php/nuance/article/view/2813/2926. Acesso em: 23 de abr. 2018.

22. Gil, A. C. (2016). *Como elaborar projetos de pesquisa* (5ª ed.). São Paulo: Atlas.

23. IBGE. (2017). *Formosa do Oeste*. Disponível em: https://cidades.ibge.gov.br/brasil/pr/formosa-do-oeste/panorama. Acesso em: 10 de dez. 2018.

24. IPARDES. (2018). *Caderno Estatístico*. Disponível em: http://www.ipardes.gov.br/cadernos/MontaCad.pdf1.php?Municipio=85830. Acesso em: 10 de dez. 2018.

25. Kassaoka, D., & Raimundo, M. G. M. (2017). *Alimentação escolar: promovendo a saúde do futuro*. São Paulo: Coordenadoria de Desenvolvimento dos agrotóxicos.

26. Leal, P. F. (2010). Ciência, tecnologia e sociedade: uma discussão para os paradigmas sociais. *Web Artigos*. Disponível em: http://www.artigos.etc.br/ciencia-tecnologia-e-sociedade-uma-discussao-para-os-paradigmas-sociais.html. Acesso em: 12 de nov. 2018.

27. Miranda, E. M. (2012). *Tendências das Perspectivas Ciência, Tecnologia e Sociedade (CTS) nas Áreas de Educação e Ensino de Ciências* (Tese de Doutorado, UFSCar, São Carlos). Disponível

em: https://repositorio.ufscar.br/bitstream/handle/ufscar/2318/5532.pdf?sequence=1. Acesso em: 10 de nov. 2018.

28. Oliveira, D. A. A. dos S., & Messender, J. C. (2007). Horta escolar como estratégia de ensino. *VII Esocite*. Disponível em: http://esocite2017.com.br/anais/beta/trabalhoscompletos/gt/34esocite2017_jorgecardosomessender.pdf. Acesso em: 22 de dez. 2018.

29. Oliveira, D. T. R., Costa, E., & Takahama, S. K. H. (2018). A importância dos jogos educativos na aprendizagem da multiplicação com alunos que apresentam deficiência intelectual e cursam a 5ª série do Colégio Estadual Vítor Soares. *Revista EXITUS*, 3(2), 123-135. Disponível em: http://dialnet.unirioja.es/descarga/articulo/6078645.pdf. Acesso em: 12 de dez. 2018.

30. Pinheiro, N. A. M., Silveira, R. M. C. F., & Bazzo, W. (2007). Ciência, Tecnologia e Sociedade: a relevância do enfoque CTS para o contexto do ensino. *Ciência & Educação*, 13(1), 71-84. Disponível em: http://www.scielo.br/scielo.php?pid=s151673132007000100005&script=sci_arttext&tlng=pt. Acesso em: 24 de nov. 2018.

31. Riess, M. L. R. (2010). *Trabalho em grupo: instrumento mediador de socialização e aprendizagem* (Trabalho de Conclusão de Curso, UFRS, Porto Alegre). Disponível em: https://www.lume.ufrgs.br/bitstream/handle/10183/35714/000816117.pdf. Acesso em: 15 de dez. 2018.

32. Rocha, A. G. da S., Amorim, S. A. L. P. de, Santos, A. T. dos, Santos, E. M. de, & Cavalcanti, D. G. M. (2013). A importância da horta escolar para o ensino/aprendizagem de uma alimentação saudável. Disponível em: http://www.eventosufrpe.com.br/2013/cd/resumos/R0272-2.pdf. Acesso em: 26 de mar. 2018.

33. Rocha, T. L. (2012). Viabilidade da utilização da pesquisa-ação em situações de ensino. *Cadernos da FUCAMP*, 11(14), 12-21. Disponível em: http://funcamp.edu.br/editora/index.php/cadernos/article/viewFile/218/194. Acesso em: 28 de dez. 2018.

34. Santos, A. M. de L., Martins, R. M. de L., Souza, R. D. de, Mota, R. M. F., & Fernandes, C. T. (2014). Incentivo ao uso da compostagem de resíduos sólidos em uma horta escolar do município de Jaciara - MT. IFMT, Cuiabá - MT. Disponível em: http://pgsskroton.com.br/ser/index.php/ensino/article/view/426. Acesso em: 24 de abr. 2018.

35. Santos, W. L. P., & Mortimer, E. F. (2002). Uma análise de pressupostos teóricos da abordagem C-T-S (Ciência – Tecnologia – Sociedade) no contexto da educação brasileira. *Ensaio – Pesquisa em Educação*, 2(2), 57-70. Disponível em: https://www.scielo.br/j/epec/a/QtH9SrxpZwXMwbpfpp5jqRL/?format=pdf&lang=pt. Acesso em: 24 de nov. 2018.

36. Silva, D. S. G. da, Matos, P. M. de, & Almeida, D. M. de. (2014). Métodos avaliativos no processo de ensino e aprendizagem: uma revisão. *Cadernos de Educação/ Faculdade de Educação – UFPel*, 47, 73-84. Disponível em: https://periodicos.ufpel.edu.br/ojs2/index.php/caduc/article/download/4651/3497. Acesso em: 01 de dez. 2018.

37. Silva, E. (2017). *Temas em ecologia e educação ambiental* [recurso eletrônico] (1ª ed.). Rio de Janeiro: Editora Gramma.

38. Silva, M. X. da, Schwengber, P., Pierucci, A. P. T. da R., & Pedrosa, C. (2013). Abordagem lúdico-didática melhora os parâmetros de educação nutricional em alunos do ensino fundamental. *Ciências & Cognição*, 18(2), 136-148. Disponível em: http://www.cienciasecognicao.org. Acesso em: 10 de dez. 2018.

39. Silva, N. M. da. (2016). Educação para além da escola: Reflexões sobre os ambientes não escolares, o ensino de história e a consciência histórica. *Temporalidades - Revista de História*, 8(2), 3728-3739. Disponível em: https://seer.ufmg.br/index.php/temporalidades/article/download/2626. Acesso em: 29 de dez. 2018.

40. Silva, A. P. da, & Oliveira, M. M. de. (2009). Sequência didática interativa como proposta para formação de professores de matemática. *VII ENpec, Florianópolis, 8/11 de 2009*. Disponível em: http://posgras.fae.ufmg.br/posgrad/viienpec/pdfs/430.pdf. Acesso em: 01 de abr. 2018.

41. Silva, V. da, & Muniz, A. M. V. (2012). A geografia escolar e os recursos didáticos: o uso das maquetes no ensino-aprendizagem da geografia. *Geosaberes*, 3(5), 62-68. Disponível em: http://www.geosaberes.ufc.br/geosaberes/article/view/117. Acesso em: 12 de dez. 2018.

42. Terso, M. M., & Leite, M. de. (2013). Horta orgânica: alimentação saudável, qualidade de vida. *Cadernos PDE*. Disponível em: http://www.diaadiaeducacao.pr.gov.br/portals/cadernospde/pdebusca/producoes_pde/2013/2013_repaz_cien_artigo_mariluce_martins_terso.pdf. Acesso em: 12 de dez. 2018.

43. Thiollent, M. (1986). *Metodologia da pesquisa-ação*. São Paulo: Cortez.

44. Tripp, D. (2005). Pesquisa-ação: uma introdução metodológica. *Educação e Pesquisa*, 31(3), 443-466. Disponível em: https://www.scielo.br/pdf/ep/v31n3/09v31n3.pdf. Acesso em: 24 de abr. 2018.

45. World Health Organization. (2002). *The World Report 2002: reducing risks, promoting healthy life*. Geneva: World Health Organization. Disponível em: http://www.agricultura.gov.br/assuntos/sustentabilidade/organicos/. Acesso em: 26 de mar. 2018.

46. Veiga, I. P. A. (1994). *A prática pedagógica do professor*. Campinas, SP: Papirus.

47. Vaz, C. R., Fagundes, A. B., & Pinheiro, N. A. M. (2009). O Surgimento da Ciência, Tecnologia e Sociedade (CTS) na Educação: Uma Revisão. *I Simpósio Nacional de Ensino de Ciência e Tecnologia*. Disponível em: http://www.sinect.com.br/anais2009/artigos/1%20CTS/CTS_Artigo8.pdf. Acesso em: 23 de nov. 2018.

Handball tactics and game model

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ABSTRACT

The objective of this study was to discuss the process of teaching and training tactics in handball, in order to enable a game model for the teaching of this sport. It is a descriptive and exploratory narrative review of handball with regard to the use of tactical elements. The databases of Bireme, Pubmed, Scielo and SPORTDicus were used. The search period for studies was from 2013 to 2023. A total of 1,142 studies were found, after analysis of which 241 were eligible and only 19 were able to meet the research criteria. It should be noted that training should not be based only on traditional teaching and training methods. From the analysis carried out with this study, the learning of defensive and offensive tactical fundamentals in handball, facilitates the teaching-learning-training process of the modality, providing a possible construction of a game model.

Keywords: Attack, Defense, Game, Tactics, Training

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INTRODUCTION

Handball is a collective sport (MEC) modality of cooperation, opposition and invasion of the opponent's terrain, requiring the athlete to present a performance associated with physiological, emotional and cognitive skills of the technical and tactical aspects of the sport (Caldas, 2014). Thus, the teaching-learning-training (E-A-T) process of handball requires professionals to provide athletes with opportunities to appropriate situations that occur in the game, especially those that favor intelligence and creativity (Galatti et al., 2014).

In Brazilian handball, research related to the E-A-T process of tactical fundamentals is rare and incipient, providing subsidies almost exclusively of aspects related to teaching methodology, physical fitness, game analysis and that concern the improvement of physical capabilities inherent to performance (Pombo, Baldy, Pereira, 2016). The literature also deals with the E-A-T process of tactical game situations in the school environment, training of intelligent players, this exclusively on the base categories (Castro, 2013).

The teaching of tactical concepts of Brazilian handball refers to ways in which the Brazilian Handball Confederation (CBHb), the body that manages the sport in the country, has fought for results against the toughest opponents in South American and Pan American sports games, world championships and Olympic games (Uzeu, 2014).

On tactical changes and concepts, Anton (2002); Ibañez, Jiménez and Antúnez (2015) point out that the game tactic is related to the adequacy of the planned behaviors in the face of the strategies of the opposing team. The development of tactics in the game is established from the characteristics of the athletes and the opponent, so that they are less advantageous temporally and spatially for the opponents.

Still on tactics, Anton et al., (2000); Scaglia, Reverdito, Leonardo and Lizana (2013), state that this comprises the totality of individual, group and collective actions of a team, see table 1, developed rationally according to the rules of the game, aiming at their success. Tactics can also be defined as the cognitive content of the teams that face each other, so the essence of team sport is characterized by the intentions of the players and that each team cooperates with each other in the pursuit of a goal, to score more goals (Mendes, 2020; Rigon et al., 2022).

In handball, tactical training can be divided into phases: initial (08 to 12 years old), learning occurs through incidental processes (games and play); positional or sectoral (14 to 16 years old), emphasis is placed on improving discoveries and decisions, placing the athlete in different playing positions, so that he discovers where he will best act and realizes the responsibility of each specific position; and the situational phase (16 years old onwards), in which there is an improvement in decision-making, in the different positions, already thinking about specialization in the face of the functional structures that the defense and attack systems provide (Menezes, Reis and Filho, 2015).

According to Dallegrave, Berno and Folle (2017), tactical training based on problem situations provides greater development of the ability to play in situations that arise in a match. This type of training fosters cooperation work, autonomy in decision-making, and the interaction of athletes in tasks within the team. It is expected to train more intelligent and creative athletes, who must know how to effectively solve problems they will face (Ibañez, Feu, Cañadas, 2016).

Table 1 below shows the tactical actions of the athletes in handball.

Table 1 – Individual, group and collective, defensive and offensive Handball tactical actions.

	Defensive Tactical Actions	
Individual	**Group**	**Collective**
Coverage	Fluctuation	Fluctuation
Deterrence	Marker change	*Specific stations
Fluctuation	* Specific defensive positions	**Defense systems
Interception	----	----
Pressure	----	----
	Offensive Tactical Actions	
Individual	**Group**	**Collective**
Offensive blocking	Circulations	Offshoot
Curtain	Intersection	Commitment
Penetrations	*Specific offensive posts	**Attack systems
Break in meaning	----	----
----	----	----

(SILVA, 2024)

* Specific Posts - These are partial zones of the defensive and offensive game, of estimated dimensions, with tactical and real possibilities of useful actions; they determine the defense and attack systems in which the teams operate (Caldas, 2014).

**Defense and Attack Systems - Within the collective tactic, the defense and attack systems are presented as ways in which the team presents itself in a zone of the field of play. These are composed of their specific posts (Caldas, 2014).

Before knowing and executing the tactical elements above, the athlete, from the initiation, must act understanding the concepts of Depth and Defensive Width that for Menezes, Reis and Filho (2015); Simões (2012) refers to: depth - increase in the movements or runs of players, within a defensive system in relation to the length of the court, widely used in pressing, deterrence and in open defense systems by zone (1:5; 3:3; 3:2:1). Width - increase in the movements or runs of the athletes, within a defensive system, in relation to the width of the court, used in the movements of floating, coverage, exchange of markers and in closed defense systems by zone (5:1; 6:0).

At the same time that the athlete evolves defensively, he will have to improve in relation to the attack, identifying offensive tactical fundamentals to improve his performance. He will have to know the phases of attack in handball (arrival in attack, positional attack, engagement and tactical actions). This, according to Caldas (2014), refers to the evolution and training process, in addition to some cognitive processes developed by the trainer with the practitioners: perception, attention, concentration, decision-making, memory, recognition, language, reasoning and learning.

The possibility of building a tactical game model that meets the characteristics of Brazilian players requires a solid foundation of the subjects involved and knowledge about the phenomenon,

principles and rules of execution of the athletes' actions (Lozano, Camerino, Hileno, 2016; Souza et al., 2015).

According to Menezes and Reis (2014), the tactical changes in handball occur through the objectives of the attacking players, with specific fundamentals, and by the defenders who try to prevent the offensive tactical strategies. All this offensive and defensive structural organization is called the operational principles of the game.

Following the reflections of the previous paragraphs, there is a primordial subject in the construction of a tactical model of play in Brazilian handball. This individual is the coach, he should be qualified as one of the pillars for the growth of the sport (Cunha et al., 2014). A group of experts must assume the role of leaders of this complex activity that is based on power relations (Mendes, 2020).

Regarding the concept of model, Amorim (2017) defines that a model is presented as a symbolic representation of an institution or entity. This is organized by its constituent elements (managers, trainers, researchers, etc.) whose role is to facilitate recognition and identification by society. With regard to the game model, this means the ideal way for a modality to function, the style of practicing a sport, essential for recognition in the national and international scenarios (Rigon et al., 2022).

Thus, the objective of this study was to discuss issues related to the teaching and training process of defensive and offensive tactical fundamentals in handball, making the professionals involved with the modality reflect and be able to outline a game model for the teaching of this sport in their work environments (reality).

METHOD

This study is a review of the narrative, descriptive and exploratory literature (Gil, 2008). This type of approach allows the description and theoretical-reflective discussion of studies already produced on a relevant and current subject, providing access and processing of knowledge as well as new ideas about the studied theme (Antunes et al., 2022). The search on "tactics in handball with regard to the use of the tactical elements of this modality". The research period was from January to February 2024 and was carried out in the Bireme, Pubmed, Scielo and SPORTDiscus databases. Books, academic papers, original scientific articles and review articles pertinent to the theme were considered. The time cut-off period of the studies was 10 years (2013 to 2023).

The keywords were worked on in three languages: "Technique" AND "tactics" AND "handball" OR "tactics in handball" OR "tactical training in handball" AND "handball" OR "tactical actions in handball" AND "handball game model", in the Portuguese language. "Technique" OR "tactical" AND "handball" OR "tactic in handball" OR "tactical training in handball" AND

"handball" OR "tactical actions in handball" AND "handball game model". "Técnica" OR "táctica" AND "balonmano" OR "táctica en balonmano" OR "entrenamiento táctico en balonmano" AND "balonmano" OR "acciones tácticas en balonmano" AND "modelo de juego de balonmano", in Spanish.

The inclusion and exclusion criteria. The following criteria were used to include the studies in this review: (a) full articles published in journals, monographic studies, dissertations and/or theses; (b) cross-sectional, longitudinal, experimental and/or case studies that have evaluated the tactical aspects of offensive or defensive handball and its relationship with the E-A-T process of athletes, and (c) articles in Portuguese and English. Studies that did not analyze the proposed modality, studies that did not verify aspects of the technique and tactics involved with the theme studied were excluded.

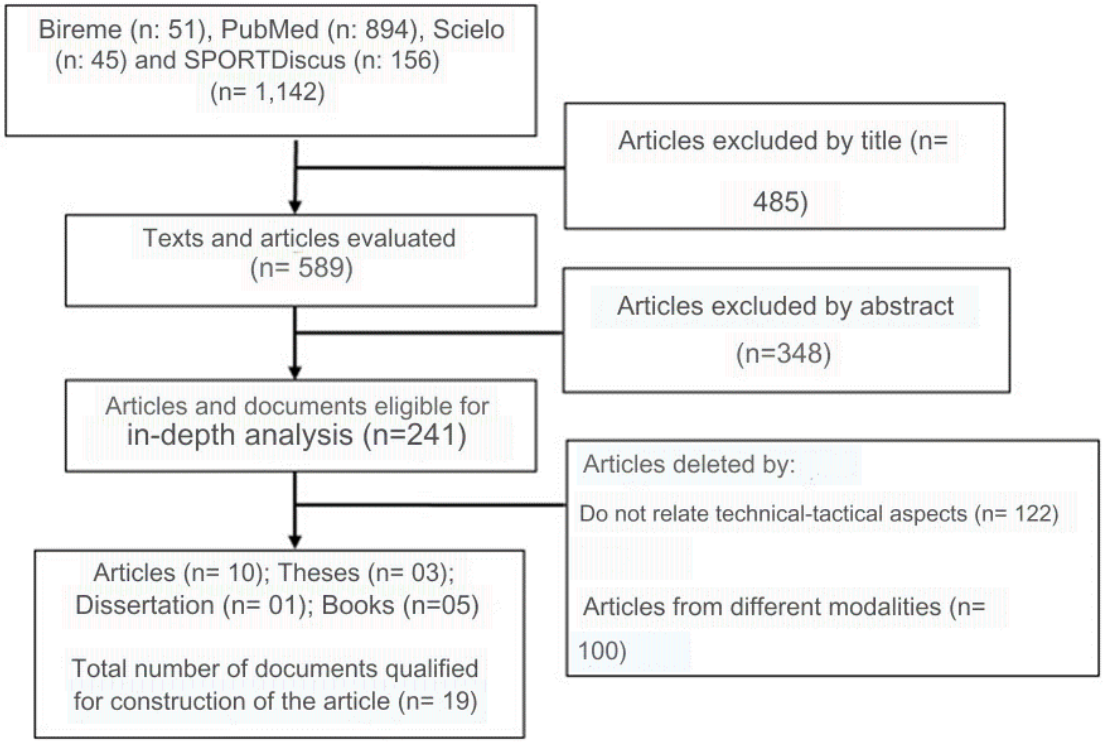
The analysis was based on the following premise: exploratory reading by title of all the material found; selection of studies that were linked to the theme; selective reading of studies as follows: exclusion of articles after reading the abstract, followed by the complete reading of compatible studies. Manuscripts unrelated to the theme were excluded.

The searches were carried out by two evaluators independently, until a consensus was reached for the inclusion of the studies. Those that presented duplicity were considered only in one database.

RESULTS

A total of 1,142 studies were found. After analyzing these, 241 documents were eligible and only 19 met the research criteria, being presented in Figure 1.

Figure 1. Flowchart of all studies found in the databases, discarded and included by type and quantity.



Source: (SILVA, 2024)

Table 2 - Studies found and included in this study; authors' perception of tactics and game model in handball.

Author and Year	Teaching Tactics in Handball	Game Model (MJ)
(Castro, 2013).	Knowledge about the internal logic of the modality.	In a MJ the main task is linked to the coaches, they will have to help the athletes to know and organize the knowledge about the game, in a coherent and logical way.
(Caldas, 2014).	Concepts about defensive and offensive tactical fundamentals in handball.	The MJ in handball will depend on the coach's planning and the environment where he is inserted.
(Menezes and Reis, 2014).	An extremely difficult task for coaches will be to understand the technical-tactical scenario of handball, to teach the relations of cooperation and opposition between athletes.	The choice for an MJ in handball is linked to the defensive and offensive characteristics provided by the opponent.
(Novaes et al., 2014).	Handball tactics are associated with the teams' ability to relate and establish coordinating situations to solve the problems that emerge in the game.	MJ is a construction of defensive and offensive actions in a coordinated way, to overcome opponents; in a successful performance of these actions to prevent the opponent's submission.
(Canãdas et al., 2015).	Establish connections between the cognitive dimensions (attention, anticipation and decision-making) with the tactical elements of the game.	GM should be based on the resources used by coaches to simplify the actions of the game, such as 2v2 and 3v3 confrontations.
(Menezes et al., 2015).	E-A-T methods should allow the development of motor, cognitive and socio-affective skills in the teaching of handball tactics.	The MJ created by the coach should be supported by various teaching methods related to handball.
(Sousa et al., 2015).	The teaching process needs to be based on the characteristics of the modality in which complexity and interactivity are decisive for the game.	The GM must be associated with the game systems. Since there is an activation relationship between these systems and defensive and offensive actions.
(Teles, 2015).	The teaching of tactical resources can be influenced by the level and improvement of technical aspects.	MJ has a peculiar profile of the players' levels and technical commitments.

(Amorim, 2017).	The teaching of tactics in handball consists of learning tactical means, linked to the athlete's motor and cognitive conditions.	GM will always be connected to the smartest and most creative player; From the training process, they should have greater autonomy and greater ability to develop their individual strategies to collaborate with the team.
(Flor et al., 2017).	Emphasis on activities that stimulate the cognitive processes of athletes and tasks related to the central nervous system, manipulating the training environment, within situations very close to the reality of the game.	To prepare a MJ, the coach in his training plan must control the technical-tactical variables involved, using teaching methods that emphasize the acquisition and improvement of motor and cognitive actions.
(Mendes et al., 2017).	The teaching of tactics is based on the reality of the game, elements of cooperation and opposition, characteristic of the sport.	MJ has structures aware of content hierarchies, such as defensive actions (recomposition/recovery of the ball), offensive (transfer to the opponent's zone/counterattack) and applied to the game, providing opportunities for creativity.
(Prudente et al., 2017).	The teaching of tactical elements must be interconnected with the player's behavioral profile and how he precedes/anticipates actions during the game.	MJ can also be established through the physical behaviors, but mainly the cognitive behaviors of the players, that is, more intelligent athletes (re)condition the game.
(Mendes et al., 2018).	In this process, athletes must be submitted to resolutions of the problem situations to be faced.	The construction of a MJ will require the coach to know the structural principles (defensive and offensive) of handball.
(Pereira, 2018).	The teaching of tactics involves understanding basic and complex tactical means.	The MJ of a team will be built from all the information obtained by the coaching staff: defensive, offensive and transition effectiveness.
(Ribeiro et al., 2019).	The teaching process based on individual (physical, understanding and situational perception) and collective (cooperation, ball recovery) elements seek to synergistically stimulate the players.	Understanding the general/global (running, jumping, and moving) and specific/local (defending, blocking, and attacking) demands of the game can ensure effective individual and collective self-organization and set up as a GM.
(Mendes et al., 2020).	It requires mastery of other variables of sports training, organization of thoughts and decisions about the process in question.	The MJ must be established based on the principles and rules of coordination of the handball game, always thinking about the opponents to be faced.
(Mendes et al., 2020).	Tactical training must have complex actions and a high level of uncertainty, but that allow athletes to develop behaviors to overcome the unpredictability of the game.	In the construction of a MJ in handball, it is necessary to hold events such as: training courses, leveling of coaches, regional and national camps, among others; This is for the technical-tactical development of athletes and coaches.
(Mendes et al., 2021).	The idea of tactical training in handball is based on the development of understanding of the game through tactical awareness, at the same time there is improvement of physical, cognitive and emotional capacities.	The creation of a GM requires several decisions from the coaches, in the selection and hierarchy of tasks that favor the assimilation and execution of objectives and contents of the problem situations that will occur in the game.
(Rigon et al., 2022).	The teaching of tactics in handball should provide athletes with the necessary adjustments to solve individual and collective team situations.	The MJ represents the basic functioning or general organization of the handball game, indicative of the minimum conditions for this game to take place.

Source: (Silva, 2024)

DISCUSSION

This discussion focuses on all the studies found and included on this topic. Thus, regarding the evolution of the athlete and the E-A-T process that the coach submits this individual, the use of problem situations in training should allow athletes to express creativity in the execution of the technical and tactical fundamentals of the game (Castro, 2013). On the other hand, according to Mendes, Dallegrave and Nascimento (2018), the tactical training process of the Brazilian women's

youth (U18) and junior (U20) teams, in relation to the activities of a training period, remains high with regard to unopposed game situations, for example "2x0" (U18=19.5% and U20=16.2%).

According to Caldas (2014), in the development of the E-A-T process, it is necessary to learn the basic tactical elements initially, in order to advance towards specific tactical skills. Thus, with regard to the content of individual defensive tactical elements, the demands must present increasing difficulties, which lead athletes to the mastery of such tactical intentions, in order to understand the variables that affect their functioning (Caldas, 2014; Menezes, Reis and Filho, 2015).

Menezes and Reis (2014) question coaches of teams in the adult female category about individual actions of defensive effectiveness, it was identified a great importance to float and cover (mutual help). For the float, an offensive characteristic was attributed to the behavior of the defenders, as it tried to anticipate the actions of the attackers. From the float a cover can occur, due to the occupation of space in the defense and, at the same time, to give more security to the floating player. It was observed by these authors that, in the view of the coaches, the initial and central element of the game in defense is the control of the 1v1 game, in which the individual tactical action of coverage is essential, making offensive numerical superiority difficult. According to Novaes et al., (2014) the construction of a game model concerns, for example, the planning and use of defensive technical and tactical elements.

As for group tactics, for Menezes and Reis (2014), the change of marking is pointed out by the coaches interviewed as a solution to a situation of creation of doubts (change of positions) by the attackers. Thus, defenders will not allow the production of spaces by the attackers, through marking by observation, body contact and by the technical action called fitting (holding the opponent). The performance of a marking exchange within a defense system occurs, for example, in the execution of a cross between two attackers (Caldas, 2014).

According to Canãdas et al., (2015) the MJ must be built from the resources available to the coach, who in the E-A-T process will try to help the athletes in solving problem situations by transmitting their knowledge about the game.

Thus, Pereira (2018) analyzed which defense system the Brazilian women's youth handball team had more facilities (higher incidence of goals) and in which errors occur (rules, finishing and technical), considering the two opposing defensive systems most faced by Brazil. Performing 260 attacks facing the 6:0 defense system and performed 56 attacks against the 5:1 defensive system. Within these attacks, against a 5:1 defense, 11 attacks were finished on goal (19.6%), 6 attacks on 7 meters (10.7%), and the rest were attacks made with finishing, technical and rule errors (Σ=75.7%). Thus, of the attacks carried out against the opponent's 6:0 system, 37.7% ended in goal (n=98) and 8.5% ended in shots from 7 meters (n=22) and ineffective attacks totaled 53.8%.

Still Pereira (2018), the results above show that the Brazilian women's youth team performed better against the 6:0 defense system, with a lower percentage of errors. Information of this nature shows that the coaches and coaching staff of the Brazilian youth teams must think about training linked to what has been discovered (science), in addition to considering the situations of adversary difficulties that they may face, that is... Construction of a game model for the investigated team.

Reinforcing the discussion, Sousa et al., (2015); Mendes (2020) state that the coach's perception is fundamental in the construction of a game model in handball. And it involves the development of knowledge about the various actions that occur in the attack and defense phases, both of the athlete and the team, depending on the forms of individual, group and collective tactical behavior, required in a match.

For Teles (2015); Mendes, Greco, Ibáñez, and Nascimento (2021), the training activities that are developed for the defense system, must be carried out with high demands of anticipation of the defenders over the attackers, using greater depth in their technical and tactical defensive gestures. And in attack, it is necessary for athletes to perform technical-tactical, individual, group and collective variations, in situations of spatial-temporal pressure, seeking high levels of effectiveness.

In the case of tactical actions or offensive MJ, this study discusses the actions in which the attack and defense are positioned. In order to have an effective game model, training must require athletes to have a diversified repertoire of individual tactical actions taught in situations of stress regarding spatial-temporal pressure, aiming at high levels of performance. In addition, it requires group and collective tactical actions (2, 3 or more athletes) with decisions for two or three possibilities, requiring athletes with an excellent reading of the game, especially in the 1st line of attack (Amorim, 2017; Sousa et al., 2015).

In the research carried out by Prudente et al., (2017) 16 games of the first 09 teams of the 2012 men's European championship were observed, 1,028 attacks positioned in the 6x6 game were analyzed, and in these there were 390 2x2 situations. This concerns the use of individual and group offensive tactical actions in a high-level game, taking into account that the defense system was organized and tried to develop its role by preventing the success of the attackers.

In the results of Mendes, Pacheco and Taborda (2017), in a training phase of the Brazilian men's youth handball team, 11 sessions were counted for the technical and tactical aspects. And many activities carried out in half a court, in which the attack and defense systems were worked on. In these situations, there was an explanation from the coaches and an understanding from the athletes of what could happen.

Mendes, Pacheco and Taborda (2017), observed in tactical training that youth athletes exercised in a period in defense, where time was controlled by coaches. And, acting as attackers, there was no control of this variable, counting the number of repetitions, and tactical actions that the

team performed. It is believed that the coaches aimed to spend more time in the attacking phase, seeking greater offensive chemistry. It was also observed that many of the activities of the attack were carried out in rows (analytical method), which often emphasizes the monotony/waiting of the athlete in training, which can cause losses in learning the tactics for the game.

For Mendes et al., (2020), the exercises proposed in a Brazilian youth team (18 years old) should not be supported only by a teaching/training methodology, but by strategies that change the game environment, causing variation in the athletes' behaviors, to make quick and accurate decisions in the face of any situation that the opponent proposes.

In the findings of Mendes et al., (2020), on the level of opposition (NOP) of the training activities of the youth teams (female = U18 and male U19), tasks with oppositional situations were used with greater frequency and percentage of time. On the other hand, the coach of the U18 team carried out activities more often in situations without opposition. These are particularities of the training verified by the authors in the distribution of tasks among the interviewees. Coincidence or not, the findings of Mendes et al., (2020), for the women's youth team (U18), are similar to other studies in the field of sports training (1x0 and 2x0 activities) (Mendes et al., 2018; Mendes et al., 2017).

Finally, the results of Mendes et al., (2020) reveal that the coach of the U18 team had greater difficulties in structuring the training, using most of the time analytical activities. This aspect was also seen for professionals who work in basic categories in other modalities (Cañadas et al., 2015). The coach of the Brazilian handball team U19, on the other hand, showed a greater ability to manipulate the training/game environment, dominating, in his activities, the aspects of time and space involving the athletes in the attack and defense exercises (Mendes et al., 2020). These methodological differences in the teaching of the modality characterize professionals with greater knowledge (Novaes, Rigon, Dantas, 2014).

For Flor et al., (2017), according to the studies cited above, in order to build a MJ, the coach must, during the execution of his training plan, control the technical-tactical variables involved, using teaching methods that emphasize the acquisition and improvement of motor and cognitive actions, manipulating the training environment, in situations very close to the reality of the game in defense and attack.

According to Amorim (2017), for several years, the Brazilian adult handball teams were directed by foreign coaches. Such a strategy has borne fruit for the sport in terms of managing the training of the base teams (cadet, youth and junior). As examples of strategies, we cite several national camps and meetings of handball teachers in higher education in Brazil, thinking about the evolution of a multidisciplinary technical commission and the athlete. But, since the dismissal of

these professionals from the national teams and the end of the meetings, these strategies have no longer been carried out, generating substantial losses in the search for a game model for the sport.

For Mendes et al., (2018); Ribeiro et al., (2019), in the construction of a tactical game model within a country, divergences will arise among handball experts, especially what should be taught for each category. The search will be a goal among the professionals involved, about the contents to be taught, so that there is a gradual increase in the complexity of individual, group and collective tactical actions of the proposed game model. It is necessary in the specialization stage (16 to 18 years old) to qualify the players for maximum sporting performance in the high-level game.

Handball teams at the top level, positioned in attack and defense organized in numerical equality, obtained results in which balanced matches are defined in the final 10 minutes. Opponents, especially attackers, wait for the right moment to make a decision and take advantage of the opponent's mistakes, opting to carry out individual tactical actions (Teles and Volossovitch, 2015; Mendes et al., 2017; Prudente et al., 2017; Pereira, 2018).

Pereira (2018) observed the Brazilian national handball team at the 2016 World Youth Women's Championship and analyzed the use of basic tactical means and complex tactical means. The latter, in Brazil, are still called rehearsed moves. The author points out that the Brazilian team used the positioned attack more frequently, executing basic and complex tactical means (77%). On the other hand, he used the game in transition (counterattack) in only 22.3% of his participation in 07 games played. These data project future investigations on a possible game model to be adopted by Brazil, assuming a philosophy of playing more in transition than is perceived today (thinking about the Brazilian youth teams).

The same author also observed that the Brazilian women's youth team, in 07 games, obtained 179 goals using tactical means in 133 actions (41.6%) and carried out counterattack actions with a value of 43 (50%). It can be seen that the team executed approximately 3.5 times more positioned attacks than counterattacks. On the other hand, the counterattack action was more effective, taking into account the amount in which each of these actions was executed.

According to Castro (2013); Ribeiro et al., (2019) and Mendes et al., (2020) what one must know to play well has been known in Brazilian handball for a long time. Therefore, this text proposes a reflection on the understanding of tactics and game model to play better, that is, to know, execute and respect all the internal logic of the modality, thinking about creating a game model for Brazil. This would be the main task of those involved with the improvement and evolution of handball in the country, helping athletes to organize their thoughts and knowledge, especially during the competition, in a precise and effective way.

Thus, in order to build a tactical game model for Brazilian handball, it requires some changes from the CBHb and the coaches, who must have a broad domain (knowledge) about scientific

methodology, planning, programming and training prescription; structuring and hierarchization of objectives and content for each phase of the athlete's evolution; criteria to select this individual and have an understanding of the game models of the opponents who command the sport worldwide (Mendes et al., 2021; Rigon et al., 2022).

CONCLUSION

From what was discussed in the aforementioned investigation about the teaching and training process of defensive and offensive tactical fundamentals in handball, it enables the effective use of them, making those involved with the sport able to create a game model for this sport within their teaching reality.

Changes and innovations of a methodological and practical nature for Brazilian handball, as well as the involvement and evolution for the sport, concern the work of several professionals. Coaches, based on a proposal suggested by the CBHb, must have knowledge of the handball teaching phases by category, regardless of the region of Brazil. The proposal for a game model must be written by experts and disseminated in the country, in training, training and leveling courses for coaches who will be responsible for treating this knowledge in a single language.

It is worth noting that the authors are concerned with broadening the discussion on the tactical issue in Brazilian handball, in addition to allowing a contextualization of the teaching possibilities inherent to the construction or proposal of a game model. Stimulating the discussion about the creation of a school of coaches in the country for the evolution of athletes and Brazilian handball.

REFERENCES

1. Amorim, A. M. (2017). *Desenvolvimento tático-técnico no handebol masculino: estratégias utilizadas nos Acampamentos Nacionais promovidos pela Confederação Brasileira de Handebol* (Tese de Doutorado). Universidade Federal de Santa Catarina.

2. Antón, J. L. G. (2002). *Balonmano: táctica grupal defensiva: concepto, estructura y metodología*. Madrid: Grupo Editorial Universitário.

3. Antón, J. L. G., et al. (2000). *Balonmano: alternativas y factores para la mejora del aprendizaje*. Madrid: Gymnos.

4. Antunes, A. S., Cavasini, R., & Franken, M. (2022). Contribuição dos esportes de aventura nas habilidades motoras em escolares: uma revisão narrativa. *Arquivos de Ciências do Esporte*, 10, 1-10.

5. Caldas, I. S. L. (2014). *Treinando Handebol* (1ª ed.). Recife: Editora da Universidade Federal de Pernambuco.

6. Cañadas, M., Ibáñez, S. J., & Leite, N. (2015). A novice coach's planning of the technical and tactical content of youth basketball training: A case study. *International Journal of Performance Analysis in Sport*, 15(2), 572-587.

7. Castro, D. (2013). *A concepção estratégico-tática no handebol: implicações para a formação de jogadores inteligentes* (Dissertação de Mestrado). Universidade Estadual de Campinas.

8. Cunha, A. F. V. P., Estriga, M. L. D., & Batista, P. M. F. (2014). Fontes de conhecimento percebidas pelos treinadores: estudo com treinadores de andebol da 1ª divisão de seniores masculinos em Portugal. *Movimento*, 20(3), 103-124.

9. Dallegrave, E. J., Berno, C. S., & Folle, A. (2017). Método situacional: aplicação nos treinamentos técnico-táticos de uma equipe de base do handebol feminino. *Corpoconsciência*, 21(1), 100-113.

10. Flor, F. K. S., Silva, L. S., Rodrigues Filho, E. A., Viana, M. T., & Leão, I. C. S. (2017). A importância da neurociência para o esporte coletivo: uma revisão narrativa. *Revista de Educação Física*, 86(3), 230-238.

11. Galatti, L. R., Reverdito, R. S., Scaglia, A. A., Paes, R. R., & Seoane, A. M. (2014). Pedagogia do esporte: tensão na ciência e o ensino dos jogos esportivos coletivos. *Revista da Educação Física*, 25(1), 153-162.

12. Gil, A. C. (2008). *Métodos e técnicas de pesquisa social* (6ª ed.). São Paulo: Atlas.

13. Ibáñez, S. J., Jiménez, A., & Antúnez, A. (2015). Differences in basketball training loads between comprehensive and technical models of teaching/training. *Revista de Psicologia del Deporte*, 24(1), 47-50.

14. Ibáñez, S. J., Feu, S., & Cañadas, M. (2016). Sistema integral para el análisis de las tareas de entrenamiento, siate, en deportes de invasión. *E-balonmano.com: Revista de Ciencias del Deporte*, 12(1), 3-30.

15. Lozano, D. J., Camerino, O., & Hileno, R. (2016). Interacción dinámica ofensiva en balonmano de alto rendimiento. *Apunts Educación Física y Deportes*, (125), 90-110.

16. Mendes, J. C. (2020). *Construção do modelo de jogo das seleções brasileiras masculinas juvenil e adulta de handebol* (Tese de Doutorado). Universidade Federal de Santa Catarina.

17. Mendes, J. C., Greco, P. J., Ibáñez, S. J., & Nascimento, J. V. (2021). Construcción del modelo de juego en balonmano. *Pensar en Movimiento: Revista de Ciencias del Ejercicio y la Salud*, 19(1), 1-25.

18. Mendes, J. C., Olivoto, R. R., Reina, M., Mancha-Triguero, D., Nascimento, J. V., & Ibáñez, S. J. (2020). Características pedagógicas das tarefas de treino: estudo das seleções feminina e masculina do handebol brasileiro. *E-Balonmano.com: Revista de Ciencias del Deporte - Journal of Sport Science*, 16(3), 147-158.

19. Mendes, J. C., Pacheco, G. J., & Taborda, D. S. (2017). Caracterização das sessões de treino de handebol: estudo da seleção brasileira juvenil masculina. *Coleção Pesquisa em Educação Física*, 16(4), 25-32.

20. Mendes, J. C., Dallegrave, E. J., & Nascimento, J. V. (2018). Estruturação do processo de treino técnico-tático das seleções brasileiras de handebol feminino. *E-balonmano.com: Revista de Ciencias del Deporte*, 14(2), 71-78.

21. Menezes, R. P., & Reis, H. H. B. (2014). Relação entre eficácia defensiva e elementos técnico-táticos do handebol a partir dos discursos de treinadores experientes. *Revista de Educação Física da UEM*, 25(4), 513-526.

22. Menezes, R. P., Reis, H. H. B., & Filho, H. T. (2015). Ensino-aprendizagem-treinamento dos elementos técnico-táticos defensivos individuais do handebol nas categorias infantil, cadete e juvenil. *Movimento*, 21(1), 261-273.

23. Novaes, R. B., Rigon, T. A., & Dantas, L. E. P. B. T. (2014). Modelo de jogo de futsal e subsídios para o ensino. *Movimento*, 20(3), 1039-1060.

24. Pereira, L. E. P. (2018). *Análise do jogo ofensivo da seleção brasileira de handebol feminino categoria juvenil no campeonato mundial 2016* (Trabalho de conclusão de curso de graduação). Universidade Federal de Santa Catarina.

25. Pombo, R., Baldy, H. H., & Pereira, M. (2016). O handebol, seu cenário imprevisível e os métodos de ensino-aprendizagem-treinamento. *E-balonmano.com: Revista de Ciencias del Deporte*, 14(3), 165-176.

26. Prudente, J., Sousa, D., Sequeira, P., López-López, J. A., & Hernández-Mendo, A. (2017). Analyzing the influence of playing time and partial score on the tactical behavior in the duel 2 vs 2 in the offensive process in handball, using the polar coordinates technique. *Anales de Psicología/Annals of Psychology*, 33(3), 515-529.

27. Ribeiro, J., Davids, K., Araújo, D., Guilherme, J., Silva, P., & Garganta, J. (2019). Exploiting bi-directional self-organizing tendencies in team sports: the role of the game model and tactical principles of play. *Frontiers in Psychology*, 10, 2213.

28. Rigon, T. A., Nogueira, F. F., Talarico, L. R., Drezner, R., Novaes, R. B., & Dantas, L. E. P. B. T. (2022). Modelo de jogo, estratégia de jogo, estilo de jogo, tática de jogo: concepções úteis para compreender o contexto do jogo esportivo. *Corpoconsciência*, 26(2), 216-235.

29. Scaglia, A., Reverdito, R., Leonardo, L., & Lizana, C. (2013). O ensino dos jogos esportivos coletivos: as competências essenciais e a lógica do jogo em meio ao processo organizacional sistêmico. *Movimento*, 19(4), 227-249.

30. Simões, A. C. (2012). *Handebol defensivo: conceitos técnicos e táticos* (2ª ed.). São Paulo: Editora Phorte.

31. Sousa, D. J., Prudente, J. N., Sequeira, P., López-López, J. A., & Hernández-Mendo, A. (2015). Análisis de las situaciones de juego 2vs2 en el campeonato europeo masculino de balonmano 2012: Aplicación de la técnica de coordenadas polares. *Cuadernos de Psicología del Deporte*, 15(1), 181-194.

32. Teles, N., & Volossovitch, A. (2015). Influência das variáveis contextuais no desempenho das equipes nos últimos 10 minutos do jogo de handebol. *Revista Brasileira de Educação Física e Esporte*, 29(2), 177-187.

33. Uezu, R. (2014). *Análise das propostas e iniciativas da Confederação Brasileira de Handebol para o aprimoramento profissional* (Tese de Doutorado). Escola de Educação Física e Esporte, Universidade de São Paulo.

Food consumption in the Brazilian Creole cultural locality: A literature review

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ABSTRACT

Culture plays a crucial role in the choices we make and the meaning we attach to what we consume. Cultural reception is key to uniting different perspectives of local communities and visitors on cultural traditions and practices, which can stimulate the development of the regions. This work aims to review the existing literature with a qualitative approach to understand the importance of Brazilian regions, with a specific focus on the Brazilian Creole cultural region. The purpose is to demonstrate how local culture influences the consumption of food and services by visitors and to explore the potential of applying these discoveries in other areas of Brazil. The research revealed that local culture has a significant impact on consumption decisions and highlighted the importance of taking into account consumption behavior in various cultural regions. The main contribution of this study is to provide valuable insights for marketing planning, based on consumer behavior. In addition, the study paves the way for future research, allowing for a deeper understanding of consumption patterns and market opportunities in different cultural contexts.

Keywords: Behavior, Consumption, Creole, Food, Marketing

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INTRODUCTION

Consumer behavior has been increasingly explored in the area of marketing planning as a crucial tool for collecting and analyzing data on the purchase of products and services (KOTLER, 1998). This concept is fundamental to understand how cultural, social, and group factors influence purchasing decisions. Detailed understanding of these factors allows businesses and organizations to adjust their strategies to better meet consumer needs and preferences.

This work focuses on the analysis of the behavior of Brazilian consumers of food products of the Creole subculture, as described by Ribeiro (1995). The Creole subculture is identified by its cultural and historical particularities, and this study aims to identify the main foods and characteristics that define it. In addition, it proposes an analysis of the interactions between the Creole subculture and other cultural regions of Brazil, investigating how these interactions can influence the consumption of food products.

The research is grounded in the literature review that explores the consumption habits of the Creole subculture, offering insights into how these habits are related to broader cultural aspects. The five cultural regions identified by Ribeiro (1995) are analyzed as distinct market niches, each with its own influences and meanings attributed to regional products.

The Creole cultural region is notable for its geographical scope and its historical specificities, which have shaped its eating habits. Studies by Cascudo (1983) and Freyre (2001; 1997; 1989) provide a solid basis for understanding the predominant foods and consumption patterns within this subculture. Cascudo explores the geography of food in Brazil, while Freyre discusses the sociocultural influences that have shaped the eating habits of Brazilian regions.

The present investigation offers an in-depth view of the habits and characteristics of Brazilian consumers, with a specific focus on the Creole subculture. By taking a closer look at the data collected, the study provides valuable insights that can guide the creation of more effective marketing strategies and foster the development of new products and services that resonate with the unique cultural preferences of this region. Meticulously reviewing the eating habits and cultural practices of the Creole subculture illuminates the influence of these factors on the market and guides businesses on how to strategically position themselves to best meet the needs and expectations of local consumers.

The methodology used in the research consists of a comprehensive bibliographic review of consumer behavior in the Creole region. This approach aims to identify key cultural influences and their implications for the market, highlighting how these factors can be leveraged to enhance economic development and encourage new investment. The study considers the relevance of consumer culture in creating business opportunities in both services and food production, offering a valuable perspective on how companies can exploit the region's cultural specificities effectively.

The article is structured in such a way as to offer a complete and integrated analysis. Initially, the fundamental theoretical and conceptual aspects related to consumer behavior and gastronomic tourism are addressed. This section explores how these concepts apply to the context of Creole subculture and the broader landscape of Brazilian cultural regions, providing a subsequent analysis.

Next, the article presents the main characteristics of the various cultural regions of Brazil, with a special focus on the Creole subculture. The cultural specificities that define the Creole region and their influence on consumption habits are detailed, highlighting how these characteristics shape the regional market. The methodology is described in detail, including the criteria for selecting sources and methods for analyzing the data, ensuring the transparency and validity of the results. This section details the process by which the research was conducted and how the data was interpreted.

The main findings of the analysis are then presented, highlighting the consumption habits and cultural characteristics of the Creole subculture. The results discuss how these factors offer practical insights for the market and highlight opportunities for the development of marketing strategies adapted to the cultural needs of the region.

Finally, the article summarizes the main conclusions derived from the research, emphasizing the implications for the food products market and for the service area. Recommendations are offered to companies and investors on how to use the cultural characteristics of the Creole subculture to drive new investments and marketing initiatives, taking advantage of the unique potential of this region.

THEORETICAL FOUNDATIONS

CONCEPTUAL ASPECTS OF CONSUMER BEHAVIOR

Consumer behavior is widely studied to understand the motivations and decisions of people and groups, with the aim of more effectively meeting their expectations and needs in relation to products and services. The study of consumer behavior is an essential tool in the field of marketing, as it allows you to better analyze and understand the buying and consumption patterns of customers.

According to Las Casas (2006), consumer behavior involves a series of mental and physical activities performed by both individuals and institutions. These activities include decision-making and actions related to the payment, purchase and use of goods and services. From this perspective, consumer behavior can be understood as a process that encompasses several stages, influenced by marketing stimuli, consumer psychology, individual characteristics, purchasing processes, and purchasing decisions.

These steps are key to understanding how consumers make their choices and how they position their purchasing decisions. However, it is important to note that these steps do not constitute

a rigid model of analysis. Each consumer reacts differently to similar stimuli, due to individual differences in their perceptions and internal processes. As Cobra (1997, p. 59) points out, "each consumer reacts differently under the same stimuli, this is because each one has a different black box." This concept highlights the complexity of consumer behavior and the need for flexible and adaptive approaches in analyzing their purchasing patterns.

> The fundamental premise of consumption in an anthropological view is that, in the sphere of consumption, men and objects acquire meaning, produce meanings and social distinctions. They are the objects that betray the presence or absence of identities, worldviews or lifestyle. Clothes, automobiles, drinks, cigarettes, food, housing and decorations of the most diverse are not consumed in a neutral way. On the contrary, they are anthropomorphized to bring to their consumers individualities and symbolic universes that have been attributed to them. (PINTO and LARA, 2011, p. 43)

Each consumer has unique characteristics that influence their choices of goods and services. These particularities result from a process of personal learning, which, according to Kotler (1998, p. 175), can be described as "all the changes caused in the behavior of an individual as a result of his experiences". Each individual's learning is shaped by a range of factors, including their culture, subculture, and social class, which play a significant role in shaping their preferences and consumption behaviors. Thus, culture emerges as a crucial element, as it shapes the individual's personality and perception of the world (Maffesoli, 1998). important for every person, as it shapes their personality and their way of perceiving the world (MAFFESOLI, 1998).

> The theory of consumer culture is not unified, as it refers to a family of theoretical perspectives that direct the dynamic relationships between consumer actions, the market and cultural meanings. More than seeing culture as a homogeneous system of collectively shared meanings, the theory of consumer culture explores the heterogeneous distribution of meanings and the multiplicity of cultural groups and manifestations that exist in the various current socio-historical formations, that is, the line of research also conceptualizes an interconnected system of commercially produced images, texts and objects that groups use through the construction of practices, overlapping identities and meanings for the creation of meanings in their environments and to guide the experiences and lives of their members (PINTO and LARA, 2011, p.45).

To understand the importance of culture, it is essential to recognize that it represents the ways of conceiving and organizing social life and its material aspects, including the way of working to ensure survival and the way of observing the world. In this way, culture is an essential determinant of a person's desires and behaviors (Kotler, 1998).

> In this way, it can be seen that culture and consumption have found a strong connection, as consumption is shaped in all its senses by cultural considerations. Consumers use the meaning of consumer goods to express cultural categories and principles, cultivate ideas, create and maintain lifestyles, (re)construct notions of themselves and survive social changes (PINTO and LARA, 2011, p.45).

However, as pointed out by Schiffman and Kanuk (1994, p. 286), "the sum total of the beliefs, values and customs learned serves to direct the consumption behavior of the members of a given society". These factors profoundly influence individuals, who acquire values, behaviors, preferences, and perceptions through family life and the basic institutions of society.

The theory of consumer culture, therefore, is organized around theoretical issues that involve the relationship between individuality and collectivity. In other words, culture shapes the universe of consumers by structuring processes and lived experiences, as well as by dynamizing sociological categories through the dynamics of consumer culture. In this way, culture plays a fundamental role in the formation of consumption behaviors and practices, reflecting the continuous interaction between cultural aspects and market practices.

> Consumption can be understood as eminently cultural. This is because, in the first place, all consumption involves meaning, that is, an individual, in order to have a need and act on it, needs to be able to interpret sensations, experiences, and situations, at the same time that he needs to give various objects, actions, and resources in relation to these needs. Secondly, consumption is always cultural because the meanings involved are shared meanings, that is, individual preferences are formed within cultures. Thirdly, all forms of consumption are culturally specified. This means that they are articulated within or in relation to meaningful and specific life forms. Finally, it is through culturally specific forms of consumption that we (re)produce cultures, social relations and society. In other words, by knowing and using the codes of consumption of culture, an individual reproduces and demonstrates his participation in a certain social order (PINTO and FREITAS, 2011, p.247).

Kotler (1998, p. 162) states that "each culture consists of smaller subcultures, which provide a more specific identification and socialization for its members". These subcultures can be based on factors such as nationality, religion, racial group, or geographic region. Each subculture has its own consumption criteria, reflected in its distinctive habits and practices. To meet these specific needs, strategic marketing develops products aimed at these subcultures, with the aim of satisfying their consumer demands (Kotler and Keller, 2007, p. 57).

The importance of subcultures lies in the need to understand and identify groups of consumers with particular needs. These groups represent potential markets to be explored. To do this, marketing strategies should focus on analyzing and identifying the profile of these consumers, understanding their needs to plan products that adequately meet their requirements. Thus, the relationship between culture and consumption becomes evident, as consumption is shaped and influenced by cultural factors in several aspects (Pinto and Lara, 2011).

Culture plays a key role in the study of consumer behavior, as regardless of efforts to separate it, it is deeply rooted in the nervous system and shapes the way the individual perceives the world (Pinto and Lara, 2011). According to anthropological analyses of consumption, cultural factors and collectivism are essential to understand purchasing behavior. These concepts were adapted by management for market planning, integrating cultural and social behavior with the analysis of market

niches and purchasing behavior. Although the conceptual bases of anthropology and marketing are similar, the methods and data collection differ, being adjusted to meet the specific objectives of each area.

The behavioral approach based on consumer culture reveals valuable data to understand what motivates certain audiences to consume certain products and what meanings these products have for them. The influence of culture on the desire to buy is significant, as lived experience is an important but often underexplored aspect of consumer satisfaction. Therefore, it is crucial that products and services are developed and adapted to meet the cultural needs and expectations of consumers, ensuring that they truly satisfy their demands.

BRAZILIAN CULTURAL REGIONS

Ribeiro (1995) dedicated himself to reconstituting and understanding the civilizing process that shaped Brazil as a nation. To do so, he analyzed the ethical and racial matrices that make up Brazilian culture, considering three main factors: ecological factors, which refer to environmental conditions that required regional adaptations; the economic ones, which address the different forms of production that have led to regional specializations; and immigration, which brought new human contingents and cultural elements, especially with the arrival of Europeans, Arabs and Japanese. Based on this study, Ribeiro presents a regionalization of Brazil that highlights cultural areas and characteristics, reflecting the formation of the country as an integrative culture around the concept of the nation-state.

According to Ribeiro (1995), at the beginning of the sixteenth century, Brazilian society was being formed in communities composed of indigenous people displaced from their villages to live with Portuguese and mestizos. This initial cultural nucleus expanded along the coast of Pernambuco, Bahia, Rio de Janeiro and São Paulo. Social relations were established through cronyism and barter with the indigenous people who remained in their villages. From these formative processes, Brazil presents itself as the first civilization that articulates and integrates America as a territory, Africa as a supplier of labor force and Europe as the main partner and consumer of these businesses.

From these communities emerged the groups that formed all the socio-cultural regions of Brazil, ranging from the old sugar-producing areas of the coast and the cattle corrals of the interior, to the mining areas in the center of the country, the extractivists of the Amazon and the pastoralists of the extreme south. Despite the immense regional cultural diversity that exists in Brazil, Ribeiro (1995) identifies a unique ethnicity as a nation. He points out that the processes of urbanization, industrialization and the expansion of forms of mass communication played

fundamental roles in the cultural uniformity of the Brazilian people. These factors helped to consolidate a national cultural identity, despite the varied regional influences.

> more than a simple ethnicity, however, Brazil is a national ethnicity, a nation-people, settled in its own territory and framed within the same State to live its destiny there. Unlike Spain, in Europe, or Guatemala, in America, for example, which are multiethnic societies governed by unitary states and, for this very reason, torn apart by interethnic conflicts, Brazilians are integrated into a single national ethnicity, thus constituting a single people incorporated into a unified nation, a uni-ethnic state. The only exception is the multiple tribal micro-ethnicities, so imponderable that their existence does not affect the national destiny (RIBEIRO, 1995, p. 22).

For Ribeiro (1995), the cultural aspects of Brazil result from the confluence, clash and fusion between the Portuguese invaders, the indigenous foresters and campineiros, and the black Africans, all enticed as slaves. He points out that this complex and multifaceted interaction gave rise to the Brazilian cultural formation, evidencing how these different influences integrated and shaped the country's cultural identity.

> in this confluence, which takes place under the regency of the Portuguese, disparate racial matrices, distinct cultural traditions, outdated social formations confront each other and merge to give rise to a new people (Ribeiro 1970), in a new model of societal structuring. New because it emerges as a national ethnicity, culturally differentiated from its formative matrices, strongly mixed, dynamized by a syncretic culture and singularized by the redefinition of cultural traits originating from them. Also new because he sees himself and is seen as a new people, a new human race different from those who exist. A new people, also, because it is a new model of societal structuring, which inaugurates a singular form of socio-economic organization, founded on a renewed type of slavery and a continued servitude to the world market. New, even, for the improbable joy and astonishing desire for happiness, in a people so sacrificed, which encourages and moves all Brazilians (RIBEIRO, 1995, p. 19).

The studies of Ribeiro (1995) result in the division of Brazil, from the cultural point of view, into five "Brazils": the Creole Brazil, the Caboclo Brazil, the Sertanejo Brazil, the Caipira Brazil and the Southern Brazil. Among these regions, Brasil Crioulo is characterized by the Sugar Mill as the main productive unit and the nucleus of development of social relations and cultural composition. This Brasil Criollo is often described as the "Brazilian fiefdom", with its historical and social particularities.

The Sugar Mill, in the context of Creole Brazil, was divided into two main areas: the Casa-Grande and the Senzala. The Casa-Grande was the residence of the Plantation Lords and their families, predominantly of European origin, living in conditions of great comfort and forming a local aristocracy. In contrast, the slave quarters were where African slaves lived in subhuman conditions, playing roles both in sugar production and as servants to the Casa-Grande. These dynamics are described in more detail in the works of Gilberto Freyre (2001), who explores the social and cultural structure of this period.

This region also has a history of global connection due to the trade generated by sugar production. This activity created a society polarized between blacks and whites, rich and poor, characterized by a dependence on the basic needs provided by those in power.

In contrast, Caboclo Brazil had as its initial objective the expulsion of the French, Dutch and English. Over time, there was an interaction between the Lusitanians, the neo-Brazilians originating from the first cells of Creole Brazil, and the indigenous people, who were used as slaves for the extraction of forest products, especially herbs and drugs, and for the construction of buildings in the new cities. The integration of the indigenous people in this emerging social organization was mediated by the Catholic Church, with the work of the Jesuits, who began to incorporate people from different tribes, languages and customs.

The society of Caboclo Brazil developed around royal authority. Subsequently, the region experienced a cycle of economic growth associated with the extraction of latex, receiving a migratory flow from the Brazilian Northeast. This movement formed a population that inherited tribal culture and was highly mixed. On the other hand, Brasil Sertanejo was initially occupied by bandeirantes and garimpeiros, with cattle raising being a remarkable activity. The people who formed in this region had to adapt to the difficult environmental conditions of the interior of Brazil, becoming pioneers in the occupation and development of this vast area.

The Midwest region of Brazil was integrated into the national territory mainly through the expansion of cattle ranching. The activity of mining, which began to be explored in the eighteenth century, also played a significant role in the occupation and development of the area. This region stood out for its own type of banditry, known as cangaço, which reflected the adverse conditions and the need to adapt to the local environment. The society formed in the Midwest is characterized by its agility, adaptability, and specific skills to deal with the challenges of the fields, evidencing the resilience and versatility of the region's inhabitants.

Caipira Brazil is characterized by prevailing poverty, which forces its people to venture out and accept any task, showing themselves more inclined to plunder than to production. This region represents the implementation of Western European civilization as a global mercantile outpost and a colonial-slave enclave, with the initial presence of the Mamelukes (indigenous people under the influence of white colonizers). However, from the eighteenth century onwards, Caipira Brazil undergoes a significant economic development, driven by the production of coffee. The region becomes an important exporter of this product, establishing international connections and attracting migratory flows from other parts of Brazil, especially the Northeast.

The formation of Brasil Sulinos was influenced by the expansion of São Paulo and was initially intended for cattle raising by the gauchos, a mixture of whites and indigenous people. The region inherited, for example, the habit of eating roasts with yerba mate from the Guarani indigenous

people. Its strategic location for the border delimitation of Brazilian territory led to strong militarization and territorial defense conflicts. Later, the region received a large influx of immigrants from Germany, Italy, Poland, Ukraine and Japan. These immigrants contributed to the local culture, favoring the industrialization and development of the region, while enriching the cultural field, making it highly diverse.

THE EATING HABITS OF THE BRAZILIAN CREOLE CULTURAL REGION

Eating habits are deeply influenced by the customs and culture in which an individual is inserted. According to Maffesoli (1998), a person's habits are shaped by the culture around them, which, in turn, determines their food choices. Food is an expression of culture and customs, as Savarin (1995) points out, who states that we are, culturally, what we eat. In the subculture of the Brazilian Creole cultural region, eating habits were shaped by the inputs and products available at the time, with emphasis on the economy based on sugar production. Sugar, as the predominant product, is widely present in the diet of this group.

According to Cascudo (1985), the diet in the region is diversified due to the influence of three main cultures: the Portuguese, the indigenous and the African. This fusion of culinary customs created a distinctive feature of the Creole subculture, particularly present in the Brazilian Northeast. The combination of these cultural elements has resulted in a rich variety of dietary practices that reflect the heritage and diversity of the region.

The consumption of grains and dehydrated proteins is a characteristic adapted to the environment of the cerrados, caatingas and agrestes, as pointed out by Cascudo (1985). The abundance of salt pans and the cultivation of sugar in this subculture were crucial to food preservation, resulting in the production of items such as jams, jellies, and salted meat. These products are distinctive in the diet of the Northeast and play an important role in the eating habits of the region.

The food consumption behavior of this group is particular and has been consolidated within the local society, reflecting the cultural and economic specificities of the group. The local way of working and the economy profoundly shape these eating habits, which are rooted in the culture and society of the region. Through this analysis, the work not only enriches the knowledge about the Brazilian Creole subculture, but also contributes to the creation of marketing approaches that respect and align with the cultural particularities of consumers. By highlighting the foods that characterize this subculture, the work provides a detailed understanding of the cultural influence on eating behavior, highlighting how specific practices and traditions contribute to the formation of food preferences.

Food consumption and associated habits are deeply rooted cultural practices passed down through generations, often unconsciously or as a means of preserving a group's cultural identity (SAVARIN, 1998). Understanding the impact of culture on consumer behavior is crucial, as culture shapes food choices and the meaning assigned to these products. To conduct an effective study on this behavior, it is essential to identify the subgroup or subculture that functions as a niche market. In this study, we highlight the relevance of the Brazilian Creole cultural region as a potential niche market, considering its geographic and cultural dimension and the characteristic eating habits of the region.

According to Freyre (1989), the food customs of the Northeast region of Brazil are strongly marked by the cultural presence of blacks. However, the power dynamics between whites and blacks, with white domination and black submission, plays a determining role in the configuration of society. Blacks introduced techniques and eating habits in the region, and, for a period, their labor force was exploited not only in the plantations, but also in the kitchens of the plantation owners and townhouses.

The coexistence between whites and blacks led to a fusion of eating practices, with whites incorporating European elements into their diet and blacks contributing their culinary techniques. Sugar, for example, has become a central ingredient due to its abundance and has been incorporated into various sweet preparations and cakes. This collaboration between African and European traditions has resulted in a regional custom of consuming preparations with a high sugar content, reflecting the rich cultural confluence of the region (FREYRE, 1997).

The practice of food preservation has deep cultural roots in the Brazilian Creole region. The salting of animal proteins, for example, was a technique developed to increase the durability of food, ensuring its preservation for prolonged periods. In the same way, jams, which after being ready can have a shelf life of up to three months, were an efficient solution to preserve fruits and ensure the availability of food out of season (FREYRE, 1997). These preservation techniques continue to be widely used in the Creole region, reflecting a commitment to traditional food practices.

In the diet of the Creole subculture, the consumption of salted meat and jams is predominant, with a particular focus on beef. According to Cascudo (1983), although the Brazilian coast is rich in fish and seafood, the interior of the capitals, particularly in the areas influenced by Creole culture, demonstrates a strong consumption of dairy products and salted beef. These eating habits are largely a consequence of the ease of access and culinary tradition of the region.

Food preservation customs and techniques continue to play a vital role in the diet of the Creole population, with the supply and demand for these products being hallmark features. To better understand the consumption behavior of this subculture, it is essential to identify the foods of

greatest significance to the region and how these products represent the culture and eating habits of individuals.

METHODOLOGICAL PROCEDURES

The methodology adopted for this study consists of a literature review, an effective approach to gather and analyze previously published information. According to Gil (2002, p. 44), "bibliographic research is based on material that has already been prepared, consisting mainly of books and scientific articles." This methodology is particularly suitable to achieve the objectives of this project, as it allows for an in-depth analysis of social and cultural concepts through existing sources.

Gil (2002, p. 44) also points out that "a good part of exploratory studies can be defined as bibliographic research." In addition, for questions involving ideologies and analysis of different positions on a problem, bibliographic research is often the main tool used.

The use of appropriate and effective methods in data collection is crucial. An academic study must delve into the pertinent social and cultural concepts to become a valuable reference for future research. According to Maffesoli (1998), "the researcher must have a creative vision for data collection, with full knowledge of the work to be researched and mastery of the concepts involved." Research that is limited to reproducing information in a superficial way has no significant relevance in the scientific environment.

Literature search offers the advantage of allowing the researcher to cover a wider range of phenomena than would be possible with direct research. Gil (2002, p. 45) observes that "the main advantage of bibliographic research lies in the fact that it allows the researcher to explore a much broader spectrum of phenomena." For a study that covers a broad geographic dimension, from Bahia to Rio Grande do Norte, the use of data from existing bibliographic sources is essential to obtain a comprehensive and enriching view of the subject.

To support the theoretical and conceptual arguments of this project, we will adopt quantitative and qualitative methods. According to Martins (2004, p. 292), "the variety of material obtained qualitatively requires from the researcher an integrative and analytical capacity that depends on the development of a creative and intuitive capacity." The use of qualitative methods is essential to deal with the complexity of research data, which can include information from images, music, and videos (Tesch, 1990).

Qualitative research differs in that it does not focus on enumerating or measuring data, nor on employing statistical instruments. Instead, it seeks to obtain descriptive data on people, processes, and interactions, seeking to understand the perspectives of the participants involved (Godoy, 1995). This method, widely explored by sociology and anthropology to analyze human behavior, is also

widely used in management for market and satisfaction studies. The combination of qualitative and quantitative methods offers a robust approach to obtaining relevant and in-depth data for research.

Methodological guidelines in marketing are of great importance when well directed, as they allow data to be aligned with research objectives (Holbrook, 2006a). The study of consumer behavior often relies on strategies from psychology to understand the factors that influence purchasing decisions. The qualitative methodology is crucial for the analysis of the collected data, providing a deeper understanding of the consumption behavior of the Brazilian Creole cultural region.

This study integrates the existing bibliography with a qualitative approach to analyze and clarify the results that reveal the consumption of certain foods and the cultural significance of these products for the subgroup studied. Thus, the research aims not only to identify consumption patterns, but also to understand the cultural and social roots that shape these eating habits.

ANALYSIS AND DISCUSSION OF RESULTS

It was found that the works of Ribeiro (1995), Freyre (1951) and Cascudo (1985) present differences in the descriptions of foods and eating habits of the regional Creole subgroup. According to Ribeiro (1995), the foods most consumed by the Brazilian subgroup, which covers the region from Bahia to Rio Grande do Norte, are highlighted in Chart 01.

Chart 01 illustrates the foods highlighted as being of greater relevance for the consumption of the Brazilian Creole subgroup. The analysis of the works allowed us to identify that, although these foods are produced in different regions, there is a wide interaction and consumption of these products throughout the territory of the Creole cultural region. Although the table does not include all the products mentioned in literary works, it focuses on those with the greatest significance attributed to consumption, considering both regional supply and demand.

This approach highlights how the variety of foods consumed reflects the rich cultural and historical diversity of the region, influencing eating practices that are distinctive and significant for the Brazilian Creole subgroup.

Table 01: Foods most consumed by the Brazilian Creole regional subgroup, cited in the works of Ribeiro, Freyre and Cascudo.

Foods	**Main producing regions**
Sun meat	Bahia, Pernambuco, Rio Grande do Norte and Paraíba
Earth butter	Pernambuco, Rio Grande do Norte and Paraíba
Curd Cheese	Pernambuco, Rio Grande do Norte and Paraíba
Shrimp	Rio Grande do Norte and Bahia
Couscous	Pernambuco, Rio Grande do Norte and Paraíba
Green beans	Bahia, Pernambuco, Rio Grande do Norte and Paraíba
Palm oil	Bahia and Paraíba
Coconut milk	Bahia and Paraíba
Tapioca flour	Pernambuco, Rio Grande do Norte and Paraíba
Cashew nuts	Pernambuco, Rio Grande do Norte and Paraíba
Sugar	Bahia, Pernambuco, Rio Grande do Norte and Paraíba

Source: Prepared by the authors based on the works of Ribeiro (1995), Freyre (1951; 1969) and Cascudo (1985).

The foods listed in Table 01 are highly sought after and consumed in the specified regions, with their productions located predominantly in the mentioned areas. This consumption pattern creates a robust market and an efficient channel for the flow of production. However, the most relevant factor for the heating of these producing regions is the cultural context, which exerts a significant influence on the demand and appreciation of these products.

Chart 02 illustrates how food consumption habits reflect the food culture of the Brazilian Creole subgroup. In coastal regions, fish consumption is predominant, while in non-coastal areas, animal protein, such as sun-dried meat, and dairy products, such as bottled butter, are more common.

Dried meat, for example, is highly valued for its durability in hot environments, and bottled butter is preferred due to its more affordable cost compared to other types of oils. These consumption

habits are deeply rooted in regional culture, and while the name and presentation of dishes may vary between regions, the mode of preparation and consumption remain consistent.

The analysis of consumption habits reveals the integration between food products and the cultural context of the Creole subgroup, showing how culture shapes and reinforces eating practices. Thus, understanding these dynamics is crucial for planning marketing strategies and for the cultural appreciation of food in the region.

Table 02: Cuisine produced from the foods consumed by the Brazilian Creole region, cited in the works of Freyre and Cascudo.

Foods	**Cuisine consumed by the Brazilian Creole regional subgroup**
Sun meat	Sun-dried meat in cream or meat paçoca
Earth butter	Frying Use or Ingredient
Curd cheese	Baked curd cheese or milk rice
Couscous	Couscous with butter or egg
Tapioca flour	Tapioca stuffed with shredded meat or fish
Cashew nuts	Black cake or chestnut paçoca
Sugar	Used in desserts such as roll cake

Source: Prepared by the authors based on the works of Freyre (1951; 1969) and Cascudo (1985).

The food consumption behavior of the Brazilian Creole subgroup is deeply rooted in a historical context of colonization, as addressed by Freyre (2001). Despite the great transformations that have occurred over the centuries, the eating habits of this specific subgroup have remained relatively consistent. These habits are passed down through family and social contexts, vividly preserving the cultural traditions of the region.

The consumption of typical foods from the region is an expression of cultural identity, reflecting both the colonial past and the adaptations to the local environment. Products such as sun-dried beef, bottled butter, and couscous are representative of this cultural heritage, playing a central role in the subgroup's diet. While the production and consumption of these foods varies across regions, the cultural and historical connection remains a predominant factor.

On the coast, for example, there is a strong presence of fish-based dishes, while in the interior, salted beef and dairy products predominate due to the climatic conditions that favor the preservation of these foods. These eating habits reflect the adaptation to the environment and the maintenance of the traditions that were established during the colonial period.

To effectively tap into the market for this cultural subgroup, marketing strategies must be carefully tailored to align with the region's dietary habits and preferences. Kotler and Keller (2011) suggested, investing in new products or creating product lines that incorporate traditional foods can

be an effective approach. It is essential to consider the cultural context when developing marketing strategies to ensure that products resonate with local consumers and preserve cultural authenticity.

Targeted investments in the Brazilian Creole subgroup should start with an in-depth market study. This study should identify the specific characteristics of the target audience and their dietary preferences, as well as analyze the market potential for new products. Detailed understanding of consumers' needs and wants will help create offerings that not only meet local demands but also respect and value cultural heritage.

Therefore, by respecting and incorporating local food traditions, it is possible to create products that have a lasting and meaningful appeal. This will not only meet the needs of consumers in the Creole subgroup, but also strengthen the cultural connection between the products and their consumers. The integration of traditional foods into product development and marketing strategies can contribute to success in the regional market and beyond by harnessing the still untapped potential of these sub-regions.

FINAL CONSIDERATIONS

We can understand the importance of culture in consumer behavior by observing that the survey reveals the significant relevance of this market. The analysis of the data highlights a high demand in the regions studied, showing that local cultural customs remain largely preserved due to social and family influence. The culture of the Brazilian Creole subgroup has considerable market potential, especially in areas where this subculture is present. These regions, predominantly located along the Brazilian coast, not only have a strong local demand, but also attract tourists, which opens up opportunities for investments in products and services that meet both local needs and tourist demand. Typical food products can, for example, be marketed as souvenirs in a growing tourism market.

The study of consumer behavior is an essential tool in marketing research, with a focus on identifying specific consumer markets, niches, or segments. Theoretical research has revealed that foods representative of this subculture have considerable potential for growth and negotiation. However, in order to obtain more robust and in-depth data, it is necessary to conduct field research that provides detailed quantitative information on consumer behavior. This type of study can be extremely relevant for investors interested in the foodservice sector.

The methodological tools applied, both qualitative and the literature review, provided data that can be improved for further research. The current study focused on the analysis of food consumption within the Brazilian Creole cultural region and the associated consumption behavior. However, gaps were identified that deserve further investigation, such as the habits and detailed cultural representations of this region, as well as the study of eating practices in other cultural

regions. These aspects can offer valuable insights for future market studies and the development of business strategies.

REFERENCES

1. Addis, M., & Holbrook, M. B. (2001). On the conceptual link between mass customization and experiential consumption: An exposition of subjectivity. *Journal of Consumer Research*, 1(1), 50-66.

2. Azevedo Barbosa, M. de L. de. (2006). Bem-vindo a uma experiência extraordinária: Proposições para uma interpretação sobre consumo de serviços. In *Encontro de Marketing, 2.* Rio de Janeiro: ANPAD.

3. Barbosa, L. (2006). Apresentação. In L. Barbosa & C. Campbell (Orgs.), *Cultura, consumo e identidade* (pp. 7-12). Rio de Janeiro: Editora FGV.

4. Barbosa, L., & Campbell, C. (2006). O estudo do consumo nas ciências sociais contemporâneas. In L. Barbosa & C. Campbell (Orgs.), *Cultura, consumo e identidade* (pp. 15-34). Rio de Janeiro: Editora FGV.

5. Barros, C. (2006). Consumo, hierarquia e mediação: Um estudo antropológico no universo das empregadas domésticas. In *EnANPAD, 30.* Salvador: ANPAD.

6. Brasil, V. S. (2007). Experiência de consumo: Aspectos conceituais, abordagens metodológicas e agenda de pesquisa. In *EnANPAD, 31.* Rio de Janeiro: ANPAD.

7. Carù, A., & Cova, B. (2003). Revisiting consumption experience: A more humble but complete view of the concept. *Marketing Theory*, 3(2), 267-286.

8. Cascudo, L. C. (1983). *História da alimentação no Brasil*. Belo Horizonte: Itatiaia; São Paulo: Editora da Universidade de São Paulo.

9. Casotti, L. M. (2004). Como enxergar diferenças no consumidor? Algumas reflexões sobre os caminhos do marketing. In *EMA, 1.* Porto Alegre: ANPAD.

10. Cobra, M. (1997). *Marketing básico: Uma perspectiva brasileira* (4ª ed.). São Paulo: Atlas.

11. Faria, S. A. (2004). Em busca da inovação no marketing brasileiro: Discutindo o processo de publicação de artigos em revistas e congressos. In *EMA, 1.* Porto Alegre: ANPAD.

12. Freyre, G. (2001). *Casa grande e senzala* (43ª ed.). Rio de Janeiro: Record.

13. Freyre, G. (1997). *Açúcar: Uma sociologia do doce, com receitas de bolos e doces do Nordeste*. São Paulo: Companhia das Letras.

14. Freyre, G. (1989). *Nordeste* (6ª ed.). Rio de Janeiro: Record.

15. Gil, A. C. (2002). *Como elaborar projetos de pesquisa* (4ª ed.). São Paulo: Atlas.

16. Godoy, A. S. (1995). Introdução à pesquisa quantitativa e suas possibilidades. *Revista de Administração de Empresas*, EAESP-FGV, São Paulo.

17. Havlena, W. J., & Holbrook, M. B. (1986). The varieties of consumption experience: Comparing two typologies of emotion in consumer behavior. *Journal of Consumer Research*, 13, 394-404.

18. Holbrook, M. B. (2006a). The consumption experience – Something new, something old, something borrowed, something sold: Part 1. *Journal of Macromarketing*, 26, 259-272.

19. Holbrook, M. B. (2006b). Consumption experience, customer value, and subjective personal introspection: An illustrative photographic essay. *Journal of Business Research*, 59, 714-725.

20. Holbrook, M. B., & Hirschman, E. C. (1982). The experiential aspects of consumption: Consumer fantasies, feelings, and fun. *Journal of Consumer Research*, 9, 132-140.

21. Kotler, P., & Keller, K. L. (2007). *Administração de marketing* (12ª ed.). São Paulo: Pearson Prentice Hall.

22. Kotler, P. (1998). *Administração de marketing: Análise, planejamento, implementação e controle* (5ª ed.). São Paulo: Atlas S. A.

23. Laverie, D. A., Kleine III, R. E., & Kleine, S. S. (1993). Linking emotions and values in consumption experiences: An exploratory study. *Advances in Consumer Research*, 20, 56-61.

24. Las Casas, A. L. (2006). *Marketing de varejo* (4ª ed.). São Paulo: Atlas.

25. Martins, H. H. T. S. (2004). Metodologia quantitativa de pesquisa. *Educação e Pesquisa*, 30(2), 289-300.

26. Maffesoli, M. (1998). *Elogio da razão sensível* (A. C. M. Stuckenbruck, Trad.). Petrópolis, RJ: Vozes.

27. McCracken, G. (2003). *Cultura e consumo: Novas abordagens ao caráter simbólico dos bens e das atividades de consumo*. Rio de Janeiro: Mauad.

28. Mathwick, C., Malhotra, N., & Rigdon, E. (2001). Experiential value: Conceptualization, measurement and application in the catalog and internet shopping environment. *Journal of Retailing*, 77, 39-56.

29. McCracken, G. (2007). Cultura e consumo: Uma explicação teórica da estrutura e do movimento do significado cultural dos bens de consumo. *Revista de Administração de Empresas*, 47(1), 99-115.

30. Pinto, M. de R., & Santos, L. L. S. (2008). Em busca de uma trilha interpretativista para a pesquisa do consumidor: Uma proposta baseada na fenomenologia, na etnografia e na grounded theory. *RAE-Eletrônica*, 7(2), 1-15.

31. Pinto, M. de R., & Lara, J. E. (2011). As experiências de consumo na perspectiva da teoria da cultura do consumo: Identificando possíveis interlocuções e propondo uma agenda de pesquisa. *Cadernos EBADE.BR*, 9(1), 37-56.

32. Pinto, M. de R., & Freitas, R. C. (2011). Aspectos simbólicos da experiência de consumo de roupas de deficientes visuais. *Percurso Acadêmico*, 1(2), 243-269.

33. Ribeiro, D. (1995). *O povo brasileiro: A formação e o sentido de Brasil* (2ª ed.). São Paulo: Companhia das Letras.

34. Savarin, B. (1995). *A fisiologia do gosto*. São Paulo: Companhia das Letras.

35. Schiffman, L. G., & Kanuk, L. L. (1994). *Consumer behavior*. Englewood Cliffs, NJ: Prentice-Hall.

36. Tesch, R. (1990). *Qualitative research: Analysis types and software tools*. Basingstoke: The Falmer Press.

37. Vergara, S. C., & Caldas, M. P. (2005). Paradigma interpretacionista: A busca da superação do objetivismo funcionalista nos anos 1980 e 1990. *Revista de Administração de Empresas*, 45(4), 66-72.

Building the Tower of Hanoi with recyclable materials: A methodological proposal for teaching empowerment in Elementary School classes

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ABSTRACT

This work presents an innovative methodological proposal for the teaching of empowerment in Elementary School II classes, using the construction of the Tower of Hanoi with recyclable materials. The main objective is to facilitate the understanding of mathematical concepts related to empowerment through a practical and playful approach, while promoting awareness of the importance of recycling and sustainability. The methodology involves several steps, starting with the selection and preparation of recyclable materials, which are transformed into components of the Tower of Hanoi game. Then, students actively participate in the construction of the game, which arouses their interest and creativity. During the assembly, concepts of recycling and reuse of materials are discussed, encouraging reflection on sustainable practices in everyday life. After construction, the game is used as a didactic tool to teach potentiation. Practical activities and complementary exercises are developed to reinforce learning, promoting a more contextualized understanding of the concepts involved. Undoubtedly, this approach tends not only to increase student engagement, but also to significantly improve content assimilation. Students are expected to demonstrate greater interest and participation in class, as well as evident progress in understanding empowerment. Another relevant aspect of this proposal is the promotion of interdisciplinarity, integrating knowledge of Mathematics with environmental themes. In conclusion, the methodological proposal of using the construction of the Tower of Hanoi with recyclable materials for the teaching of empowerment proves to be efficient and enriching. It is recommended to continue and expand this type of initiative, exploring other forms of integration between mathematics education and environmental education, aiming at the formation of individuals more prepared for the challenges of the future.

Keywords: Tower of Hanoi, Methodology, Empowerment, Teaching.

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INTRODUCTION

Because it is a complex science and treated in such a formalistic way throughout the history of mathematics education, there are those who think that it is impossible or, at least, very difficult, to relate Mathematics with other areas of knowledge.

However, as we set out to give a more palpable meaning to those contents studied, we realized that a large part of it is present, directly or indirectly, in the lives of the different individuals that make up society. Thus, there is a lot of mathematical knowledge in the daily work, for example, of the engineer, the historian, the geographer, the biologist, the anthropologist, as well as those individuals who did not even attend university, such as the bricklayer, the seamstress, the baker, etc. Thus, Mathematics is also present, as simple as it may be, in the daily lives of all teachers and, in order to further improve our knowledge, it is essential to incorporate a close relationship with other areas into our teaching practice.

This interdisciplinary approach will enhance our knowledge, enriching the educational experience and providing students with a more comprehensive and integrated view of knowledge. In this perspective, this work aims to present a methodological proposal to work Mathematics from the perspective of environmental education in elementary school classes, through the production of the Tower of Hanoi game with recyclable materials, considering the importance of preserving the environment. In addition to the environmental relevance, there will be a significant pedagogical contribution to Mathematics classes, which almost always follow that traditional teaching script, basically composed of the exposition of the content, presentation of examples and application of a list of exercises, in which there is no space to contextualize that knowledge, which generates, unfortunately, little interest on the part of the students, ending up in an unsatisfactory level of learning. In other words, such a proposal will enable an interdisciplinary and playful teaching of Mathematics, which motivates students to get actively involved, which will provide more meaningful learning.

As for the structure of this work, initially a bibliographic review is presented, which will deal with mathematics education, playfulness, interdisciplinarity and environmental education, as well as the history and rules of the game in question. Later, the description of the methodological proposal will be made in detail. Finally, we will make some observations that may be useful during an eventual implementation.

OBJECTIVES

GENERAL

Present a proposal for a non-conventional methodology for the teaching of Mathematics, which will integrate mathematical concepts and environmental issues through the creation and use of games made with recyclable materials.

SPECIFIC

- Reflect on the importance of learning mathematical content through play, as well as contribute to the strengthening of environmental awareness through the reuse of recyclable materials;
- Explore the content of the Towers of Hanoi with the students;
- Stimulate logical-mathematical reasoning during the practice of the game.

THEORETICAL FOUNDATION

MATHEMATICS EDUCATION

In the early days of humanity, Mathematics was used by different peoples only to solve everyday situations, such as dividing land and counting animals. Over time, great characters emerged and made this science more and more systematized. Thus, man has made the applicability of this knowledge increasingly complex, not limiting himself, then, simply to the solution of problems that basically concerned survival.

What can be seen, therefore, is that Mathematics, without a doubt, has had and will continue to have a primordial role in the construction of society. It is inconceivable to think about the evolution of humanity without attributing to it, among others, of course, the existence of this science, as D'Ambrósio (1999, p. 97) brings us, when he states that "mathematical ideas appear in the entire evolution of humanity, defining strategies to deal with the environment [...]".

Because it is such an important area of knowledge for us, because it is so complex from a certain point and because it is also so demanded in a general way, it is essential that there is extra attention to the formulation of its teaching process, because "currently, it is perceived that, in the educational context, universality, objectivity, the sharpness and perfection of the languages used in mathematics do not guarantee its relationship with society." (CORREIA; SILVA, 2021, p. 62-63).

Like this

> In the teaching of Mathematics, in particular, education restricted to the presentation of contents formalized in textbooks and/or that require the student to reproduce processes for the resolution of activities, provokes the conception that Mathematics is restricted to calculations and formulas. This invariably reinforces the students' demotivation. In this sense, research in Mathematics Education has pointed to the effectiveness of developing activities that reward a context of "discovery". Individually or in a team, the provocation of

> situations that present playful and recreational aspects emerges as motivating elements in the approach to mathematical concepts. When learning is pleasurable, it becomes a relatively simple process. Students, when motivated, have their curiosity aroused and learning becomes something natural (LONDERO, 2020, p. 12).

From this perspective,

> In order for our students to develop knowledge, acquire intellectual autonomy and have the capacity for critical reflection, educational processes must reward challenging experiences and situations. The student must find out for himself and not just know. He must feel like a citizen, be critical, responsible, competent and respect the limits of living in the community. When the student is encouraged to use their investigative and/or creative skills, the process of reproducing content is minimized, favoring sustainable learning (LONDERO, 2020, p. 12).

Following this line of reasoning,

> The naturalness of understanding the mathematical exercise awakens in the student the desire and curiosity to identify the Mathematics around them, making them recognize themselves as mathematicians. Realizing that Mathematics is not as complicated as one imagines, leads the student to understand the importance of Mathematics in his life, feeling its naturalness and being able to master it without major complications. Mathematics is part of the world and the world is present in it (CORREIA; SILVA, 2021, p. 63).

To make happen, in fact, what is proposed by the authors is obviously not easy. The efforts of teachers alone are not enough. However, if we want to at least start this process, it is up to us, teachers, to kick things off, since we are the ones who recognize the relevance of the link between scientific knowledge and popular knowledge, in order to create significant knowledge for the formation of a sensitive, reflective and engaged individual in his environment.

In this way, "both the school and the teacher must become observers so that they can seek resources that help in the teaching and learning process [...]" (CORREIA; SILVA, 2021, p. 63). One of the methodological resources that can be used is playfulness.

PLAYFULNESS

In an attempt to make the teaching and learning process more pleasurable, meaningful and connected with reality, playfulness emerges, which "stimulates the child while working with concrete material, games, that is, everything he can handle, reflect and reorganize [...]" (MODESTO; RUBIO, 2014, p. 4).

"Playfulness is part of the children's universe and can contribute to the child's learning and development." (BIZERRA, 2017, p. 13). According to Santos (2000) *apud* Bizerra (2017), "the word Playful means to play. Play happens from the beginning of existence to the end of life."

We can understand then that

> The game is a very significant pedagogical tool. In the cultural and biological context, it is a free, joyful activity that encompasses a meaning. It is of great social value, offering numerous educational possibilities, as it favors bodily development, stimulates psychic life and intelligence, contributes to adaptation to the group, preparing the child to live in society, participating and questioning the assumptions of social relations as they are set (KISHIMOTO, 2006, p. 26).

Complementing this idea,

> Playfulness is a human need at any age and cannot be seen only as fun. The promotion of playful activities, whether individual or group, provides privileged situations that lead to learning and personal, social and cultural development, producing knowledge and experiences that will be incorporated into the student's life, opening up possibilities for them to be free and to make decisions according to their own conscience (FREIRE, 2008).

Thus, Mafra (2008) emphasizes that playfulness plays a fundamental role for teachers who wish to promote transformations in their educational practice, since it is a flexible and adaptable tool that can be incorporated into the methodological proposal.

In the teaching of mathematics, playfulness, in addition to bringing a feeling of satisfaction, opens space for imagination. Playfulness in mathematics education brings the student closer to scientific knowledge, introducing a language that "little by little will be incorporated into formal mathematical concepts, by developing the ability to deal with information and by creating cultural meanings for mathematical concepts and the study of new contents." (MOURA, 2009, p. 95).

So

> The learning of Mathematics consists of creating strategies that enable the student to attribute meaning and construct meaning to mathematical ideas in order to become capable of establishing relationships, justifying, analyzing, discussing and creating. In this way, it surpasses teaching based only on developing skills, such as calculating and solving problems or fixing concepts through memorization or lists of exercises (PARANÁ, 2008, p. 45).

This alerts us to the need to overcome teaching based only on memorization and the mechanical practice of exercises. Instead, it is more interesting to seek active learning, in which the student becomes an active agent in the construction of knowledge, exploring, investigating and understanding mathematical concepts in a deeper way. This pedagogical approach that values the understanding, reflection and application of mathematical concepts, allows students to develop critical thinking, problem-solving and creativity skills. In this way, the learning of Mathematics becomes more meaningful and prepares students to face the challenges of the real world.

INTERDISCIPLINARITY

Interdisciplinarity is of paramount importance, as it helps students in their difficulties by providing more meaningful learning, which ends up building a logical and critical sense about what is studied. Disciplinary approaches create a broad learning, thus facilitating the resolution of various

problems, however, it is not possible to do interdisciplinarity without integration. This allows the collaboration of ideas simultaneously, by connecting the knowledge of one discipline to another with the aim of solving a problem. Complementing this idea,

> We live and work in a world of academic disciplines that alone are ill-equipped to deal with the complexity of society's problems, leaving us with something of a conundrum: disciplinary approaches are an essential and ever-present part of any problem-solving strategy. However, without integration, they are insufficient to solve problems in all their complexity. Interdisciplinarity enables integration by providing ways and means to combine wisdom and science, to expand and refine information, and to build a tradition of problem-solving that mixes old and new ideas, while maintaining the capacity for cumulative learning that refines, clarifies, and simplifies (KOBARG, 2021, p.87).

Interdisciplinarity brings, therefore, the conception that it is increasingly necessary to unite two or more disciplines, seeking to get out of the traditional way, through the various approaches focused on a single subject, as explained below:

> Mutual exchange and interaction of diverse knowledge in a reciprocal and coordinated manner; a methodological perspective common to all; integrate the results; the interests of each discipline remain, however, they seek solutions to their own problems through articulation with the other disciplines (KOBARG, 2021, p.86).

What is noticeable, fortunately, is that currently educators have, as far as possible, tried to work in a more interdisciplinary way, since it is perceived that there have been profound changes in various aspects related to teaching and learning in our country. Adding to this idea,

> Nowadays, interdisciplinarity and contextualized practices have been part of the routine of most educators, since such an attitude generates a broad construction of knowledge, breaking with the limits of the disciplines, as just integrating the disciplines would not be satisfactory. It should, then, be part of the Elementary School routine, teachers encouraging students to build relationships between the different contents present in the various subjects (KOBARG, 2021, p.134).

Thus, simply integrating disciplines is not enough, but promoting a broad construction of knowledge, which goes beyond the boundaries of individual disciplines.

ENVIRONMENTAL EDUCATION

The human being has been producing, transforming and building the geographical space without feeling an integral part of this environment. As a result, we are now experiencing environmental destruction and irrational use of natural resources, causing a series of socio-environmental problems that affect the global community. To understand the concept of the environment is to create conditions for human beings to feel morally responsible for their behavior in relation to nature [...]. (COSTA; VIVIANE, 2012, p. 15).

The preservation of the environment is fundamental, as it is in the environment that we have the natural resources for our survival. One of the ways to take care of it is through the recycling of materials.

As we live and "wait" for new global environmental transformations, we have a duty to use all the intelligence and technology achieved throughout our evolution to mitigate our influence on these climate changes. How can we do this? As mentioned by Costa and Viviane (2012, p. 64), it is recommended to acquire knowledge about recycling, reducing the use of fossil fuels, exploring alternative energy sources and taking advantage of renewable natural resources, such as wind energy. In addition, it is important to demonstrate respect for the environment and promote environmental education in an interdisciplinary way, covering everyone.

Another very important point is the role of the school for the environment: it is there where pedagogical plans aimed at environmental development are created. At school, this knowledge is learned and discussed and so we can apply it in our daily lives.

According to Costa and Viviane (2012, p. 88), the relationship between the environment and the individual is not restricted only to the community sphere, but also extends to the school context. In this sense, it is essential that the pedagogical work in the classroom is constant and based on previously established objectives and knowledge, according to the context in which it is inserted.

In this sense, Costa and Viviane (2012, p. 89) explain that, by considering the environment within the school environment, we provide an environmental education that is meaningful, concrete and endowed with meaning for the individuals for whom it is intended. Thus, all those involved in the educational process play an integral and fundamental role in ensuring that theory is contemplated in practice and vice versa.

The edition of volume 9 of the PCNs will discuss the issue of the environment and health, making analyses of the modes of interaction between man and nature:

> […] to deal with issues related to the environment in which we live, considering its physical and biological elements and the modes of interaction of man and nature, through work, science, art and technology (BRASIL, 1997, p. 15).

Human beings have contributed significantly to the pollution of the environment, mainly through large companies. We need to take a more critical look at the consequences we may face if we do not take action. Through environmental education, it will be possible to promote the change of our habits. By each one doing their part, we can build a better world.

A HANOI TOWER

The following is a brief history of the games, as well as their rules.

The Tower of Hanoi is a famous mathematical puzzle that was invented by the French mathematician named Édouard Lucas (1842-1891) in the nineteenth century. The name was given in reference to the city of Hanoi, the capital of Vietnam, where there is a legend associated with the tower.

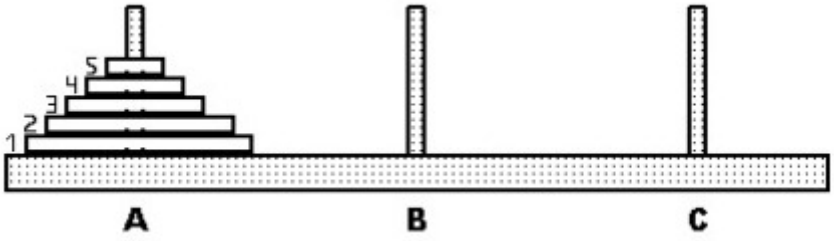
Figure 1: Édouard Lucas.

Source: MacTutor History of Mathematics Archive. Disponível em: <https://mathshistory.st-andrews.ac.uk/Biographies/Lucas/pictdisplay/>.

The legendary history of the Tower of Hanoi says that in the temple of Hanoi, there is a tower with 64 (sixty) gold discs, initially stacked in ascending order of size, on one of the three pins of the temple. Legend states that when all the disks are moved to the third pin, the world will come to an end.

The puzzle consists of a base with three pins and a set of discs of different sizes. The disks are stacked from largest to smallest on one of the pins (see image below), and the goal is to transfer the entire stack of disks to another pin, following a few rules.

Figure 2: Tower of Hanoi.



Source: UNESP. Available at: <https://www.ibilce.unesp.br/Home/Departamentos/Matematica/labmat/torre_de_hanoi.pdf>.

The rules of the puzzle are simple: only one disk can be moved at a time, and a larger disk can never be placed on top of a smaller one. Therefore, in each movement, a disc is taken from the top of a pile and placed on top of another pile. The challenge lies in figuring out the sequence of movements that allows you to transfer all the discs to the target pin, using the middle pin, without violating the rules.

While the legend of the Tower of Hanoi may just be a fictional story, the puzzle itself is an interesting mathematical challenge and has been the subject of study in many fields. There are several strategies and algorithms that can be used to solve the puzzle efficiently, regardless of the number of disks.

The Tower of Hanoi is considered a classic example of recursion, and its solution requires 2N − 1 (two to the nth power, minus one) moves, where N is the number of disks. Therefore, for the initial stack with 64 (sixty-four) disks mentioned in the legend, it would take 264 – 1 (two to the sixtieth power, minus one) moves, which is an astronomical amount.

Nowadays, the Tower of Hanoi is popular as a tabletop puzzle as well as a computational challenge. It is used as a teaching tool to develop problem-solving, logical thinking, and mathematical skills, as well as provide fun and entertainment for people of all ages.

METHODOLOGY

The initial stage of the research that resulted in this TCC began with the choice of the theme. Once defined, the objectives were established and the methodology was selected, opting for bibliographic research.

According to Gil (2002, p. 44), the bibliographic research "[...] it is developed based on material already prepared, consisting mainly of books and scientific articles". Complementing this, Severino (2007, p. 122) tells us that bibliographic research is carried out by:

> [...] available record, resulting from previous research, in printed documents, such as books, articles, theses, etc. Data from theoretical categories already worked on by other researchers and duly recorded are used. The texts become sources of the themes to be researched. The researcher works from contributions from the authors of the analytical studies contained in the texts. (SEVERINO, 2007, p.122).

In this way, the texts chosen by the researcher play a fundamental role in providing the basis and support necessary for the elaboration of the work. They not only broaden the researcher's understanding of the topic, but also clarify the limits and possibilities of research, allowing for a more in-depth and comprehensive analysis.

In this sense,

> This research aims to know the different forms of scientific contribution already made on a given subject, aiming to enter current and relevant data on the investigated theme. It uses exclusively material already prepared and available, in particular books and scientific articles, and is the basis for any type of research [...] (METRING, 2010, p. 64).

After the bibliographic survey, a selection of the most relevant texts to the research theme was made. With the systematic reading of this material completed, the writing of this TCC was carried out, integrating the readings related to the theme studied.

RESULTS AND DISCUSSIONS

To achieve the objectives, we will describe the activities to be carried out in elementary school classes.

For the making of the game, the predominant material will be cardboard. The use of scissors, ruler and glue is essential. For a better finish, some extra materials will also be needed, such as paint and tape. The applicator (teacher, intern, etc.) will guide each phase of the game production process.

Now, we will introduce the steps to follow:

1st pedagogical action – **Introduction** (10 to 15 minutes): Initially make a discussion, through images printed on A4 sheet, of how various mathematical concepts are, even if in a simple and sometimes almost imperceptible way, present in people's daily lives. These images may be of some professionals performing their activities. To finish this first part, discuss the importance of preserving the environment, emphasizing recycling as one of the resources, as well as how Mathematics can relate to environmental issues.

2nd pedagogical action - **Production** (60 minutes): This moment will be dedicated to the production of the game. Depending on the number of students present, divide the class into groups of 4 or 5 members, so that each of these groups will produce a unit of the game. Before the day of application, ask the classes to bring cardboard and, as far as possible, other materials. It is important that the applicator in charge also gets these materials, since some may not take them. Due to time, it is recommended to provide some disc molds to speed up the manufacturing process. It is important to emphasize that Styrofoam, which is 100% recyclable, is an alternative to cardboard. However, it is harder to find, which could cause some to buy, and that is not the idea, at least at first. Specifically with regard to production, this process will consist essentially of three phases: the first is the construction of a firm base, through the gluing of some rectangular layers of cardboard (it may be more practical to use adhesive tape to join the layers); after that, the production phase of the discs begins, which will be similar to the previous one, which will also be formed by overlapping cardboard (we reinforce the importance of making molds available); Finally, the finishes must be made, which will depend on the creativity of the groups and the material available. For example, plastic straws can be used as rods.

3rd pedagogical action – **Practice** (25 minutes): After this practical moment, talk about the mathematical nuances present in the game. Explore the potentiation content from the fact that the minimum number of moves to solve the game is given by a power, 2N-1, where N is the number of discs. Propose to the students that they try to solve the puzzle, at first, with a small number of discs, 3 or 4. As they succeed, gradually increase this amount, always paying attention to the number of movements performed, in order to verify whether or not it matches the 2N-1 relationship. It can also be proposed that, once the number of movements is known, determine the number of existing disks.

For example: If someone solved the puzzle with 255 moves, how many discs were there in the tower? In this case, it would be enough to solve the equation 2N – 1 = 255, where N = 8. This example would be for an initial approach. The problems can and should gradually be improved.

4th pedagogical action – **Reflection** (10 minutes): Dedicate these final minutes to listening to them. To do this, ask some questions, such as "What is your opinion about the use of games in Mathematics classes?". Throughout the implementation of the project, carefully monitor the students' receptivity to the proposal, evaluating whether they are real interest in creating the resources and if, by presenting the mathematical content in a different way, they are more engaged in learning.

FINAL CONSIDERATIONS

By using recyclable materials in the construction of the game, students are encouraged to explore their creativity and develop practical skills, actively collaborating in the learning process. This methodology is capable of engaging students, making learning more dynamic and meaningful. In addition, the playful nature of the activity contributed to the creation of a lighter and more motivating learning environment.

From this perspective, the use of practical and concrete tools, such as the Tower of Hanoi, can significantly improve the understanding of abstract concepts of Mathematics. Students tend to show greater interest and participation in classes, in addition to a better assimilation of the contents covered.

Another relevant aspect is the interdisciplinarity promoted, by integrating knowledge of Mathematics with environmental themes. This holistic approach not only enriches the school curriculum, but also forms more conscious and responsible citizens. Thus, the methodological proposal presented in this work has a great potential for improvement both in the mediation of mathematical knowledge and in the promotion of sustainable values. It is recommended that future research and projects explore other forms of integration between mathematics education and environmental education, further expanding the benefits for students and society. The continuity and expansion of this type of initiative can contribute significantly to a more integral and transformative education.

REFERENCES

1. Bizerra, E. T. C. (2017). *A ludicidade na relação ensino-aprendizagem: O papel do professor de uma escola de educação infantil de Castanhal – PA* (TCC, Licenciatura em Pedagogia). Faculdade de Pedagogia do Campus de Castanhal da Universidade Federal do Pará. Castanhal.

2. Brasil. (1997). *Parâmetros Curriculares Nacionais*. Brasília: Ministério da Educação. Disponível em http://portal.mec.gov.br/seb/arquivos/pdf/livro091.pdf. Acesso em 18 jan. 2024.

3. Correia, D. M. das N., & Silva, G. L. B. (2021). Contribuições da ludicidade no processo de inclusão no ensino de Matemática no quinto ano do Ensino Fundamental de uma escola municipal de Nova Olinda-PB. *Revista Principia, 58*, 60-68. Disponível em https://periodicos.ifpb.edu.br/index.php/principia/article/viewFile/5661/1832. Acesso em 07 fev. 2024.

4. Costa, C. A. P. da, & Viviani, D. (2012). *Meio ambiente e saúde*. Indaial: UNIASSELVI.

5. D'Ambrósio, U. (1999). A história da Matemática: Questões historiográficas e políticas e reflexos na Educação Matemática. In M. V. Bicudo (Org.), *Pesquisa em Educação Matemática: Concepções e perspectivas* (pp. 11-24). São Paulo: UNESP.

6. Freire, P. (2008). *Pedagogia do oprimido* (47a ed.). São Paulo: Paz e Terra.

7. Gil, A. C. (2002). *Como elaborar projetos de pesquisa*. São Paulo, SP: Atlas.

8. Kishimoto, T. M. (2006). O jogo e a educação infantil. In T. M. Kishimoto (Org.), *Jogo, brinquedo, brincadeira e a educação* (pp. 13-43). São Paulo: Cortez.

9. Kobarg, A. P. R. (2021). *Prática pedagógica interdisciplinar: Escola e sociedade*. Indaial: UNIASSELVI.

10. Londero, E. F. (2020). *Matemática lúdica*. Indaial: UNIASSELVI.

11. Mafra, S. R. C. (2008). *O lúdico e o desenvolvimento da criança deficiente intelectual*. Paraná: Secretaria de Estado da Educação.

12. Metring, R. A. (2010). *Pesquisas científicas: Planejamento para iniciantes*. Curitiba: Juruá.

13. Modesto, M., de Alcântara, J., & Rubio, S. (2014). A importância da ludicidade na construção do conhecimento. *Revista Eletrônica Saberes da Educação, 5*. Disponível em http://docs.uninove.br/arte/fac/publicacoes_pdf/educacao/v5_n1_2014/Monica.pdf. Acesso em 21 jan. 2024.

14. Moura, M. O. de. (2009). *A séria busca no jogo: Do lúdico na matemática*. São Paulo: Cortez.

15. Paraná. Secretaria de Estado da Educação. Superintendência da Educação. (2008). *Diretrizes Curriculares da Educação Básica Matemática*. Curitiba: SEED.

16. Severino, A. J. (2007). *Metodologia do trabalho científico*. São Paulo, SP: Cortez.

The foundation of political science: Historical questions about its emergence and consolidation

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ABSTRACT

What will be tried to be explained in this article is the path taken by political science, from its emergence to contemporaneity. What is sought to be apprehended is then the path of formation of a Discipline, or of a branch of study that is practiced all over the world. One cannot leave aside its origins, which come from philosophy, through sociology, more specifically political sociology, until we reach the contemporary world and the consolidation of this area of study as a discipline taught in the most diverse universities around the globe.

Keywords: Politics, Political Thought, History, Political Theory.

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INTRODUCTION

What will be tried to be explained in this article is the path taken by political science, from its emergence to contemporaneity. What is sought to be apprehended is then the path of formation of a Discipline, or of a branch of study that is practiced all over the world. One cannot leave aside its origins, which come from philosophy, through sociology, more specifically political sociology, until we reach the contemporary world and the consolidation of this area of study as a discipline taught in the most diverse universities around the globe.

It is therefore necessary to understand what is the statute that determines today what we call "political science", we could ask what its content and method would be, if we are talking about "science" in the canons of modern science. To what extent are philosophical precepts still present in political science, and to what extent are they something negative or positive in their influence?

Throughout this essay, we will try to resolve some of these questions, even if not always exhaustively, and to explain the main paths taken by this science until it was constituted as such. Whenever possible, it will also seek to outline its methodology and its object of study, so that the main characteristics of this "science" that apparently took so long to gain independence from the others can be clarified.

According to Scwartzenberg's text (Scwartzenberg, 1979, 61-66), the so-called "political sociology" had existed for a long time, well before the emergence of sociology understood as a science properly so-called, as it was inaugurated by Auguste Comte. Sociology, in its emergence, had acquired the status of a science that proposed to understand society, that is, it aimed to seek to understand social phenomena.

But as Scwartzenberg himself points out, one can already speak of a "political sociology" well before Comte. Of course, it did not exist properly under that name, but it was already based on the thought of several authors. Many will agree that there were two main precursors of what can be called political science today, they are: Aristotle and Machiavelli.

On Aristotle's contribution I quote Scwartzenberg:

> "His philosophical reflection, in fact, is based on the examination of effective behavior and social reality, based on concrete, very varied and very extensive research, conducted in a spirit of scientific observation." (Scwartzenberg, 1979, p. 12).

Let us observe that before Aristotle there were other thinkers of politics, among whom Plato stands out, but none of them achieved an approach as systematized as the Aristotelian one, since he employed a comparative and inductive method, which we could already consider as a genesis of the method of political science. Aristotle is not exactly doing political philosophy by using a comparative method, for example when he studies the various Greek and foreign constitutions of his time, but rather a kind of political science.

Since we are talking about political science and political philosophy, a small comment on these two terms is necessary. The big question is: how is political philosophy different from political science? At first glance it seems to us that the first is much more located in the field of ideas, that is, political philosophy or philosophy of politics works with a "ought to be" of phenomena. On the other hand, what can be considered political science is more related to political reality as it is, as it presents itself empirically to the scientist.

Politics, in order to achieve a scientific character, tries to gain objectivity by creating a language appropriate to the phenomena it examines, it would be a language free of values, "sterilized", factual. But would this be possible? The possibility of abstaining from one's personal values (as Durkheim wanted) is something very complex. It does not follow from this that one cannot speak of a political science, nor that there is no possibility of rational knowledge in such an area, and that political philosophy is something inseparable from political science.

On the contrary, there is a huge field to be explored by political science, the most generic definition of which is found in Bobbio's Dictionary of Politics:

> "The expression Political Science can be used in a broad and non-technical sense to indicate any study of political phenomena and structures, conducted systematically and rigorously, supported by a broad and careful examination of the facts exposed with rational arguments." (Bobbio, 2000).

It can be said that there is an independence of this science from philosophy, even though it cannot ignore its roots. From this, and already closing the reasoning about the difference between the terms political philosophy and political science, let us return to their historical origin.

After Aristotle there were also those who made their contribution to political thought, but only after a long time, already in Modernity, is the true creator of political science located.

It was Machiavelli who inaugurated the thought that we can consider as the precursor of political science. He did this because he was the first thinker who brought politics "from heaven to earth", that is, Machiavelli sought in his writings, notably in *the Prince* , to show politics as it is, to detach it from metaphysical values and based on Christian ethics. He promoted the separation between politics and ethics.

Machiavelli sought in his thought to break with traditional political thought, which had lasted since Aristotle. He sought to establish that the world of politics belonged to a cruel, cunning, contradictory, chaotic empirical reality, very different from what was previously preached. He then separates two worlds (don't understand two metaphysical worlds!), the world of everyday life that is governed by Christian values and customs, based on ethics and golden rules, and the other, that of politics, governed by a framework of values completely different from the first.

In the world of politics, the Prince must make use of cunning, dissimulation, use the imagination of the people, to benefit himself. Machiavelli tries to show the actual truth of things, what they really are, and not what they should be. And the real world of politics is this, practically devoid of moral values. Thus, he inaugurates a thought that can be considered "scientific" of politics, by examining its empirical, factual reality, leaving aside a philosophical interpretation of "ought to be".

Other thinkers are also of paramount importance in the construction and consolidation of politics as science, especially Montesquieu and Tocqueville. Both authors of very important works, which were based on enormous empirical studies, but which were still more on the plane of political philosophy than on political science.

Over the years, and already taking a leap to the contemporary world, we have the enormous contribution of Marx, who was more concerned with understanding the capitalist world in which we lived, thus providing important categories of analysis of social reality for a large part of social scientists.

The Marxist method, called "Dialectical Historical Materialism" seeks to study social reality from the historical development of the productive forces, that is, to understand such a society it is necessary to study how it produced and produces its material life. Thus, on a material infrastructure, for Marx, an ideological superstructure rises, which is dependent on the former.

Even Marxist thought still finds itself in a certain way with one foot in philosophy, or perhaps both feet. But, then, you could ask, after all, when did political science appear? The answer is that this emergence was gradual, historical, and that it occurred together with the emergence of the social sciences, with the so-called political sociology.

But a cut can be made, and thus determine a rupture between political science and the other human sciences, insofar as it has a determined method and an object of study. In this regard, we refer once again to Scwartzenberg's text, in which he points to political science itself as something of the twentieth century, when it then enjoys a certain autonomy in relation to general sociology.

This branch of study was consolidated mainly between the years 1890 and 1914 when numerous American universities created political science departments, and was further solidified in 1903 with the foundation of the APSA (American Political Science Association). According to Scwartzenberg, early political scientists were concerned with improving existing institutions, directing political studies toward practical political action. It was first necessary to observe and know the facts, breaking with the antecedent tendency of philosophy and theories that preached what should be instead of describing what is.

This first focus of thought of political scientists clearly reflects an institutionalist approach, in which researchers sought to understand the American people and their institutions as they are. After

these first studies, there was an overcoming of this institutional approach, giving rise to the concept of "*political processus*" that sought to encompass the interaction of public institutions with social groups.

This type of approach that sought to capture the social process, made room for a school based on people's political behavior, the so-called "behavorism". Scwartzenberg considers that "reacting against conventional political science, against the institutional approach, it is a matter of formulating political problems in terms of observed and observable behavior" (Scwartzenberg, 1979, p.24).

The main aspect defended by this school concerned the scientific method. The inaugurators of this thought, especially Charles Merriam, said that political thought should be definitively replaced by developing scientific techniques. Behavorists seek in any way to systematically observe people's behavior, looking for regularities and uniformities that could be studied scientifically and that could provide models for future elaboration of theories.

Despite this number of variants, even those that succeeded the behaviorist school, with its criticisms of this model and new ways of looking at the study of political reality, it is possible to conclude from what has already been seen that political science is based on the study of power. It is a "science of power", and because it has such a character, it often ends up distinguishing between the rulers and the ruled and understanding the phenomenon of authority.

Scwartzenberg argues that:

> "In summary, political sociology (let us understand political science here) is the branch of the social sciences that studies the phenomena of power, understanding that the most evident manifestations of power are produced in the state framework, but that similar manifestations are also produced in restricted frameworks". (Scwartzenberg, 1979, p.53).

Thus, politics has as its most specific object the relations of power, relations that are most often institutionalized in the figure of the State. Perhaps for this reason there is a very great interdependence between the first studies in the area with the state question and consequently with the question of the elites.

The theory of elites is in this context an important branch of political science thought, as it constitutes in a certain way the basis of such thinking and its emergence. In Alan Zuckerman's text (Zuckerman, 1982), there is a discussion regarding this regard, in which the author examines two of the greatest exponents in this regard, Mosca and Pareto.

Zuckerman seeks a sample of the various interpretations on the subject, which have already been suggested by other authors such as Lasswell, Wright Mills and Robert Dahl. But he comes to the conclusion that he will develop the question of elites from a perspective that considers "the domination of the elite as the collective manipulation of the masses by a small leading group or several of these groups" (Zuckerman, 1982, p. 8). It starts from the assumption "that all the members

who make up an elite are aware of their group interests" and that this awareness "is provided by an implicit or explicit sense of class or group solidarity", and that it manifests itself "through a common will aimed at action." (Zuckerman, 1982, p. 8).

This author understands and shares Mosca's concept of political class, which refers to all groups that exercise power or influence and are directly engaged in the political struggle. Among this political class, the author narrows his conceptualization by distinguishing a smaller group, the group of the political elite, these are the individuals who really exercise political power in a society in a given space of time.

Without dwelling any longer on this issue of the elitist approach to politics, the important thing is that the content of this type of approach is clear, almost in its institutional exclusivity. This analysis strictly takes into account the small number of people who at first glance hold the power of decision-making in society. It is an institutionalist approach, and one that ends up impregnating political science a lot.

This type of approach, which gave great importance to the State and its institutions, ended up providing an object for political science. Thus, we can speak of politics as a science, as a science that investigates mainly the relations of the State with society. This meaning has expanded, and we can speak today of a political science that studies power relations and conflicts in society.

At the end of Scwartzenberg's text, he points out some main branches of science that are consolidated in the twentieth century, according to the author, it is still a pragmatic classification, but it meets the needs of the formation of the curriculum of a political scientist. There are four broader areas that are subdivided. The first is that of political theory, divided into political theory and the history of ideas, the second is that of political institutions, which is divided into: the constitution, the central government, the regional and local governments, the public administration, the economic and social functions of the government and the comparative political institutions.

The third part is that of parties, groups and public opinion, which are separated into: political parties, groups and associations, citizen participation in government and administration, and public opinion. And finally the fourth part, international relations, which contains international politics, international politics and organization, and international law. (Scwartzenberg, 1979, p.54)

This is one of the existing subdivisions, however several others can be found. This is believed to be an important classification in a summarized explanation of the main themes of political science. Finally, it would be important to highlight that political science managed to develop and assert itself as a science, especially in the twentieth century, with a profound influence of North American schools.

Due to its genesis in the American school, political science was also the target of much criticism and questioning. These derived in large part from the influence, direct or indirect, that the

American government had in the financing and direction of the research carried out. Many of the studies carried out can be called into question, with respect to their intent and possible imperialist interests, especially with regard to international relations and the reproduction of forms of world domination by US power.

On this subject, Chilcote's text (Chilcote, 1998, chap 2) stands out, in which the author states that ideology is relevant to politics, and that "political scientists tend to be ideological in that their values are linked to property, money, and influence – a reflection of the capitalist world around them." (Chilcote, 1998, p. 70).

This same author draws attention to the fact that the understanding of ideologies ended up causing a reevaluation of political science. This reassessment lies in the fact that the capacity of political science to challenge the current power structure must be questioned in order to promote an ethics in academia and teaching, which enable a radical, and not biased, understanding of reality.

Towards the end of this reflection, it is worth making a general overview of the path taken so far. First, the genesis of political science, in its philosophical origins, was discussed. The main authors who contributed to the foundation of what we can currently call political science stand out. Among them, Aristotle and Machiavelli are essential and primordial figures.

Machiavellian thought is considered essential in the rupture of political philosophy, thus establishing an important distinction between the "ought to be" of politics and what it is in empirical reality. Other political philosophers who contributed to the advancement of politics in its scientific path were also cited, such as Montesquieu, Tocqueville and Marx, the latter of whom provided important categories of study for social scientists.

Then it was emphasized that there is the possibility of talking about a political science, separate from philosophy and sociology. It is understood that the period of birth of this science was long, but its genesis as we understand it today took place mainly in North American universities, with the first approaches based on institutionalism, that is, on an analysis that sought to understand political phenomena from the study of the country's institutions.

As a response to this model, the so-called behavorist or behaviorist studies emerged, which sought to apprehend social reality from political behaviors, trying to give them a scientific status, and that used rigorous methods of understanding empirical reality.

Finally, the constitution and focus of political science were also examined, in its essence, which falls on the study of the power relations of societies, particularly with regard to the state sphere. And then, at the end of the work, the criticism contained in Chilcote's text was explained, which raises the question of the legitimacy of the knowledge produced by political scientists linked to US imperialist interests.

Thus, to conclude, the complexity of the topic is highlighted, and it is hoped that this text has contributed in some way to a clarification on such a broad subject. It is a fact that political science was constituted as such only in the twentieth century, but it had its origins long ago in the so-called political philosophers.

Of course, in order to gain the scientific status as it is understood from modernity, it had to find a method and a set of defined objects, and this happened gradually. The so-called immunity and scientific impartiality are not relevant, because it is known that it has its degree of influence, however, even so, this is not a reason to prevent the construction of objective and rigorous political knowledge, which can be shared by the scientific community and serve in some way for the improvement of human societies.

REFERENCES

1. Schwartzemberg, R.-G. (1979). *Sociologia política: Elementos de ciência política*. São Paulo: DIFEL.

2. Zuckerman, A. (1982). Elite política: Lições de Mosca e Pareto. In A. Oppo, M. Duverger, N. Bobbio, & T. B. Bottomore (Eds.), *Curso de introdução à ciência política; Unidade V: Partidos políticos e elites políticas* (pp. 71-83). Brasília, DF: Editora UnB. (Original work published as "The Concept 'Political Elite': Lessons from Mosca and Pareto," *Journal of Politics*, 39, May, 324-344).

3. Chilcote, R. H. (1998). *Teorias de política comparativa: A busca de um paradigma reconsiderado*. Petrópolis: Vozes.

4. Bobbio, N., Matteucci, N., & Pasquino, G. (2000). *Dicionário de política* (5ª ed., Vols. 1-2, C. C. Varriale, G. Lo Mônaco, J. Ferreira, L. G. P. Caçais, & R. Dini, Trads.). Brasília: Editora Universidade de Brasília; São Paulo: Imprensa Oficial do Estado.

Current developments in the approach, diagnosis and treatment of preeclampsia

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ABSTRACT

Introduction: Preeclampsia is a clinical syndrome, characterized by predominantly cardiovascular symptoms, manifestations attributable to systemic inflammation, endothelial dysfunction and generalized vasoconstriction resulting in hypertension, hypoperfusion and multiorgan failure. It affects between 3 and 10% of pregnancies, and is the leading cause of maternal death in the world.
General objective: To know new strategies for approaching, diagnosing, and treating preeclampsia.
Materials and methods: Articles in English and Spanish published from 2019 to 2022 were selected, using available electronic databases.
Conclusions: New molecules have been discovered for the early diagnosis of preeclampsia, based on the angiogenic relationship, including high levels of sFlt-1, sEng, IL-16, Activin A, ICAM and VCAM, as well as low levels of PAPP-A, PlGF and placental protein 13. In addition, new drugs and treatments such as sildenafil, pravastatin, and stem cells are being researched for more effective management. However, due to discrepancies in outcomes for mother and fetus, its widespread recommendation is not yet possible.

Keywords: Preeclampsia, Angiogenic relationship, Maternal death.

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INTRODUCTION

Preeclampsia is a clinical syndrome, characterized by predominantly cardiovascular symptoms, manifestations attributable to systemic inflammation, endothelial dysfunction, and generalized vasoconstriction resulting in hypertension, hypoperfusion, and multiorgan failure. (Melchiorre, 2022)

In 2014, the International Society for the Study of Hypertension in Pregnancy (ISSHP) issued an update stating that preeclampsia is defined as the de novo onset of blood pressure greater than or equal to 140/90 mmHg after the 20th week of gestation along with evidence of maternal organ damage. (Sasser, 2020)

The syndrome is thought to be triggered by abnormal levels of Fms-like Soluble Tyrosine Kinase-1 (sFlt-1) and Placental Growth Factor (PlGF), known as angiogenic imbalance. (Melchiorre, 2022)

Women with preeclampsia have lower PlGF and higher sFlt-1 concentrations compared to pregnant women without preeclampsia. PlGF-based tests are now recommended as a diagnostic adjunct in women with suspected pre-eclampsia for clinical use in the UK. (Wiles, 2020).

METHODOLOGY

The bibliographic review was based on the selection of articles in English and Spanish with a publication date from 2019 to 2022 in electronic media databases such as PubMed, UpToDate, Google Scholar, Elsevier, SciELO and Redalyc.

EPIDEMIOLOGY

Affecting between 8 and 10% of pregnant women, the incidence of Preeclampsia in Pregnancy (PE) is estimated to be approximately 1% of all pregnant women and 1.5% of primiparous women. It causes 16% of maternal deaths, being one of the main causes of maternal morbidity and mortality and premature birth in developing countries. (Poniedziałek- Czajkowska, 2021).

In Mexico, the prevalence of preeclampsia-eclampsia syndrome oscillates around 8%, corresponding to 3.75% to preeclampsia with severity criteria and 94.5% to preeclampsia without severity criteria and 1.75% to eclampsia, the latter being more frequent in primigestas, up to 85%, and in multigestas it appears in 14 to 20% of cases. Various reports indicate that maternal death occurs in one in 50 women with eclamptic symptoms. (López, 2022)

DEFINITION

The American College of Obstetricians and Gynecologists (ACOG) defines PE as new-onset hypertension after the 20th week of gestation with systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg, measured twice at least 4 h apart and proteinuria ≥0.3 g per 24 h or ≥ 1+ proteinuria, detected by urine dipstick. PE may also be diagnosed in the absence of proteinuria when hypertension occurs with the onset of any of the following symptoms: thrombocytopenia (platelet count < 100,000/μL), renal failure (serum creatinine concentration > 1.1 mg/dL or a doubling in the absence of other kidney diseases), impaired liver function (elevated liver transaminase concentrations at twice the mean levels), pulmonary edema or brain or visual problems. (Poniedziałek- Czajkowska, 2021)

RISK FACTORS

The Centers for Disease Control and Prevention confirms that black women still have a maternal mortality rate 2.5 to 3 times higher. The higher prevalence of preeclampsia among them is thought to be related to the higher incidence of chronic hypertension in that population. (Johnson, 2022)

The protective effect of parity on the development of PE may be due to the persistence of maternal cardiac adaptation from previous pregnancies, which in cardiology is called "preconditioning". Capeless et al. (1991) performed an echocardiographic evaluation before pregnancy and found that ventricular volumes and cardiac output (CO) during pregnancy were significantly higher by 15% to 20% in multiparous women versus nulliparous women, and maternal cardiovascular indices (CO, peripheral vascular resistance, and uterine artery pulsatility) in the first trimester of pregnancy improved with increasing parity.

The increased risk of PEs conceived through in vitro fertilization (IVF) has been consistently explained by advanced maternal age and multiple pregnancy, except in the case of egg donation. These risks confer a 2- to 3-fold increase in the likelihood of developing PE, the latter observation has been used to support the immunological origins of PE based on differences in human lymphocyte antigen compatibility between a hemialogenic fetoplacental graft at natural conception and a fully allogeneic conception with egg donation.

The main risk factors established for PE are obesity (body mass index >30), diabetes, chronic hypertension, chronic kidney disease, obstructive sleep apnea, systemic lupus erythematosus, antiphospholipid syndrome, rheumatoid arthritis, maternal age over 35 years, multiple gestation, hydrops fetalis, hydatidiform mole and physical inactivity, so it is extremely important to take preventive measures and/or treat them even before the pregnancy. (Wiles et al, 2020)

PATHOPHYSIOLOGY

The clinical syndrome begins with an abnormal invasion of the trophoblast. During normal implantation, trophoblasts invade the decidualized endometrium, leading to remodeling of the spiral artery and obliteration of the tunica media of the spiral arteries of the myometrium, allowing for increased blood flow to the placenta. In preeclampsia, trophoblasts fail to adopt an endothelial phenotype, leading to impaired trophoblast invasion and incomplete remodeling of the spiral artery. The resulting placental ischemia leads to an increase in markers such as fms-like soluble tyrosine kinase-1 (sFlt-1) and soluble endoglin (sEng). sFlt-1 binds to and decreases levels of vascular endothelial growth factor (VEGF) and PlGF. Therefore, endothelial dysfunction develops in the maternal vasculature. sEng is a cell surface co-receptor that binds to and decreases levels of transforming growth factor (TGF)-β, which normally induces endothelial cell migration and proliferation. These factors mediate downstream effects that create endothelial dysfunction, a vasoconstrictor state, oxidative stress, and microemboli that contribute to the involvement of multiple organ systems. (Jena, 2020)

In preeclampsia, helper T cells shift toward the Th1 phenotype, which increases the release of proinflammatory cytokines such as interleukin (IL)-12 and IL-18, and decreases IL-10, leading to apoptosis and reducing trophoblast invasion. (Jena, 2020)

DIAGNOSTIC STRATEGIES

At a minimum, women should be screened for clinical risk markers for preeclampsia in prenatal care.

If tests are available, after appropriate counseling, women should be screened between 11 and 14 weeks for risk of premature preeclampsia, using a combination of risk factors, blood pressure, uterine artery pulsatility index, and PlGF. (Camacho-Mendez, 2018)

Moreno (2019) reports that angiogenic imbalance is assessed by reducing PlGF (< 5th percentile for gestational age) or increasing the sFlt/PlGF ratio (e.g., >38 according to the Roche trial).

With respect to the Doppler study of uterine artery resistance in cases of preeclampsia, according to Conde-Agudelo et al. (2004), it is determined that the ideal time during pregnancy to predict preeclampsia is between 20 and 24 SDGs, and they rate the usefulness of this study as "moderate".

The use of angiogenic markers can reduce adverse maternal outcomes (4-5%), the time to diagnosis of preeclampsia (by an average of 2 days), identifies women at higher risk of severe maternal peripartum morbidity (including postnatal hypertension), and saves costs that may be particularly useful in the face of pre-existing proteinuria, chronic hypertension, or Chronic Kidney Disease (CKD).

The concentration of Pregnancy-Associated Plasma Protein A (PAPP-A) increases continuously until the time of delivery. However, research has shown that in patients who later develop preeclampsia, a decrease in PAPP-A levels is observed.

Placental growth factor (PlGF) in normal pregnancies generates an uninterrupted increase during the first two trimesters of pregnancy of PIGF, with a maximum peak at 29-32 weeks of gestation. (Moreno, 2019)

Activin A is thought to play an essential role in the early stages of embryo implantation, invasion of the extravillous trophoblast, and the production of placental hormones. It is significantly elevated in the blood of pregnant women prior to the presentation of clinical symptoms, and has been investigated as a potential biomarker for the early identification of women who will develop preeclampsia. The combination of maternal factors, biophysical markers (mean arterial pressure and uterine artery pulsatility index) and multiple biomarkers (PAPP-A, PlGF, activin A and soluble endoglin) gave a detection rate of 91% with a false-positive result of 5% in singleton pregnancies. (Barber, 2023)

IL-16 is a cytokine with potent action on the vascular endothelium that induces structural and functional alteration in these susceptible patients, as well as oxidative damage, leading to alterations in vascular integrity and tone. (Camacho-Méndez, 2018)

In a study carried out at the Hospital de Especialidades of Centro Médico Nacional Siglo XXI, ICAM and VCAM found that only VCAM-1 concentrations were different with the control group, resulting higher in PE, correlating with systolic blood pressure. (Camacho-Méndez, 2018)

SEng is elevated in the sera of preeclamptic women and has been correlated with disease severity at weeks 17-20. (Camacho-Méndez, 2018)

Placental protein 13 is involved in placental implantation, vascular remodeling, trophoblastic migration, regulation of blood pressure of the spiral arteries, and placental tissue oxygenation. Low concentrations were found at 11-13 weeks of pregnancy in women who developed intravascular coagulation and PE, compared to controls. The first trimester of gestation is considered the optimal time for the determination of placental protein 13, because it has been given the greatest predictive capacity in this period. (Camacho-Méndez, 2018)

The first evidence linking micro-RNA (miRNA) and PE was found in Pineles' study. miRNAs play an important role in angiogenesis, crucial for the remodeling of the spiral arteries of the placenta during pregnancy. Several upregulated miRNAs in the human placenta, such as miR-210 and miR-20b, block angiogenesis and/or trophoblast proliferation, invasion, and migration. miR-16, miR-26b, miR-29b, miR-181a, miR-195, miR-222, and miR-335 have been determined to be overexpressed in preeclamptic placentas. Because these miRNAs alter the expression of angiogenic factors, including VEGF, they can cause downregulation of those target genes. (Hornakova, 2020)

In the case of PE, the most studied miRNAs are miR-155 and miR-210. miR-155 can affect trophoblast migration and differentiation and is upregulated in preeclamptic placentas, elevated levels of circulating miRNAs, including miR-155, miR-210, and also miR-215, miR-650, and miR-21, were detected in women with PE. (Hornakova, 2020)

MacDonald (2021) mentions GATA2 and nitric oxide. GATA2 is a transcription factor expressed in the endothelium, it regulates vascular homeostasis by controlling the transcription of genes and miRNA, including miR-126. Both GATA2 and miR-126 in whole blood were reduced in the circulation of patients with early-onset preeclampsia (<34 weeks) and before diagnosis of preeclampsia at term.

Nitric Oxide (NO) is an important signaling messenger in the cardiovascular system, maintaining endothelial integrity by regulating vasodilation, leukocyte adhesion and platelet aggregation. It is synthesized by Nitric Oxide Synthase (NOS), using L-arginine as a precursor. Several groups have evaluated the biomarker potential of Asymmetric Dimethyl Arginine (ADMA) for preeclampsia. It is a methylated product of L-arginine that endogenously inhibits NOS to reduce NO production. Two meta-analyses have recently evaluated ADMA and show that it is altered in those people destined to develop early-onset preeclampsia if samples are taken after 20 weeks, albeit with modest predictive efficacy. Endothelin-1 (ET-1) is a potent vasoconstrictor peptide, secreted predominantly by vascular smooth muscle and endothelial cells. Early studies and more recent work have shown 2- to 3-fold increases in circulating ET-1 in preeclamptics. A combination of stable circulating precursor protein, terminal proendothelin-1 C (CT-pro-ET1), sFlt-1, and systolic blood pressure produced a sensitivity of 80% with a specificity of 90% for the development of severe preeclampsia within one week in women with subclinical preeclampsia, gestational hypertension, essential hypertension, or moderate preeclampsia. (Mcdonal, 2020, p 7)

PREVENTION

The American College of Obstetricians and Gynecologists, the U.S. Preventive Services Task Force, and the International Society for the Study of Hypertension in Pregnancy recommend daily aspirin for high-risk women 12-16 weeks gestation (SDG) to reduce the risk of preeclampsia. After multivariable screening, aspirin should be administered at a dose of 150 mg/night. (Magee, 2022)

Aspirin also reduces the risk of preeclampsia by inhibiting cyclooxygenase-1 and cyclooxygenase 2, which contribute to prostaglandin biosynthesis and subsequent endothelial dysfunction. (Wiles et al, 2020)

Administration of acetylsalicylic acid results in downregulation of transcription of the proinflammatory cytokines TNFα, IFN-γ, IL1, IL6, and IL8, whose genes are regulated by NFkB; All of these cytokines are strongly related to the mechanical pathway of preeclampsia. It is possible

that oral administration of acetylsalicylic acid before 16 SDGs effectively inhibits the secretion of these factors by maternal immune cells, allowing a shift from a profile of pro-inflammatory cytokines, associated with Th1 and Th17 cells, to an anti-inflammatory profile, associated with Th2 lymphocytes, this change is desirable for the normal evolution of pregnancy. The anti-inflammatory activity of salicylates is related to the regulation of NFkB activity; in fact, aspirin prevents the nuclear translocation of NFkB and its consequent binding to the DNA motive element. Aspirin was also found to act as a competitive inhibitor of ATP, binding to the IKKβ protein, one of the activators of NFkβ in the canonical pathway. After inactivation, IKKβ cannot activate NFkβ, thus inhibiting its nuclear translocation. (Sakowicz, 2022)

It is recommended to follow the protocol of a previous study of 50 min of exercise at least 3 days per week, which was associated with a reduction in weight gain and the incidence of PE. (Poniedziałek-Czajkowska, 2021)

Women with a dietary calcium intake <900 mg/day, oral calcium supplementation of at least 500 mg/day is suggested. One proposed mechanism is that hypocalcemia may stimulate the release of parathyroid hormone or renin, which may increase intracellular calcium in vascular smooth muscle, leading to vasoconstriction and higher blood pressure. Calcium supplementation can reduce the release of parathormona, thereby reducing intracellular calcium and smooth muscle contractility. Similarly, calcium administration can reduce uterine smooth muscle contractility and improve placental uterine blood flow, preventing labor and preterm birth. (Poniedziałek-Czajkowska, 2021)

The relationship between vitamin D and PE development may explain its impact on implantation, angiogenesis and endothelial status, regulation of immune response, effect on the renin-angiotensin-aldosterone system (RAAS), and calcium metabolism. A beneficial effect of vitamin D on pregnancy development could only be observed if supplementation is initiated during placental implantation. Vitamin D indirectly by intensifying the synthesis of progesterone and human chorionic gonadotropin (hCG) can improve trophoblast implantation.

The process of implantation of the trophoblast requires the destruction of the extracellular matrix, for which metalloproteins (MMPs) are responsible. Reduced levels of vascular MMP-2 and MMP-9 have been shown to be responsible for vasoconstriction and, as a result, lead to PE development; vitamin D by enhancing the expression of MMP-2 and MMP-9 promotes human trophoblastic migration and invasion in the first trimester of pregnancy.

It is essential to evaluate the concentration of vitamin D in the periconceptional period and/or the beginning of the first trimester and to define levels that reduce the risk of developing PE. Women with risk factors for vitamin D deficiency, such as obesity, kidney, liver, thyroid gland diseases, chronic intestinal diseases, autoimmune diseases, asthma, diabetes, hypertension and chronic treatment with glucocorticoids, antiepileptics and antiretrovirals, would benefit the most. Patients

with risk factors for the development of PE and vitamin D deficiency may require higher doses than those commonly recommended for pregnant women (Poniedziałek-Czajkowska, 2021)

Women should not receive low molecular weight heparin, vitamins C or E, or folic acid for the prevention of preeclampsia. This recommendation relates to the use of heparin for the prevention of preeclampsia and not for other indications, such as thromboprophylaxis in antiphospholipid antibody syndrome.

Pravastatin has been proposed as an adjunctive therapy to reduce the risk of preeclampsia. Statin treatment led to a reduction in LDL levels, resulting in a depletion of its oxidative forms, which are strong stimulators of Toll-like receptors (TLRs). TLR signaling is one of the most important mechanisms that elevate IL6 and TNFα levels following increased transcriptional activity of NFκ β. In addition, statins inhibit the activation mechanism of NFκ β by blocking phosphatidylinositol 3-kinase (PI3k)/protein kinase β (Akt) signaling. This pathway is activated in endothelial cells in response to TNFα stimulation. It has also been involved in the generation of reactive oxygen species. (Sakowicz, 2023)

The American Food and Drug Administration (FDA) does not yet recommend the use of these medications for all pregnant women. Statins lower cholesterol levels, reducing their accessibility to the developing fetus and thus increasing the risk of miscarriages or fetal birth defects. (Sakowicz, 2023)

MANAGEMENT

ANTIHYPERTENSIVE THERAPY

Severe hypertension during pregnancy, i.e., Systolic Blood Pressure (SBP) ≥160 mmHg or Diastolic Blood Pressure (DBP) ≥ 110 mmHg, requires urgent antihypertensive treatment, in a monitored setting. The target for treatment should be a DBP of 85 mmHg, regardless of SBP. Non-severe hypertension should be treated with the first-line agents: oral methyldopa, oral labetalol, or oral nifedipine. Severe hypertension should be treated with first-line agents or intravenous (IV) labetalol or IV hydralazine.

Women with eclampsia should be given magnesium sulfate to prevent recurrent seizures, and women with preeclampsia with severity data should be given for the prevention of eclampsia. (Magee, 2022)

SCHEDULED BIRTH

Indications for planned birth at any gestational age include: Abnormal neurological features (such as eclampsia, severe intractable headache, or repeated visual scotomas), repeated episodes of severe hypertension despite maintenance.

CORTICOSTEROIDES PRENATALES

Do not administer corticosteroids to accelerate resolution of Hemolysis Syndrome, Elevated Hepatic Enzymes and Low Platelets (HELLP). (Magee, 2022)

PHARMACOLOGICAL TREATMENT

Drugs such as sulfasalazine (an anti-inflammatory and antioxidant) that reduces sFlt-1 and sEng levels and increases PlGF secretion, and relaxin plays an important role in maintaining blood pressure in normal pregnancy, are under investigation and could be used as therapeutic agents.

Fasudil is a first-generation Rho/Rho-associated protein kinase (ROCK) inhibitor that is frequently used for the treatment of hypertension and other cardiovascular diseases. RhoA proteins (Ras homologous gene family, member A) are expressed at higher levels in PE, suggesting a role in the pathogenesis of PE.

Antioxidants such as vitamin C and vitamin E inhibit the p38 signaling pathway and thus block the secretion of sFlt-1.

Studies have also revealed that exogenous antitrypsin α-1 can alleviate hypoxia/reoxygenation injury by reducing oxidative stress by inactivating Rac1/p38 signaling. Eduardo et al. (2018) reviewed the use of VEGF and PlGF as therapies to curb PE and suggested that modified stabilized members of the VEGF family could be used as therapeutic agents for treatment, but recent studies reveal that VEGF and PlGF could be triggers for increased sFlt-1 production.

A study of metformin showed that it was able to prevent PE by reducing the production of sFlt-1 and sEng and improving endothelial dysfunction through effects on mitochondria.

MSCs are adult stem cells that have an anti-inflammatory, immune regulator and repairing effect. The regenerative potential of MSCs isolated from the placenta and umbilical cord could be harnessed for the treatment of hypertension in PE, ameliorate the damage caused by Intrauterine Growth Restriction (IUGR), kidney damage, and impaired spiral artery remodeling. (Jena, 2020)

Sildenafil citrate enhances the action of NO by inhibiting the enzyme phosphodiesterase-5, which is responsible for the degradation of cyclic GMP, a key second messenger for NO signaling. Consequently, several preclinical studies have evaluated the efficacy of sildenafil as a treatment in established phenotypes similar to preeclampsia, consistently lowers maternal blood pressure, and in most studies also reduces proteinuria and maternal kidney damage.

CONCLUSIONS

New molecules have been found for early diagnosis based on the angiogenic relationship present in preeclampsia, such as high levels of sFlt-1, sEng, IL-16, Activin A, ICAM and VCAM, as well as low levels of PAPP-A, PlGF and placental protein 13, as well as new drugs and interventions

for effective treatment such as sildenafil, pravastatin, stem cells, however, Due to discrepancies in outcomes for both mother and fetus, they cannot yet be widely recommended.

REFERENCES

1. Barber, C. V., Yo, J. H., Rahman, R. A., Wallace, E. M., Palmer, K. R., & Marshall, S. A. (2023). Activina A y patologías del embarazo: una revisión. *Placenta, 136*, 35-41.

2. Camacho-Méndez, K., Ventura-Arizmendi, E., Zárate, A., & Hernández-Valencia, M. (2018). Utilidad de los biomarcadores séricos involucrados en la fisiopatología de la preeclampsia como predictores tempranos de diagnóstico. *Perinatología y Reproducción Humana, 32*, 39-42.

3. Capeless, E. L., & Clapp, J. F. (1991). When do cardiovascular parameters return to their preconception values? *American Journal of Obstetrics and Gynecology, 165*, 883-86. https://doi.org/10.1016/0002-9378(91)90432-Q

4. Conde-Agudelo, A., Villar, J., & Lindheimer, M. (2004). World health organization systematic review of screening tests for preeclampsia. *Obstetrics and Gynecology, 104*(6), 1367–1391. https://doi.org/10.1097/01.aog.0000147599.47713.5d

5. Reyna-Villasmil, E. (2018). Factores anti-angiogénicos y preeclampsia. *Avances en Biomedicina, 7*(2018), 23–34. Recuperado de https://www.redalyc.org/journal/3313/331355419004/html/

6. Hornakova, A., Kolkova, Z., Holubekova, V., Loderer, D., Lasabova, Z., Biringer, K., & Halasova, E. (2020). Diagnostic potential of microRNAs as biomarkers in the detection of preeclampsia. *Genetic Testing and Molecular Biomarkers, 24*(6), 321–327. https://doi.org/10.1089/gtmb.2019.0264

7. Jena, M. K., Sharma, N. R., Petitt, M., Maulik, D., & Nayak, N. R. (2020). Pathogenesis of preeclampsia and therapeutic approaches targeting the placenta. *Biomolecules, 10*(6), 953. https://doi.org/10.3390/biom10060953

8. Johnson, J. D., & Louis, J. M. (2022). Does race or ethnicity play a role in the origin, pathophysiology, and outcomes of preeclampsia? An expert review of the literature. *American Journal of Obstetrics and Gynecology, 226*(2S), S876–S885. https://doi.org/10.1016/j.ajog.2020.07.038

9. Arriaga López, A., Álvarez Torres, A., Meléndez Cruz, S., Vera Sánchez, M. D., & Quintero Gordillo, A. B. (2022). Reporte de seis casos de eclampsia en un hospital rural de la selva de Chiapas. *Revista de la Facultad de Medicina (México), 65*(3), 24-32. https://doi.org/10.22201/fm.24484865e.2022.65.3.04

10. MacDonald, T. M., Walker, S. P., Hannan, N. J., Tong, S., & Kaitu'u-Lino, T. J. (2022). Clinical tools and biomarkers to predict preeclampsia. *EBioMedicine, 75*, 103780. https://doi.org/10.1016/j.ebiom.2021.103780

11. Magee, L. A., Brown, M. A., Hall, D. R., Gupte, S., Hennessy, A., Karumanchi, S. A., Kenny, L. C., McCarthy, F., Myers, J., Poon, L. C., Rana, S., Saito, S., Staff, A. C., Tsigas, E., & von Dadelszen, P. (2022). The 2021 International Society for the Study of Hypertension in Pregnancy classification, diagnosis & management recommendations for international practice. *Pregnancy Hypertension, 27*, 148–169. https://doi.org/10.1016/j.preghy.2021.09.008

12. Melchiorre, K., Giorgione, V., & Thilaganathan, B. (2022). The placenta and preeclampsia: villain or victim? *American Journal of Obstetrics and Gynecology, 226*(2S), S954–S962. https://doi.org/10.1016/j.ajog.2020.10.024

13. Moreno, A. D. (28 de Octubre de 2019). Asociación entre las características materna y del control prenatal con el desarrollo de. Monterrey, Nuevo León, México.

14. Protocolo: "ADG090162 2019": Asociación entre las características maternas y del control prenatal con el desarrollo de preeclampsia y sus complicaciones en población adolescente, Versión 2.0, fechado Septiembre del 2019, Monterrey, N.L., México.

15. Poniedziałek-Czajkowska, E., & Mierzyński, R. (2021). Could vitamin D be effective in prevention of preeclampsia? *Nutrients, 13*(11), 3854. https://doi.org/10.3390/nu13113854

16. Sakowicz, A. (2022). The targeting of nuclear factor kappa B by drugs adopted for the prevention and treatment of preeclampsia. *International Journal of Molecular Sciences, 23*(5), 2881. https://doi.org/10.3390/ijms23052881

17. Sakowicz, A., Bralewska, M., Rybak-Krzyszkowska, M., Grzesiak, M., & Pietrucha, T. (2023). New ideas for the prevention and treatment of preeclampsia and their molecular inspirations. *International Journal of Molecular Sciences, 24*(15), 12100. https://doi.org/10.3390/ijms241512100

18. Turbeville, H. R., & Sasser, J. M. (2020). Preeclampsia beyond pregnancy: long-term consequences for mother and child. *American Journal of Physiology. Renal Physiology, 318*(6), F1315–F1326. https://doi.org/10.1152/ajprenal.00071.2020

19. Wiles, K., Chappell, L. C., Lightstone, L., & Bramham, K. (2020). Updates in diagnosis and management of preeclampsia in women with CKD. *Clinical Journal of the American Society of Nephrology: CJASN, 15*(9), 1371–1380. https://doi.org/10.2215/CJN.15121219

Use of laser therapy in the postoperative period of colocephalectomy in dogs

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ABSTRACT

For a better postoperative rehabilitation of colocephalectomy in dogs, laser therapy has been shown to be an alternative modality that is being considered efficient because it is safe, painless, regenerative and improves animal welfare. This therapy uses low-level laser that positively assists in the healing process, presenting analgesic, anti-inflammatory, healing and circulatory effects. The laser used is therapeutic, being a coherent, monochromatic and collimated light source, for this reason it does not present side effects when used at the correct power. Hip dysplasia is described as an impairment of the hip joint, and is considered one of the most important orthopedic dysfunctions in large and giant dogs, and can present in different degrees and different forms of joint degeneration. It manifests itself through specific clinical signs, which contribute to a conclusive diagnosis. The treatment of hip dysplasia has as its main objective pain control, its indication is variable according to factors related to each patient, and can be conservative or surgical, as is the case with colocephalectomy.

Keywords: Hip Dysplasia, Laser Therapy, Orthopedics, Rehabilitation.

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INTRODUCTION

Laser therapy is used in post-surgical veterinary rehabilitation because it promotes pain control, helps in bone strengthening, treatment of peripheral nerve injuries and edema and especially in wound healing, and can thus be used to accelerate the post-surgical recovery process from colocephalectomy (DINIZ, 2019). Low-power Light Amplification by Stimulated Emission of Radiation is a great alternative to assist in the treatment of chronic and acute pain in animals with hip dysplasia (RYCHEL, 2010).

Classified as an anomaly in the development of the hip joint, hip dysplasia especially affects large dogs due to the inconsistency of the hip joint, causing the dragging of the acetabulum and changes in the head and neck of the femur, resulting in secondary degenerative joint disease (DASSLER, 2007). Common clinical signs of hip dysplasia are unilateral or bilateral claudication, arched back, limb rotations, and reduced hip range of motion. These clinical manifestations may not be compatible with the radiological findings (BRASS, 1989).

Among the therapeutic recommendations for hip dysplasia are conservative therapies, such as the use of chondroprotective drugs and physical therapy, which help relieve pain in acute cases or when the patient cannot perform the surgical procedure (PERRUPATO, QUIRINO, 2014), and also surgical intervention, for example, colocephalectomy. Factors such as the clinical condition and age of the animal influence the preference for treatment (ANDERSON, 2011).

Collocephalectomy is an excisional arthroplasty indicated for surgical correction of hip dysplasia, but it is also a procedure that can be performed when there is a fracture of the femoral head or acetabulum (DEJARDIN, 2007). The postoperative rehabilitation time for colocephalectomy considered adequate without the aid of alternative therapies is 43.2 months (BARBOSA et al, 2012), and the total recovery from the procedure associated with the use of different physiotherapeutic techniques is only one month, and a decrease in clinical manifestations can be observed (MARTINNS and ROCHA, 2022), thus, physiotherapy has proven to be very efficient, especially when used in postoperative recovery, especially in the locomotor system, or even in cases where the treatment is conservative (RIVIÈRE et al., 2005). Although the branch of physiotherapy in human medicine has its rehabilitation techniques recognized as essential in postoperative care, in veterinary medicine it is still expanding, supported by studies adapted for use in animals (VICENTE, 2019).

This study aims to encourage the postoperative period of colocephalectomy in dogs through the approach of physiotherapy techniques, especially laser therapy, for the patient's recovery.

DEVELOPMENT

Laser therapy (Light Amplification by Stimulated Emission of Radiation) is used at a low power, where it emits radiation in a photon flux, thus generating the biological effect through

artificial light. There is no tissue heating, however, the energy that is produced by the equipment has biostimulant effects, which has a very low percentage of side effects. The laser light is absorbed by induction into the cell, evaluated directly in chronic or acute pain, in order to accelerate the process of tissue repair, bone repair, wound healing, and other processes in order to accelerate the body in the healing process (LUZ, 2018).

Studies carried out by Ozawa (1998) prove that the effect of laser irradiation at a low intensity stimulates bone formation when applied to bone cell cultures in rats, which can also be verified in tissues of veterinary patients.

Hip dysplasia, also known as CFD, is an orthopedic disease that affects the canine species (ROCHA et al. 2013), more frequently in large animals (MINTO et al. 2012). DCF is defined as an alteration in the formation of the hip joints, which can be unilateral or bilateral (SOMMER, 1998). That is, when unilateral, one of the joints is normal and the other affected, and bilateral in both limbs, with different degrees (MORGAN, 1986).

This alteration has different degrees of sub-luxation and degenerative joint alteration (MINTO et al. 2012), where it has a predominance in soft tissues and local instability (ROCHA et al. 2013). Therefore, limb instability is directly linked to joint effusion, elongation of the joint capsule and weakening of the round ligament, resulting in subluxation of the femoral head and bone deficiency (SANTANA et al., 2010).

Joint instability is one of the first clinical signs that can be observed before the first year of life. (RISER, 1975). The other manifestations reported are subluxation or total dislocation of the femoral head, unilateral or bilateral lameness, in addition to rotation of the limbs and a perceptible crack when the animal moves (DASSLER, 2007). The diagnosis of hip dysplasia in dogs is made mainly through anamnesis, physical examination and radiographic alterations identified through ventrodorsal projection with the pelvic limbs stretched, collateral to the pelvis, the spine and each other, and rotated medially (FOSSUM, 2014).

The treatment for hip dysplasia aims to control pain, inflammation and reduce degenerative changes to improve animal welfare. Conservative therapy is used in acute cases through the administration of chondroprotectors, physiotherapy and analgesics, (PERRUPATO, 2014). In chronic cases, supportive treatment is not efficient, and it is necessary to define the surgical procedure as a protocol (ALBUQUERQUE, 2017).

Approximately 75% of the animals with mild hip dysplasia manifest clinical improvement with conservative treatment administered in a palliative manner. In the remaining cases, in which the form is more severe, surgical treatment is indicated (HUMMEL; VICENTE, 2019).

Colocephalectomy, also known as ostectomy of the femoral head and neck, is a procedure that consists of extracting the femoral head and neck, in order to reduce the impact between the

femur and provide the formation of a pseudoarthrosis, made by the fibrous tissue (SCHULZ, 2014). Postoperative care is based on the analgesic therapy protocol to reduce discomfort. It is advisable to perform physiotherapy to stimulate muscle mass and movement capacity (DEJARDIN, 2007), restore and promote an improvement in function, focusing on quality of life (LEVINE et al, 2008). Several studies carried out by Oliveira (2018) showed a significant evolution after the seventh day in healing factors and bone neoformation with the use of laser therapy applied to wistar rats.

The use of techniques such as laser therapy can be employed in these cases to reduce edema, relieve pain, assist in osteoarticular conditions and peripheral nerve injury (HUMMEL, 2019). The laser is characterized as a booster of electromagnetic radiation, as described in 1960 by Theodore Maiman (VINCK et al., 2003). In the use of therapeutic laser, it is applied at low power, especially gallium or aluminum arsenic aluminum (VENANCIO et al., 2002).

The laser therapy applied in colocephalectomy should be applied to the skin perpendicular to the affected region, in this case the hip joint, with a distance of one centimeter from the stitches, as in figure 1. Its application is through the emission of a laser beam, where the head comes into contact with the area slowly. The laser therapy protocol is performed through the pen in a prepared area, and can be performed from 12 to 25 sessions, daily or at an interval of 48 hours. The area of application intended for therapy should be in a radius of incidence of 15 to 40 seconds perpendicular (LAMAS, 1999). The suggested dose of laser for pain control is 2 and 6 J/cm2. Similarly, for anti-inflammatory effects, 4 to 8 J/cm2 (MILLIS; SAUNDERS, 2014).

Figure 1: Patient with hip disease receiving treatment with laser therapy

Source: The author.

The use of laser therapy is not recommended for pregnant female animals, laser over tumor sites, periocular regions and carotid sinuses. Likewise, it should not be applied to open molera, growth plates and coagulation disorder (IOLANDA, 2017).

The expected effects of the laser are diverse, some of them are: analgesia, where the stimulation of the increase in serotonin, beta endorphins and nitric oxide, which causes the

normalization of ion channels, in addition to increasing the action potential of nerve cells, which occurs by blocking and depolarizing the afferent nerves of fiber C. That is, in pain control, the laser stimulates the production of endogenous peptides and changes in cellular electrical interference, analgesic effect occurs through the repolarizing inhibitor. Likewise, it has anti-inflammatory action, where the process that decreases the synthesis of inflammatory prostaglandins and the level of C-reactive protein occurs, reduction of interleukin-1, accelerating leukocyte activity, to increase angiogenesis (MIKAIL, 2009).

CONCLUSION

We conclude that laser therapy has been shown to be an adjuvant technique with promising results in the post-surgical treatment of colocephalectomized patients.

REFERENCES

1. Albuquerque, L. K., & Carvalho, Y. K. (2017). Emprego da acupuntura veterinária na displasia coxofemoral em cães. *Enciclopédia Biosfera: Centro Científico Conhecer - Goiânia, 14*(26), 1466.

2. Anderson, A. (2011). Treatment of hip dysplasia. *The Journal of Small Animal Practice, 52*, 182-189.

3. Brass, W. (1989). Hip dysplasia in dogs. *Journal of Small Animal Practice, 30*, 166-170.

4. Barbosa, A. L. T., Schossler, J. E. W., Bolli, C. M., Lemos, L. F. C., & Medeiros, C. (2012). Recuperação funcional coxofemoral pós-operatória em cães: estudo clínico, radiográfico e biomecânico. *Ciência Rural, 42*(11), 2011-2017.

5. Dassler, C. L. (2007). Displasia do quadril canino: diagnóstico e tratamento não cirúrgico. In *Manual de Cirurgia de Pequenos Animais* (3ª ed., pp. 2019-2029). São Paulo: Manole.

6. Dejardin, L. M., & Schulz, K. S. (2007). Tratamento cirúrgico da displasia coxofemoral canina. In D. Slatter (Ed.), *Manual de Cirurgia de Pequenos Animais* (3ª ed., pp. 2029-2059). São Paulo: Manole.

7. Diniz. (2019). A face transdisciplinar das ciências agrárias. In J. C. Ribeiro (Org.), *A face transdisciplinar das ciências agrárias* (pp. 1-15). Ponta Grossa, PR: Atena.

8. Fossum, T. W. (2014). *Cirurgia de pequenos animais* (4ª ed.). Rio de Janeiro: Elsevier.

9. Hummel, J., & Vicente, G. (2019). *Tratado de fisioterapia e fisiatria de pequenos animais* (Vol. 1). São Paulo: Payá.

10. Lamas, M. C. S. (1999). *Laser a diodo de arseneto de gálio (As-Ga) aplicado às fraturas do terço médio do rádio em cães* [Dissertação de mestrado, Escola de Veterinária da UFMG].

11. Levine, D., et al. (2008). *Reabilitação e fisioterapia na prática de pequenos animais*. São Paulo: Roca.

12. Luz, D. S. (2018). *Fisioterapia em afecções coxofemorais de pequenos animais* [Trabalho de conclusão de curso, UFRGS].

13. Martins, L. V., & Rocha, R. T. (2022). Recuperação funcional de cães submetidos à reabilitação pós ressecção de cabeça e colo femoral. *PubVet - Medicina Veterinária e Zootecnia, 16*(1), 1-7.

14. Millis, D. L., & Saunders, D. G. (2014). Laser therapy in canine rehabilitation. In *Frontiers of Knowledge: Multidisciplinary Approaches in Academic Research* (e-book).

15. Millis, D. L., & Levine, D. (2014). *Canine rehabilitation and physical therapy* (2ª ed.). Philadelphia: Elsevier.

16. Mikail, S., & Pedro, C. L. (2009). Laser terapêutico. In *Fisioterapia Veterinária* (2ª ed., pp. 89-97). Barueri: Manole.

17. Minto, B. W., et al. (2012). Avaliação clínica da denervação acetabular em cães com displasia

coxofemoral atendidos no hospital veterinário da FMVZ – Botucatu – SP. *Veterinária e Zootecnia*.

18. Moraes, C. L. D., Dias, F. G. G., Pereira, L. F., Honsho, C. S., Conceição, M. E. B. A. M., Jorge, A. T., & Dias, L. G. G. (2015). Colocefalectomia e osteotomia pélvica tripla no tratamento da displasia coxofemoral em cães. *Revista Investigação – Medicina Veterinária, 14*(1), 72-77.

19. Morgan, J. P. (1986). Canine hip dysplasia: asymmetry of change. *Calif. Vet., 40*, 17-20.

20. De Oliveira, F. L. (2018). *Avaliação dos efeitos da terapia fotodinâmica com azul de metileno, e laser de baixa intensidade, em diferentes intervalos de tempo, na cicatrização de feridas ósseas cirúrgicas em ratos Wistar: análise radiográfica e histopatológica* (Tese de doutorado, Universidade Federal de Juiz de Fora).

21. Ozawa, Y., & Shimizu, N. (1998). Low-energy laser irradiation stimulates bone nodule formation at early stages of cell culture in rat calvarial cells. *Bone*.

22. Perrupato, T. F., & Quirino, A. C. T. (2014). Acupuntura como terapia complementar no tratamento de displasia coxofemoral em cães - relato de caso. *Rev. Ciên. Vet. Saúde Públ., 1*(2), 141-145.

23. Pinto, Q. L. (2017). *Modalidade Terapêuticas em Reabilitação Funcional de Pequenos Animais*. Porto: Laserterapia.

24. Riser, W. H. (1975). The dog as a model for the study of hip dysplasia. Growth, form, and development of the normal and dysplastic hip joint. *Veterinary Pathology, 12*, 234-334.

25. Rivière, S., et al. (2005). La rééducation fonctionnelle chez les carnivores domestiques: application aux troubles locomoteurs d'origine orthopédique ou neurologique. *Bulletin de L'academie Veterinaire de France*, 269-274.

26. Rychel, J. K. (2010). Diagnosis and treatment of osteoarthritis. *Topics In Companion Animal Medicine, 25*(1), 20-25.

27. Rocha, L. B., et al. (2013). Denervação articular coxofemoral em cães com doença articular degenerativa secundária à displasia. *Ciência Animal Brasileira, 14*(1), 120-134.

28. Santana, L. A. (2010). Avaliação radiográfica de cães com displasia coxofemoral tratados pela sinfisiodese púbica. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia, 62*(5), 1102-1108.

29. Sommer, E. L., & Fratocchi, C. L. G. (1998). Displasia coxofemoral canina. *Revista de Educação Continuada do CRMV-SP, 1*, 36-43.

30. Schulz, K. S. (2014). Afecções articulares. In T. W. Fossum (Ed.), *Cirurgia de pequenos animais* (4ª ed.). Elsevier.

31. Venâncio, R. A., et al. (2002). Laser no tratamento de desordens temporomandibulares. *Jornal Brasileiro de Oclusão, ATM e Dor Orofacial, 2*(7), 229-234.

32. Vinke, T. H., et al. (2003). Increased fibroblast proliferation induced by light emitting diode and low power laser irradiation. *Lasers in Medicine and Science, 18*, 20.

Study of the effect of calcination in obtaining nanostructured HAp by combustion reaction

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ABSTRACT

Human bone is made up of 9% water, 20% organic components, and 69% calcium phosphates. These phosphates are also present in the bone composition of different animal species, arousing great biological and medical interest, as it is a highly biocompatible material, that is, it could be compatible with living tissues and organic fluids without toxic effects or even immunological reactions. One of the most widely used representatives of the group of bioactive materials of calcium phosphate of synthetic origin is hydroxyapatite - HAp, Ca10(PO4)6(OH)2, due to its high osteinduction, which enables bone regeneration, structure and composition similar to that of phosphate present in skeletal tissue, also known as biological apatite, and its excellent biocompatibility. This research work proposed to study the influence of different calcination temperatures, within a predetermined range, combined with the use of two distinct fuels, glycine and urea, through the method of synthesis by combustion, in obtaining HAp formed by nanometric grains, so that its structure would be as similar as possible to biological apatite. For this investigation, the following techniques were used as methods of structural and morphological characterization: X-ray diffraction (XRD), energy dispersive spectroscopy (EDX), scanning electron microscopy (SEM) and thermogravimetry (TG). The results of the characterizations showed that using the two fuels it was possible to obtain the HAp phase, with grains of nanometric size forming heterogeneous clusters of easy deagglomeration, being the most efficient and with a higher degree of purity when using glycine, and calcined at 1200°C.

Keywords: Hydroxyapatite, Combustion reaction, Biomaterial, Calcination.

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INTRODUCTION

Approximately 70% of human bone is composed of calcium phosphates, and this inorganic part consists of an amorphous phase and a crystalline phase, formed by biological apatite (TORKITTIKUL and CHAIPANICH, 2012). Ceramic materials based on this phosphate have been attracting more and more attention in the medical-dental area due to their similarity with the biological material, and the main examples of this are hydroxyapatite (HAp) [$Ca_{10}(PO_4)_6(OH)_2$] and β-phosphate tricalcium [$Ca_3(PO_4)_2$], due to their high biocompatibility, excellent osteoinduction, in addition to structure and composition very close to those of bioskeletal material (EPPLE and TADIC, 2003). HAP is also widely used in dental implants, reconstructive surgeries and orthopedic surgeries, replacing bone grafts, as described in the medical literature.

The uses of the most diverse reagents and methods to synthesize HAP in the laboratory are reported in the literature, as examples of the latter are: gravitational (NATHANAEL et al, 2011), hydrothermal (SIMOMUKAY, 2013), microwave (KALITA and VERMA, 2009), precipitation (ARAÚJO et al, 2012), combustion reaction (GHOSH et al, 2010) and sol-gel (RODRIGUES, 2008). The choice of the synthesis method used is made considering the particle size that can be obtained, which is an extremely important characteristic with regard to its application.

The characterization of the powders obtained can be carried out through the X-ray diffraction technique (XRD), as to its structure, scanning electron microscopy (SEM), as to its morphology and for chemical analysis it can be used to the technique of energy dispersive spectroscopy (EDX), among others.

This work proposed to obtain hydroxyapatite formed by nanometric grains, through the method of synthesis by combustion, studying the influence of different calcination temperatures, within a predetermined range, combined with the use of two distinct fuels, glycine and urea, on the structure of the HAp obtained. The combustion reaction synthesis method was chosen due to its easy execution and low cost, and it can be used to produce HAp powders on a large scale.

Synthesis by combustion reaction is further described by ALVES, BERGMANN and BERUTTI (2013) as:

> A method based on the principle that once a reaction under heat is initiated, an exothermic reaction occurs and becomes self-sustaining for a certain period of time, resulting in a powder as the final product. The exothermic reaction starts at the ignition temperature and generates a certain amount of heat which is called maximum temperature or combustion temperature. Solution by combustion synthesis has the advantage of quickly producing fine and homogeneous powders. Because it is an exothermic and self-sustaining process, and with a high rate of heat release, it can be explosive and must be carried out with extra care.

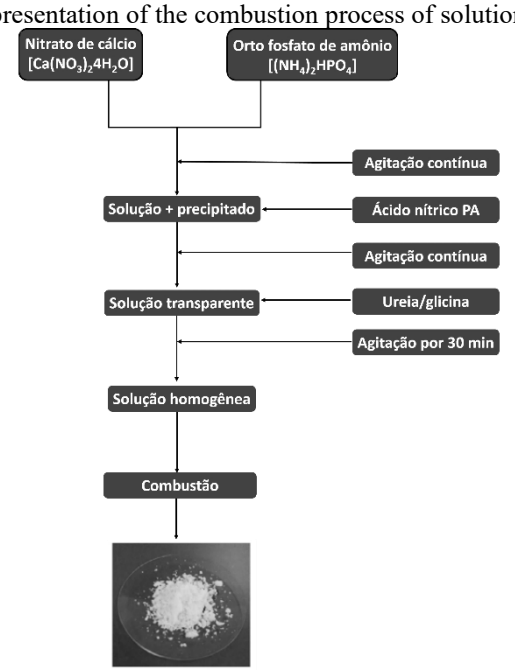
MATERIALS AND METHODS

For study purposes, hydroxyapatite powders were synthesized and analyzed as described in the following subsections.

EXPERIMENTAL PROCEDURE

Fig. 1 illustrates the procedure for obtaining HAP.

Figure 1 – Schematic representation of the combustion process of solution for HAp synthesis [10].



To carry out the syntheses in this work, the methodology and proportions of reagents proposed by Ghoshet al (2010) were followed. Calcium and phosphorus precursors were calcium nitrate tetrahydrate (Vetec – Química Fina, Brazil) and di-basic ammonium phosphate (Vetec – Química Fina, Brazil). The mixture was then placed under magnetic stirring, and nitric acid (Vetec – Química Fina, Brazil, 69%) was added in small quantities until the precipitate was completely diluted.

Subsequently, the resulting solution was removed from the agitator and added to the fuel, being placed under agitation again. The solution was then transferred to a crucible and placed in an electrical resistor for combustion.

The product obtained was left to cool until it reached room temperature, being macerated Three of the samples were placed to calcine in a muffle furnace, with an initial temperature of 25ºC until they reached 600ºC, 900ºC and 1200ºC, respectively, at a rate of 10ºC/min and remaining at these temperatures for 12 hours.

The steps for obtaining HAP powders by combustion reaction are illustrated in Fig. 2 and 3, for glycine and urea fuels, respectively.

Figure 2 – Stages of obtaining HAP by combustion reaction, using glycine as fuel. (a) Heating of the reactant mixture in the resistance, (b) release of gases from combustion and (c) HAp powders obtained after complete combustion.

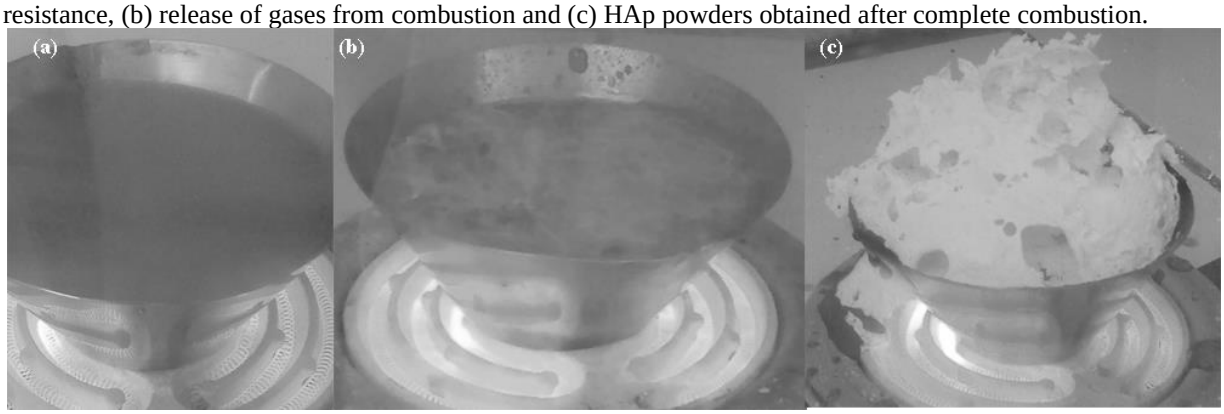
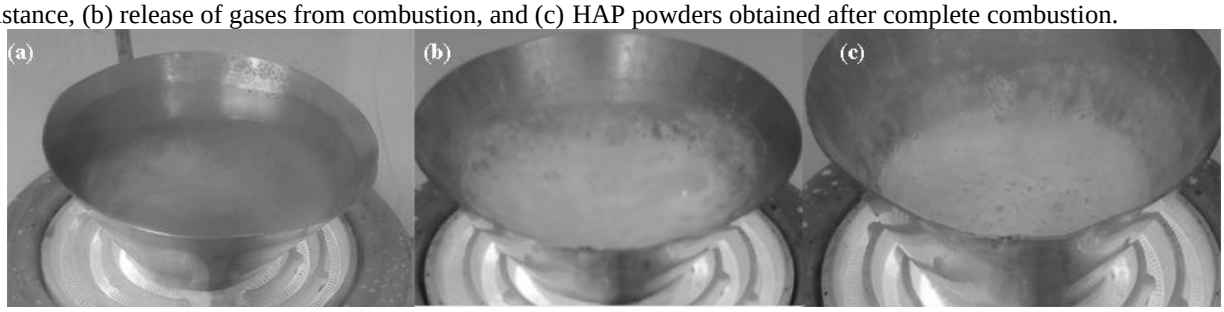


Figure 3 – Stages of obtaining HAP by combustion reaction, using urea as fuel. (a) Heating of the reactant mixture at the resistance, (b) release of gases from combustion, and (c) HAP powders obtained after complete combustion.



CHARACTERIZATIONS

The structural characterization of the HAP powders obtained was performed by the X-ray diffraction (XRD) technique. A BRUKER D2 PHASER diffractometer was used to record the data at 2θ in the range of 3º to 70º. The data obtained were analyzed using the Origin 9.4 software and the peaks classified according to the JCPDS chart for HAp. The chemical analysis was performed through Energy Dispersive Spectroscopy (EDS) using a Bruker XFlash 430 H detector. Morphological characterization was performed by Scanning Electron Microscopy (SEM) using a Hitachi tabletop electron microscope model TM-3000. To perform the thermogravimetric (TG) analyses, the TG 209F1 thermobalance model NETZSCH was used, in the range of 0 to 1000°C at a rate of 50/20.0 (K/min).

RESULTS AND DISCUSSION

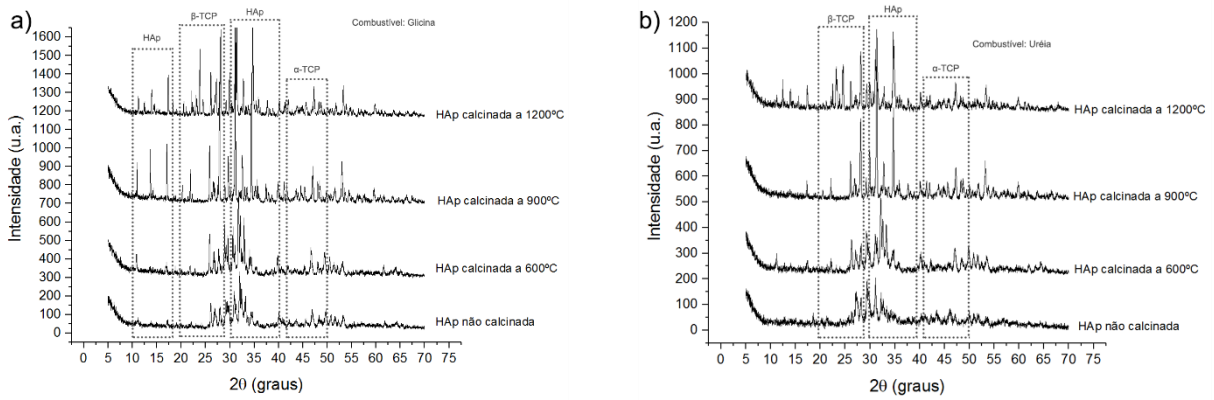
X-RAY DIFFRACTION (XRD)

From the analysis of the crystallographic peaks present in the diffractograms and their comparison with the standard HAp sheet of the JCPDS and results presented by Bezzi et al (2002), Ghosh et al (2009) and Kalita and Verma (2010), it was possible to prove the formation of HAp as the main phase for the two fuels used. However, there was also the formation of two other phases: β-phosphate tricalcium (β-TCP), which occurs between 20 and 30°, this phase being similar to that of HAp in urea samples, and α-phosphate tricalcium (α-TCP), which occurs between 40-50º. In the

glycine samples, the predominant phase was HAP, which occurs in the intervals between 10 and 20° and between 30 and 40°, as illustrated in Fig. 4.

Thus, it is possible to verify, through the diffractograms, that the material obtained in the synthesis by combustion reaction was not the pure hydroxyapatite phase as desired, but a mixture of three phases of calcium phosphate.

Figure 4 – HAp synthesized using (a) glycine and (b) urea as fuel



SCANNING ELECTRON MICROSCOPY (SEM)

The results of the morphological analysis showed that the increase in the calcination temperature and the type of fuel used had a direct influence on the morphology of the grains, with the HAp grains synthesized using glycine as fuel being smaller, more irregularly shaped and their agglomerates more porous, as shown in Fig.5 and 6.

Figure 5 - Micrographs of the HAp samples synthesized with glycine fuel, with 200X magnification. (a) Non-calcined, (b) Calcined at 600°C, (c) Calcined at 900°C, (d) Calcined at 1200°C.

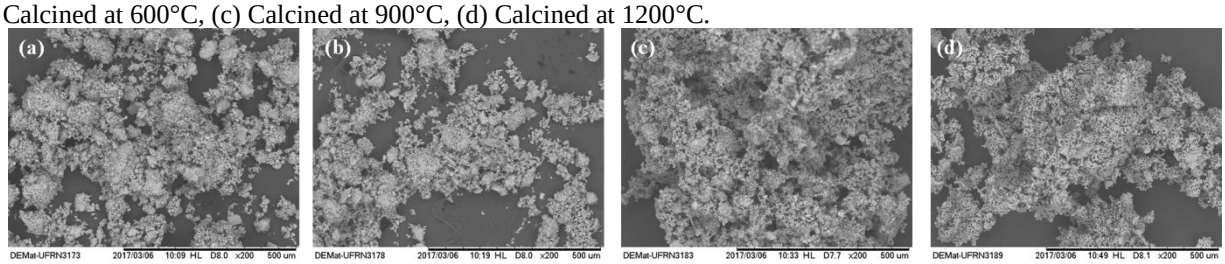
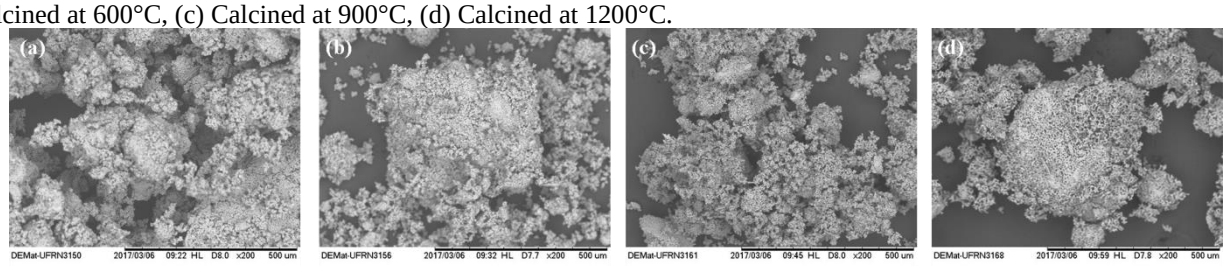


Figure 6 - Micrographs of the HAp samples synthesized with urea fuel, with 200X magnification. (a) Uncalcined, (b) Calcined at 600°C, (c) Calcined at 900°C, (d) Calcined at 1200°C.



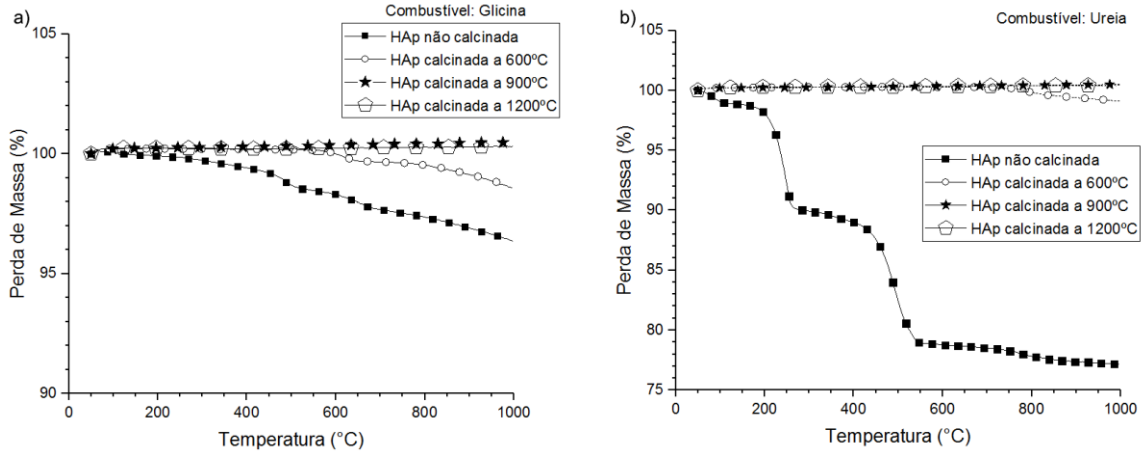
THERMOGRAVIMETRIC ANALYSIS (TG)

It was possible to prove, through the thermogravimetric analyses, illustrated in Fig. 7, that the increase in the calcination temperature has a direct influence on the loss of mass of the powders obtained. The non-calcined samples showed a higher percentage of mass reduction for both fuels.

In the non-calcined sample of HAp synthesized using urea as fuel, as reported in the literature, the mass loss was due to the thermal decomposition of urea into complex compounds and the evaporation of water. While the sample synthesized with glycine and not calcined, there was a mass loss of approximately 3%, Fig. 7a, contrary to the results found by Ghosh et al (2009).

For the samples calcined at 600°C, the percentage of mass variation was lower when urea fuel was used, with an increase of approximately 0.16% at 760.2ºC and a reduction of 0.89% at 997.5ºC, against an increase of 0.27% at 568.7ºC and a reduction of 1.42% at 997.5ºC, for glycine fuel. For the samples calcined at 900 and 1200ºC, with both fuels, no significant changes were observed in the mass percentage, indicating that for this temperature range, the HAp obtained is stable.

Figure 7 - Thermogravimetric analyses of the HAp samples synthesized using the fuels (a) glycine and (b) urea.



ENERGY DISPERSIVE SPECTROSCOPY (EDX)

Through chemical analysis, observing the spectra obtained and the percentages of elements estimated for each sample, it was found that the composition of the eight samples corresponds to the composition of HAp, as expected. However, the quantitative analysis revealed that the Ca/P molar ratio varied according to the fuel and calcination temperature, Fig. 8 and Fig. 9, with the samples calcined at 600ºC, for both fuels, presenting values closer to the expected molar ratio, of 1.67.

Figure 8 - Energy dispersive spectroscopies of HAp samples synthesized with glycine fuel and their Ca/P molar ratios (a) Uncalcined, (b) Calcined at 600°C, (c) Calcined at 900°C, (d) Calcined at 1200°C.

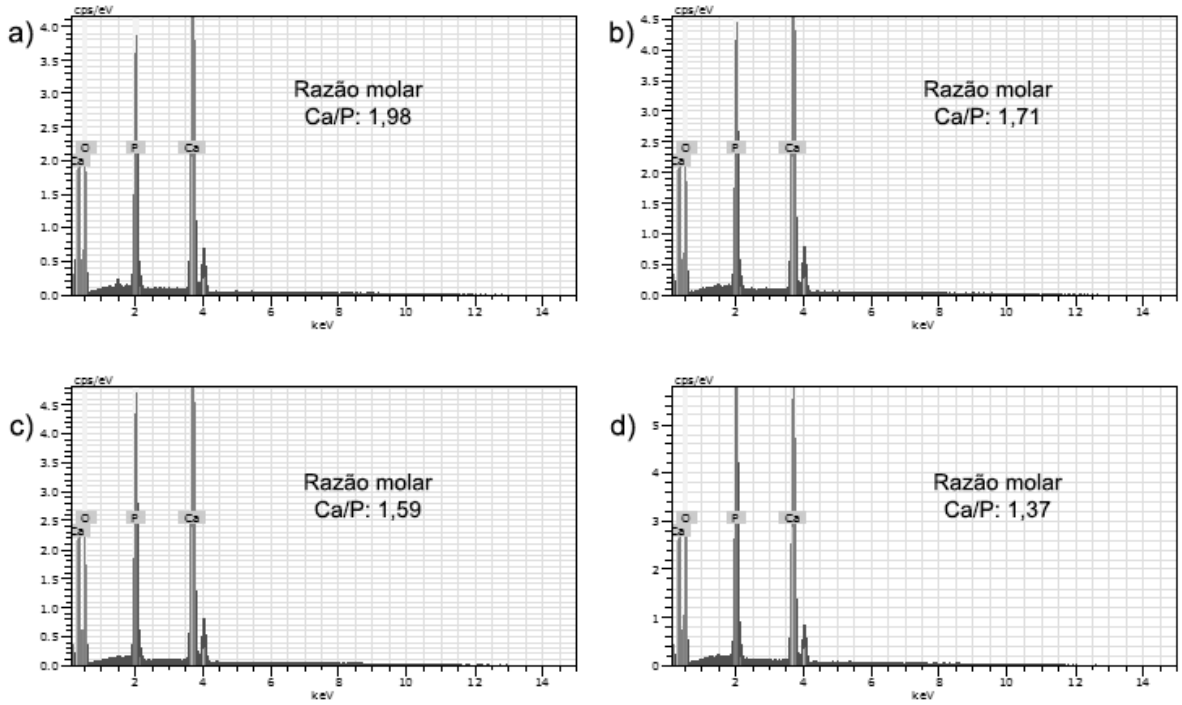
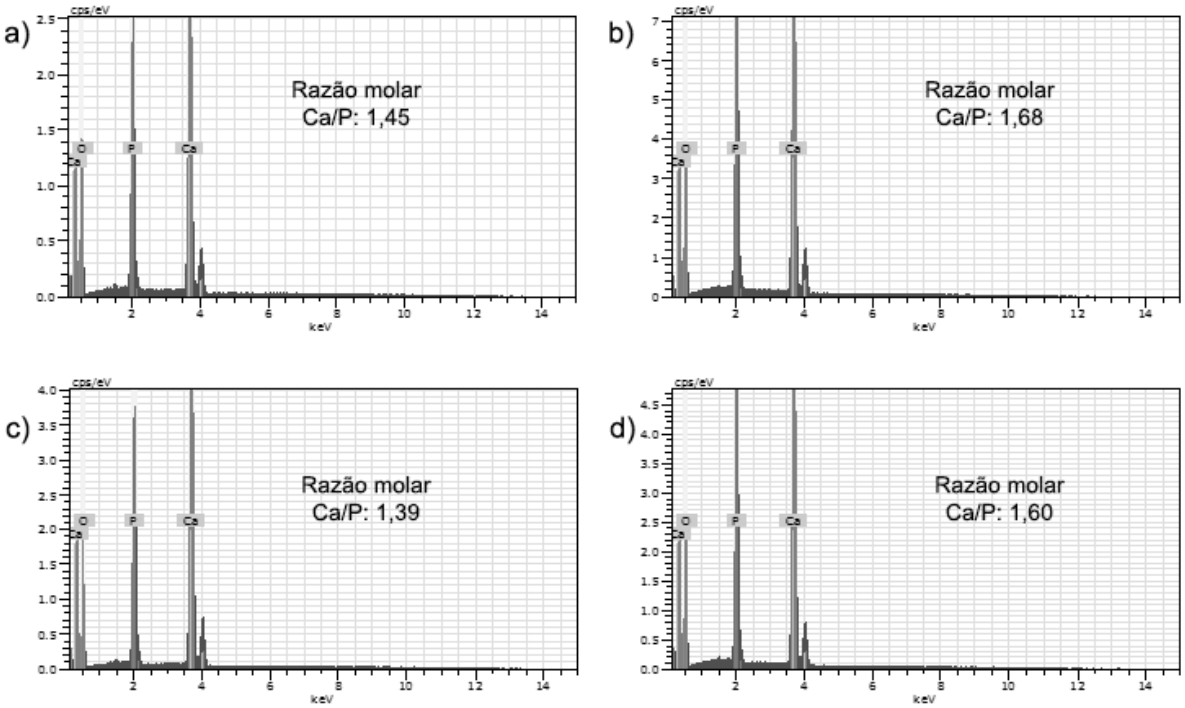


Figure 9 - Energy dispersive spectroscopies of HAp samples synthesized with urea fuel and their Ca/P molar ratios (a) Uncalcined, (b) Calcined at 600°C, (c) Calcined at 900°C, (d) Calcined at 1200°C.



Thus, the HAp sample synthesized with urea and calcined at a temperature of 600ºC was the one that came closest to the Ca/P molar ratio of 1.67 that refers to pure HAP (Brunette et al, 2012)

CONCLUSIONS

Differently from the initial interest, the samples synthesized in this work were not composed only of the hydroxyapatite phase (HAp) but a mixture of three phases of calcium phosphates (HAp + β-TCP + α-TCP). Through the morphological characterization it was possible to classify the powders of the samples as porous agglomerates, with urea samples sizes between 2 and 10μm and glycine samples between 2.5 and 12μm. Through the analysis of the results of the characterizations, it was concluded that the most favorable fuel for the synthesis of hydroxyapatite, although presenting the highest percentage of mass reduction and molar ratio of Ca/P different from that desired for pure HAP, was glycine, since the predominant phase obtained was that of HAP. However, there is a need to improve the synthesis conditions to obtain 100% pure HAP.

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REFERENCES

1. Alves, A., Bergmann, C. P., & Berutti, F. A. (2013). Combustion Synthesis. In *Novel Synthesis and Characterization of Nanostructured Materials*. Springer Science & Business Media.

2. Araújo, M. S. O., Fook, M. V. L., Furtafo, G. T. F. S., Silva, M. F. A., & Melo, O. B. Síntese e caracterização de hidroxiapatita carbonatada obtida pelo método de precipitação. In *7º Congresso Latino-Americano de Órgãos Artificiais e Biomateriais*, Natal.

3. Bezzi, G., Celotti, G., Landi, E., La Torretta, T. M. G., Sopyan, I., & Tampieri, A. (2002). A novel sol-gel technique for hydroxyapatite preparation. *Materials Chemistry and Physics, 78*, 816-824.

4. Brunette, D. M., Tengvall, P., Textor, M., & Thomsen, P. (2012). Calcium-phosphate coatings. In *Titanium in Medicine: Material Science, Surface Science, Engineering, Biological Responses and Medical Applications*. Springer Science & Business Media.

5. Carrodeguas, R. G., & de Aza, S. (2011). α-Tricalcium phosphate: Synthesis, properties and biomedical applications. *Acta Biomaterialia, 7*, 3536-3546.

6. Epple, M., & Tadic, D. (2003). Mechanically stable implants of synthetic bone mineral by cold isostatic pressing. *Biomaterials, 24*, 4565–4571.

7. Ghosh, S. K., Roy, S. K., Kundu, B., Datta, S., & Basu, D. (2009). Synthesis of nanosized hydroxyapatite powders through solution combustion route under different reaction conditions. *Materials Science and Engineering B, 176*, 14–21.

8. Kalita, S. J., & Verma, S. (2010). Nanocrystalline hydroxyapatite bioceramic using microwave radiation: Synthesis and characterization. *Materials Science and Engineering C, 30*, 295–303.

9. Nathanael, A. J., Hong, S. I., Mangalaraj, D., & Chen, P. C. (2011). Large scale synthesis of hydroxyapatite nanospheres by high gravity method. *Chemical Engineering Journal, 173*, 846–854.

10. Rodrigues, L. R. (2008). *Síntese e caracterização de hidroxiapatita e titânia nanoestruturadas para a fabricação de compósitos* (Dissertação de Mestrado). Unicamp, Campinas.

11. Santos, T. L., Leite, A. M. D., & Viana, K. M. S. (2016). Análise da influência do combustível na obtenção de HAp via reação de combustão. In *XXII Congresso Brasileiro de Engenharia e Ciência dos Materiais*, Natal, 92-99.

12. Sasikumar, S., & Vijayaraghavan, R. (2010). Synthesis and characterization of bioceramic calcium phosphates by rapid combustion synthesis. *Journal Of Materials Science & Technology, 26*, 1114-1118.

13. Simomukay, E. (2013). *Síntese e Caracterização de Ortofosfatos de Cálcio dopados com Nióbio (V) por meio da Rota Hidrotérmica e Avaliação de Citocompatibilidade* (Dissertação de Mestrado). UEPG.

14. Torkittikul, P., & Chaipanich, A. (2012). Optimization of calcium chloride content on bioactivity and mechanical properties of White Portland cement. *Materials Science & Engineering C, 32*(2), 282-289.

15. Williams, D. F. (2008). On the mechanisms of biocompatibility. *Biomaterials, 29*, 2941-2953.

Realism-naturalism as a new expression of art in the conception of Eça de Queirós

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ABSTRACT

Realism and Naturalism were literary movements that strongly marked European literature. They brought new literary strategies with the aim of conceiving a new expression of art. We aim to clarify Realism-naturalism through the conception of the Portuguese writer Eça de Queirós, based on comments and explanations about texts found in the book "The Casino Conferences in periodicals: primary sources and literary history", a collection by Rosane Gazolla Alves Feitosa. The purpose is to discuss the Fourth Casino Conference, which had Eça de Queirós as a speaker, in order to obtain an idea of the Portuguese literary moment in which the periodicals had an important role. There is an approach to the culture and political history of Portugal in the nineteenth century, as well as comments on what each journalist expressed in their reports, in relation to the point that each one explained more, explaining what they said about Eça's exhibitions, which made him a landmark in literature. This is an unprecedented research in the sense of bringing a presentation referring to the important primary sources for the construction of Realism-naturalism in Portugal.

Keywords: Realism, Naturalism, Casino Conferences, Eça de Queirós.

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INTRODUCTION

Searching for roots and seeking a national identity with the use of subjectivity was no longer enough for the literature of the second half of the nineteenth century. Evolution came bringing with it the need to think objectively and to make use of reason. Therefore, intellectuals began to examine a new conception of literature, which valued reasoning and revealed the reality of beings and things, which brought to light the true human psychological state. Realism emerges in 1857 in France with "Madame Bovary", by Gustave Flaubert. And, in Portugal, from the 1860s onwards, through an intellectual clash entitled Questão Coimbrã (1865-1866).

Our proposal is to approach the lecture that Eça de Queirós gave at the Fourth Casino Conference, which was reported from different perspectives, with views of journalists who published them in periodicals of the time. In this way, we understand, through the elucidations of Eça's discourse, the history of how Realism-naturalism was conceived in Portugal. Some newspapers covered the event at that time, highlighting the talent of the young Eça, such as *A Revolução de Setembro*, *Jornal da Noite*, *Diário Popular*, *Partido Constitunte*, *Diário de Notícias*. Luciano Cordeiro, Pinheiro Chagas and Alberto de Queirós gave their opinions, exposing their point of view in relation to the ideas defended by Eça de Queirós. Pinheiro Chagas was the most critical. There is a certain focus on the culture and political history of Portugal in the nineteenth century.

Carlos Reis (1999) argues that the analysis of various literary periods and sub-periods is carried out in an articulated way, with the characterization of one period in close relation with that of another period or sub-period: "The appearance, disappearance and extinction of literary periods results, therefore, from a periodological interaction that, on the other hand and as already suggested, it cannot be dissociated from other cultural phenomena" (REIS, 1999, p. 412). In view of the above, due relevance is given to phenomena such as the reinterpretation of past movements, with internal transformations, which go through certain ruptures, that is, one period is formed against the other. So, it is possible to understand why Realism-naturalism presented ideals opposed to Romanticism.

> Realism has a relatively well-determined French origin and is connected in different ways with Romanticism and Naturalism: with Romanticism, this relationship is one of confrontation and overcoming [...]; with Naturalism, this relationship is one of partial convergence, since Realism founds and consolidates technical-literary procedures that were later readjusted and ideologically refined, in context and with a naturalistic purpose (REIS, 1999, p. 436).

From the Coimbra Question, a group of young intellectuals emerged who entered into a debate with defenders of Romanticism in Portugal. The debate took place through newspapers between 1865 and 1866. They expressed opinions in defense of a literary ideology of their own. It is

worth remembering that in 1865, the Portuguese romantic writer Antônio Feliciano de Castilho[2] made a publication to censor the group of young people from the press of the University of Coimbra, asserting that they were obscure exhibitionists who subverted the notion of poetry, concluding that there was a lack of common sense and good taste.

Antero de Quental felt strongly affected when reading Castilho's text, as he led the new generation of writers. Then, a pamphlet published by the Coimbra press wrote the text of response, the "Letter to the Most Excellent Mr. Antônio Feliciano de Castilho", whose title included the expression "Good sense and good taste". It was a sarcastic criticism of those who built their own path, without asking permission from the masters, but consulting their own conscience, trying to walk autonomously, without repeating or copying. In his position, the writer's mission is comparable to the priesthood, which requires an ethical position and, at the same time, asks for independence of character and thought. In short, it contests the poetry that promotes the word to the detriment of the idea, conservative poetry, the one that sounds good, but does not teach, nor elevate.

In 1871, a group of young intellectuals later known as the "Generation of 70" gave rise to a movement in Lisbon that advocated arguments around the situation of the Portuguese nation. They talked about issues that interested the contemporary population that had common interests. They planned the Casino Conferences. According to Carlos Reis (2001), it was a "[...] a fundamental initiative promoted by the Generation of 70 (and promoted above all by the charismatic figure of Antero de Quental), the Casino Conferences, in which Eça proclaims Realism as a new form of artistic expression" (REIS, 2001, p. 12).

Among those involved were Antero de Quental, Eça de Queirós, Guerra Junqueiro, Teófilo Braga, Ramalho Ortigão, Oliveira Martins and Jaime Batalha Reis. They defended the idea that political and literary action influenced the way society was conceived. It was a sociocultural transformation designed by writers, some of them linked to journalism. They met to talk about the cultural and political life of Portugal. They planned and organized the Democratic Conferences of the Lisbon Casino, where they discussed topics on literature, politics, education, religion, etc. These conferences were part of a project of cultural, political and social intervention, however they were prohibited by the government of the time. The project was for ten Casino Conferences to be held, but only five conferences took place.

[2] Antônio Feliciano de Castilho was a viscount in the nineteenth century and author of Romanticism. He lost his almost complete sight at the age of six due to measles, so he was an example of overcoming, being admired by fellow writers of his time. He was an influential intellectual and polemicist. As a pedagogist, he was the inventor of the Castilho Method of reading.

THE CONFERENCES OF THE LISBON CASINO

Antero de Quental[3] was the one who headed the group that was leaving for a collective cultural event. According to Carlos Reis (2002), "Antero wanted to dynamize and lead, Eça accepts, deliberately and consciously, the project that we found formulated and that he subscribed to in the program of the Casino Conferences" (REIS, 2002, p. 18). The Generation of 70 helped to compose the history of this important literary phase, first in Coimbra and then in Lisbon. They were unhappy with the national culture and the political moment.

In the spring of 1871, Quental promoted the celebrated Casino Conferences. They managed to hold the first five conferences of the ten planned, in partnership with Eça de Queirós, Manuel de Arriaga, Teófilo Braga, Jaime Batalha Reis, among others. With the ideologies they had, they envisioned the possibility of transforming social issues such as politics, economics and religion in Portugal. The conferences held were: "The Spirit of the Conferences", by Antero de Quental; "Causes of the Decadence of the Peninsular Peoples", by Antero de Quental; "Portuguese Literature", by Augusto Soromenho; "A Literatura Nova" or "Realism as a new expression of art", by Eça de Queiroz; "The Question of Teaching", by Adolfo Coelho. The conferences not held were: "The Critical Historians of Jesus", by Salomão Saragga; "Socialism", by Jaime Batalha Reis; "The Republic", by Antero de Quental; "A instrução prima", by Adolfo Coelho; "The positive deduction of the democratic idea", by Augusto Fuschini.

The Fourth Casino Conference took place on June 12, 1871 and featured a presentation by Eça de Queirós. In it, Eça analyzed the so-called "New Literature", which proposed to conceive Realism-naturalism as a New Expression of Art. According to Massaud Moisés (1975): "Passing through Júlio Dinis, the Portuguese novel finds in Eça de Queirós its great representative within Flaubert-style Realism" (MOISÉS, 1975, p. 186). For Carlos Reis (2002), Eça was a talented cultivator of the aesthetics of detail, which is the subtle strategy of placing a significant element as an aesthetic resource in literary production.

The work of Rosane Gazolla Alves Feitosa, "The Casino Conferences in periodicals, primary sources and literary history", is a collection that brings a rare collection about the Casino Conferences, an event that is more political than literary. The Generation of 70 aspired for the country to renew itself culturally. The newspaper *A Revolução de Setembro*, of June 8, 1871, published on page 2: "The fourth conference that will be held at the Cassino Lisbonense is on New Literature, with Mr. Eça de Queiroz as the speaker" (FEITOSA, 2023, p. 279). Some journalists who

[3] Antero de Quental led the generation of 1870, his grandfather was an important politician from Terceira Island, one of the nine islands of the Azores. He was considered, in a way, rebellious. In the classroom, he belonged to the group of rabbits, those who sat at the back of the room. The ones that sat in the front were called bears. The writer had suffered psychotic episodes of schizophrenia, starting in 1973, at a time when there was practically no medication for the condition. He committed suicide in 1891. Friends considered him generous and humane, so much so that he adopted two daughters of his deceased friend Germano Meireles. He was the master, ideologue and mentor of the conferences of the generation of 70.

published journalistically around Eça de Queirós' explanation were: Alberto de Queirós, Luciano Cordeiro and Pinheiro Chagas.

EÇA DE QUEIRÓS AND THE CONCEPTION OF REALISM-NATURALISM

Among the themes of the Fourth Casino Conference, Modern Literature consisted of investigating society as it is and as it should be, with ideologies that formed currents of thought and reformist ideals. Thus, Reis (2002) clarifies that "[...] the conferences have tried to show that what is at stake here is a vast and global plan of action [...]" (REIS, 2002, p. 18), an action plan that could transform social and cultural practices that involved a collective in crisis. Thus, artistic production was not isolated, as it presented, represented and portrayed the world, united to the realistic ideology that sought to reach the truth. According to the Diário Popular of June 15, 1871:

> Unreadable and venal love, with its dreadful procession of hallucinations, remorse, terrors, debasements, shames, and ruins, appears to our eyes dripping with misery and rottenness, dreadful as a spectre before which one instinctively recoils with repulsion and horror. This is Realism in art, not only because the descriptive process employed by the artist characterizes it, but mainly because of the moral intention of justice and truth that the author imposed on himself and achieved (FEITOSA, 2023, p. 295).

With regard to the artistic moment, Carlos Reis (1999) asserts that Eça de Queirós answered with immaturity the question about what they wanted with Realism, saying that the writer's answer was that they wanted to make photography or caricature of the old bourgeois, sentimental, devout, Catholic, exploitative and aristocratic world.

> It must be said that these words of Eça's suffer from some immaturity, which the writer would try to compensate for in subsequent novels and testimonies; this immaturity is denounced in that purpose of photographic representation of reality and also of the revolutionary emphasis that closes the transcribed passage (REIS, 1999, p. 438).

Portugal was inspired by French literary culture, so Eça was influenced by Honoré Balzac, a French writer who used to make psychological observations of the characters in his novels. The Portuguese writer and Balzac had a detailed, photographic style. The Portuguese nation was closely linked to France, since the Portuguese identified themselves with the French bourgeoisie.

Eça de Queirós[4] wrote – in co-authorship with Ramalho Ortigão – the book "The Mystery of the Sintra Road", being a work about a crime that happened in the city of Sintra. It is the first Portuguese detective novel, also the first book written by two authors, in addition to being a book

[4] Eça de Queirós graduated in Law at the University of Coimbra, in 1866. He practiced law for a short time in Lisbon, as he soon founded and directed the opposition newspaper *Distrito de Évora*. Later, he joined *the Cenaculo* group and worked as a collaborator at *Gazeta de Notícias*, *Jornal da Noite*, *Diário Popular* and *Diário de Notícias*. In 1871, he gave the conference "Realism as a New Expression of Art" at the Lisbon Casino. In 1872, he was appointed consul of the first class in Havana when he entered the diplomatic career through a competitive examination, being ranked first. He published his texts in periodicals before they became volumes. Eça had a critical and reformist spirit.

represented by two of the greatest representatives of Portuguese literature of the second half of the nineteenth century. Among the main Queirosian productions are "The Maias", "The Crime of Father Amaro", "Cousin Basilio", "The Relic", "The Illustrious House of Ramires" and "The Barbs". He published chapters through periodicals that later became volumes.

> Let's go to the ROMANCE. We don't know what it is in Portugal. It only reveals that we have no morality. Adultery is romanticized; the most vile and heinous vices are sublimated; the black and disorderly truth is exposed; the pictures of virtue are not shown; but present-day society is still not as perverse as literature would have it suppose; the novels of Júlio Dinis still have appreciators. And often the authors of these wanton novels are excellent heads of families. The heart is pure, but the spirit and the taste corrupt. Morality is the basis of all literature. Art is the production of the spirit; this is a faculty that is rooted in the soul, and the soul houses love, friendship, and all virtues (FEITOSA, 2023, p. 259).

Of a scientific, descriptive and didactic nature, the naturalist Queirosian novels conquered the public for the way the author used words and the information they transmitted. Eça presented the scientific rationality that leads us to skepticism and relativism, foundations that propose a photographic look at social ills. Worldly problems form the human, so from the deterministic perspective we analyze Juliana's blackmail in "Cousin Basilio", when she makes her employer's adultery with her cousin a foundation to impose her humiliated and wounded ego, leaving Luísa under her cruel submission. In the perspective of Massaud Moisés (1975): "[...] The Queirosian worldview goes little beyond the alcove of a frivolous and hollow bourgeoisie of finis-secular Lisbon" (MOISÉS, 1975, p. 347).

When Eça published "O Primo Basílio", Machado de Assis wrote a harsh critical review of the work in Brazil. He raised variant hypotheses for the work of the Portuguese author, even stating that Eça de Queirós imitated Zola. Machado, as a critic, dismantled works. He said that the Portuguese writer was a disciple of the French writer Émile Zola. He also asserts that "The Crime of Father Amaro" was nothing more than an imitation of the book "The Crime of Father Mouret", by the same French author. However, there is information to prove that Eça de Queirós wrote and published his book first, and the critical judgment of Machado de Assis was considered exaggerated and erroneous. It should be noted that the Portuguese Realism of Eça de Queirós was different from the Brazilian Realism of Machado de Assis.

On the other hand, Machado de Assis also highlighted in his review the strengths of Eça de Queirós. He reports that "O primo Basílio", even though it was the second novel by Eça de Queirós, already showed the maturity of the young author. He reported that the Portuguese writer was at the beginning of his career, but that he recognized his talent and artistic vein. Therefore, Machado's review was far from being considered a devastating criticism. In fact, what happened was a confrontation of two great writers in formative time. It is worth remembering that Carolina, wife of

Machado de Assis, was the sister of the Portuguese writer Faustino Xavier de Novais, a friend of her husband.

It is our knowledge that Eça de Queirós possibly had the influence of the prolific French writer Honoré de Balzac. It should be noted that Eça had a link with Brazil, as he wrote for the newspaper *Gazeta de Notícias*, in Rio de Janeiro. He published texts produced for the Brazilian public. In some of these texts, he reflected on the mediation that the newspaper exerts between the individual and the information.

Eça and Machado get closer when they analyze the social perspectives of their time. However, Machado de Assis was more subtle in his analyses, leaving the reader to draw his own conclusions. Who influenced him was the Irish writer Laurence Sterne. Eça de Queirós went to the last consequences, showing the adultery that happened, the evident exploitation, without subtleties.

In another partnership with Ramalho Ortigão, Eça de Queirós produces "As Farpas", it is the second work of the two friends. The first was "The Mystery of the Sintra Road", which was successful, having been initially published in the Diário de Notícias. Due to the recognition, they decided to release "As Farpas", provoking the state of things, the *status quo* of Lisbon society. Both authors manifested journalistic entrepreneurship, were irreverent, critical and conditioned by Portuguese youth.

THE FOURTH CONFERENCE

Newspapers and journalists covered the Fourth Conference of the Lisbon Casino. The newspapers *Revolução de Setembro*, *Jornal da Noite*, *Diário Popular*, *Diário de Notícias* addressed the event. Alberto de Queirós, Luciano Cordeiro and Pinheiro Chagas explained about the lecturer of the conference.

The comments on the Fourth Conference were about the new literature that was emerging. According to the journalists who covered the Fourth Conference, on June 12, 1871, Eça de Queirós proposed the conception of New Literature and Realism as a New Expression of Art. The democratic conference, whose subject was Modern Literature, had positive and negative reviews published in the periodicals of the time.

THE SEPTEMBER REVOLUTION OF JUNE 13

Alberto de Queirós, brother of the lecturer Eça de Queirós, published his programmatic reflections, exposing a favorable opinion about Eça's conference, asserting that the subjects presented were beautiful, elevated and interesting. He admits that art has a powerful influence on customs and morals, contributing to the realization of justice, which should be the basis of social relations.

> [...] Since art has a powerful influence on morals and morals, it should contribute as much as possible to the realization of justice, the only basis that social relations should have. Nor can it fail to see it this way, because historical evolutions comprehend and encompass within themselves all the manifestations of the human spirit. They produce a philosophy, a politics, they will necessarily produce a literature, an art, because they are a faithful mirror in which all their truth is reflected by the spirit and consciousness of any epoch. Individual action plays an important part in the formation of a great work, but the physical and social environments have left their deep and "indelible" mark on it (FEITOSA, 2023, p. 284).

In *A Revolução de Setembro*, of June 13, Alberto also maintains that he believes that there was no man who exceeded his time, his time, even though he was a genius, and justifies: "Jesus himself did nothing more than obey the current of ideas that dominated his time" (FEITOSA, 2023, p. 284). Therefore, each art and literature had its own moment, that is, one cannot condemn the manifestations of the spirit. In short, what the journalist Eça's brother clarifies is that Greek art cannot be imitated and never will be because it is very difficult to achieve the simplicity of the time of the Greek philosophers, a simplicity that made them glory, with perfect harmony between form and idea, because the ideal of the new generation was to live from infinitely more complex elements.

Furthermore, Alberto de Queirós identifies with Eça's conception of realism: "This is the realism as Eça de Queirós understands it, as I accept it" (FEITOSA, 2023, p. 286), with a view to achieving justice in man and society. For him, the arts are not an isolated fact of society, but something that is linked to its progress and decadence. Literary art has been criticizing temperaments and customs, being a helper of science and conscience. The artist takes everything that encloses the society in which he lives, that is, when in a time or in a country there is corruption in politics, this appears in the form of denunciation in literary art, this is exposed in the form of drama, novel, short story, poetry, having as a noble mission to mirror justice, truth and law.

From Alberto's perspective, there is the question of whether there is a realist art in Portugal, whose answer he himself mentions, about at that time there was not, and that in the works there was a small tendency towards Realism, but it would be an ideal of enlightened and disillusioned criticism, a literature that did not criticize anything was produced. However, there were poems of rare exceptions, such as those of Antero de Quental, Manuel de Arriaga, Guilherme de Azevedo and Bulhão Pato.

> [...] Let us hope that art, being one of the forms that affects the progress of societies, will take its true form with the development of our country, and that we will not be pointed out for the future as relapses and this general law that governs the development of the human spirit. We will not undo the harmony and unity that art will have when it enters this broad and fruitful path. We ended by telling Mr. Eça de Queirós, who at the time he spoke of Romanticism, and who said that he sought to be inspired by ancient ideas, and that they belonged to the past, quoted *Notre-Dame*, by Victor Hugo. It has been forgotten that this man wrote *Les Châtiments* and *Les Misérables* which, if they are not a realistic novel, are a great social epic (FEITOSA, 2023, p. 287).

It should be noted that Eça was inspired by old ideas, he did not despise them, he even mentions the romantic Victor Hugo who, in Alberto's view, had built a social epic with his works. According to Marques Rebelo (1970), Eça is the maximum exponent of Realism in Portugal. He lived in a decadent country, did not belong to parties, "barbed" with Ramalho Ortigão and classified the heterogeneous aggregation of inactivities that cause boredom.

> "[...] This position is reflected in his novels of a realistic nature. It is not that of a destroyer, but that of one who rebelled against misery, injustice and ignorance; of those who loved their country and wanted to see it magnified. Such love is later confessed in another form, sometimes in a pouring idyll, in the best pages of "The City and the Mountains" (REBELO, 1970, p. 152).

Finally, Eça de Queirós' speech at the conference was analyzed by the journalist and brother Alberto as an exhibition that sought the realization of justice in man, so that justice could later be realized in society, understanding that art must have an intimate alliance with philosophy and consciousness. Therefore, individual action has an important part in the formation of great works, because the individual's social environment can leave marks that are not possible to erase. Even if each art and each literature has its own moment, they can fatally leave history. Therefore, there can be progress in the understanding of art, considering the artistic ideal in different ways, respecting the manifestations of the spirit and principles of each artist.

EVENING NEWSPAPER, JUNE 14 AND 15

In *Jornal da Noite*, journalists discuss, between June 14 and 15, that Eça proposed Realism in Portugal not only as a form, but as a content of philosophical basis in the artistic conception of the beautiful, the good and the just. He would paint adultery as immorality embedded in the mores of society.

> He described the Second Empire and its art at length. He said that with the awakening of the public spirit in France, the appearance of Realism coincided. He presented as an example the novel *Madame Bovary*. He presented the theory of Realism: since its conditions should be, 1st take its matter in contemporary life; 2° to proceed by experience, physiology, sciences of temperaments and characters; 3rd to have the modern ideal that governs societies, that is, justice and truth (FEITOSA, 2023, p. 290).

The aforementioned newspaper addressed that corruption and immorality are the shames and ruins of society, immersed in misery: "Art must become realistic or it will be destined to decay" (FEITOSA, 2023, p. 290-291). Eça de Queirós advocates literary art serving the interests of the "world in which it exists", criticizing Romanticism with vividness of words.

Eça spoke about the modern literature of the time, defending the ideas of Realism[5] and burying the romantic literary current in vogue at the time. He recalled the French Revolution of 1789, showing that Romanticism was divorced from the ideas of revolution, justice, freedom and truth advocated by the new literary current it defended, Realism-naturalism, in accordance with the revolutionary ideals of the time. Eça said that the art of the future was realism. In fact, such a focus persists in literary art to this day, especially in contemporary Brazilian literature.

The democratic conferences, of which Eça was one of the speakers, presented revolutionary ideas, developing the theory of justice over art. Eça pondered that art did not appear in society as an isolated fact, but as something closely linked to progress and social decadence. He explained that French literature led civilization to significant changes. He asserted about the state of the art in the period of the first French Revolution, as emphatic and sterile, presenting means that were proper to a counter-revolution. He made reference to the influence of Romanticism on customs and the decadence caused by this literary movement. As for Realism, he presented the moral theory of this movement, which helped the development of the idea of justice in societies, criticizing temperaments and customs, helping in science and in the formation of conscience, proposing that truth and justice can end the actions of the human being.

DIÁRIO POPULAR, JUNE 15

The newspaper *Diário Popular*, of June 15, expounds on the law of modern art in a playful and witty way. It is the new literature analyzing Greek art, classical art and the revolutionary movement of 1830. He affirms that art obeys the law that determines great evolutions of principles, which leads to improvement, elevation and progress. Eça spoke to auditoriums in which the presence of some ladies was noticeable. He was not a democrat, but he was true to his propaganda and his duty. He was the representative of Realism in the Democratic Conference hall, dressed in clothes that expressed formality.

There is the reference to art nouveau as the mother idea of justice. For Eça, Realism in art is characterized as a descriptive process employed by the artist, with the moral intention of justice and truth, which the writer imposes on himself and seeks to achieve it. Here, the moment of denial of art for art's sake is also highlighted, procreating the conventional, the false, the hollow, the lachrymose, the mushy. Realism ceases to be what some falsely suppose, it ceases to be a simple way of exposing

[5] The Realism of Eça de Queirós was for art the moral intention of promoting justice and truth. For example, "The Crime of Father Amaro" where there is an exposition of the problem of priestly celibacy, since a priest is a human being, has his desires. Or in "Cousin Basilio" where there is the problem of adultery and the blackmail of the governess. In "The City and the Mountains", the encounter with nature can be more synonymous with happiness than wealth and modernity.

the trivial, the boring, the photographic, because one cannot falsify reality. Therefore, Realism is for Eça the form by the essence, it is the process by the doctrine.

CONSTITUENT PARTY, OF JUNE 15

The newspaper *Partido Constitunte*, of June 15, reports that Eça spoke at the fourth democratic conference to show, through words, his as yet unknown talent as an ingenious and brilliant writer. He spoke with "[...] Serenity of spirit, a lot of eloquence, a lot of elegance and softness of phrase. His style is of a graceful, delicate and natural simplicity, which pleases and holds the audience [...]" (FEITOSA, 2023, p. 299). It should be noted that he always had at hand a rich and varied cloak of words to involve the audience in his inspired idea, to deal with the conference of modern literature, to present the idea of art as it should be understood in a world transformed by the spirit of revolution. It was a theory of abundant arguments, exemplified with lucid exposition and critical sense.

In *The Constituent Party*, there is also a considerable reference to ideas: "Just, great and generous ideas will survive false principles" (FEITOSA, 2023, p. 300). In fact, such ideas have survived in literary art to this day. The entire auditorium was amazed by the speaker's competence in exposing his ideas while still in his "green years" at the time.

In the second half of the nineteenth century, the characteristic feature of individuality and originality was no longer useful, because it was a simplistic imitation of the past. The false principles of faith and charity that lead to ridicule will be exchanged for just ideas of a strong, studied and applied intelligence. Eça was considered young for so much erudition, ardent imagination and a spirit of lucid criticality, to the point of leaving the auditorium in awe, he received prolonged applause.

DIÁRIO DE NOTÍCIAS, JUNE 15

The newspaper *Diário de Notícias*, of June 15, reports that Eça presented pure language, yet forming sentences with elegance. Taken from his discourse, he argued about modern literature, about art and the theory of justice, explained about the revolution of the permanent fact, analyzing terms such as politics, economics, ethics, system, mechanism and form, mentioning the revolution that is understood by an aesthetic principle.

> Art appears linked to all social movements, determined by permanent causes, and accidental or historical causes: permanent ones derive from the soil, climate, race, to the influence of which the artist has to obey fatally; the accidental ones are taken from a certain order of areas that form the various historical periods, which determine customs, and which also subject the artist to his despotism (FEITOSA, 2023, p. 303).

Furthermore, the artist cannot become exempt from the influence of the environment in which he lives, as well as from the customs of his time and the state of the spirits. Each historical era offers

an idea about art, for example, ancient Greece when it valued the beautiful man from a physical point of view, valuing the outer plane, to the detriment of the inner plane, neglecting moral improvement and good morals.

What is expressed is that the artist is at the mercy of the influence of the environment in which he lives. It is also necessary to think that each age emits its ideal of what is beautiful in art. There is criticism of the imitation and copying of romantic literary art, in need of change. Writers cannot flee terrified of their time.

There is a veiled criticism of greed, which does not act in favor of denouncing the ills of society in literary art: "[...] exploits the people, selfishness, the love of money, are the watchword in all branches of activity" (FEITOSA, 2023, p. 305). Finally, he proposes Realism as "the art of the present and the future". Then, Eça exemplifies that famous novels such as Eurico, the Cistercian Monk, the Youth of D. João V and the Arco de Santa Anna sin by being art outside the present time: "Art must correct and teach" (FEITOSA, 2023, p. 305), aiming at a moral end. This is what it all says: to try the regeneration of morals through art, aspiring to the beautiful and the good, through the condemnation of vice and the aggrandizement of work and virtue.

THE SEPTEMBER REVOLUTION OF JUNE 16

In the Folhetim of the newspaper *A Revolução de Setembro*, of June 16, Luciano Cordeiro praises his friend Eça, and also leaves some criticism when he believes that Eça praises too much the ideas of art and revolutionary ideals only of France, abandoning the Greeks and the rest of Europe, such as Shakespeare, Goethe, Luther and so many other idealists with their different strands. It was not only praise in favor of Eça, on the occasion of his participation in the Fourth Casino Conference, as someone who loves Realism, thus completely in disagreement with his own previous ideas. He also remembers Shakespeare, a work of social criticism close to current Realism (from the nineteenth century) already written so long ago, also remembering Michelangelo's brush, all to contradict Eça at the aforementioned conference.

Luciano Cordeiro approaches the literary lecture on which Eça presented from a didactic purpose, talking about the struggle of advertising for literary regeneration, of reason that makes serious scientific criticism, with the movement of modern ideas. He points out that it has long been affirmed at the conference that in the periodical and in the book there are certain principles that imply a certain literary communion. And social life finds in art an exclusion that persists, premeditated, systematic, being a social synthesis of the work that aspires to the spirit of revolution. There are three phases: "the *true* in science, the *just* in consciousness, the *beautiful* in art" (FEITOSA, 2023, p. 308). Finally, he summarizes the fatal notion of the natural and historical

environment influencing the individual, emphasizing the good criticism about which there is no vanity by saying that in Portugal there is no conference on Naturalism.

It should be noted that the naturalist movement had objectivity as its main element. Contrasts were made to the canon when they manifested critical sense and scientific vision, with solidity and harmony in the face of the doctrine that emerged. They made use of legal theory, of the permanent fact that was invasive and caused pride in the societies of that time. They described the souls of the Platonic lovers who, from a constellation of Eden, said that the theory they dealt with was beautiful. However, the theory of the new generation was more beautiful, because the issue was not beauty, but the truth, the positive proof. And what would revolution be? An abstraction, a generalization, an ideal that merges to substantiate and contradict itself.

Cordeiro reports on the nature of any nature to be defined, especially that of the pure idealist theory, the theory of the just, the true, the exclusive, the intolerant who denied beauty in art, an item that the revolution dethrones. Social law consists of evolution to transform natural law, transforming thinking, action, and life. It is a great complexity that encompasses biology with its spontaneous generations, the sociological current of human efforts, together with the theory of free will: "Everything has a positive, natural, fatal reason for being: if it is missing or if it has ceased to exist, the *fact* does not progress or the *fact* falters. Look at the incendiary Commune and the Empire-Caesar" (FEITOSA, 2023, p. 309). Consequently, the art of the French Revolution addressed the First Empire, the Restoration, the Second Empire, reinforcing its critique. The revolutionary movements of Germany, England, and Europe were silenced.

> Luther forgotten, Shakespeare forgotten, and even closer to us, Goethe, forgotten too. The *encyclopedists themselves* can almost be said to have been forgotten, and only France was talked about: France replaced not only Europe, but the world. Criticism suffers from this: the friend himself would suffer; the great social elements are not isolated with impunity in explanation and critical appreciation (FEITOSA, 2023, p. 309-310).

Eça de Queirós was known by the readers of the newspaper *Diário de Notícias*, especially because they were accomplices of the famous production "The Mystery of the Sintra Road", where there are elegant descriptions that have the collaboration of Ramalho Ortigão. The Portuguese authors of that time had the influence of Gustave Flaubert who, in accordance with what Roland Barthes (1984) mentions, produced a narrative fabric due to its size and care in detail. Barthes (1984) states that in Flaubert it is possible to verify that the aesthetic objective of description is still very strong: "In *Madame Bovary*, Rouen's description (real referent, let's say) is subject to the tyrannical limitations of what is necessary to call the aesthetic plausible [...]" (BARTHES, 1984, p. 91). Finally, the most exact considerations made in the Rouen model, as seen by Flaubert, remain the same.

DIÁRIO DE NOTÍCIAS, JUNE 19

To the *Diário de Notícias*, on June 19, Pinheiro Chagas expounds on the revelation of Eça de Queirós' beliefs and Realism in correlation with "Madame Bovary", the materialism of art, sentimental education, moral truths, among others. Chagas reveals that he would take into account Eça's talent, clarifying that the author would be one of the most notable figures in Portuguese literature. However, he criticizes what he was able to evaluate from the summary that the newspapers made of Eça's lecture: "Which does not prevent it from being completely in disagreement with many of the ideas he expressed there" (FEITOSA, 2023, p. 312). In addition, he asserts that he is not sure if Eça himself is completely in favor of his opinion in his speech, supposing that deep down not even the author can agree with what he said.

> Mr. Eça de Queirós was convinced that Realism was his idol, he adopted that official religion, he was baptized in that church, he had Gustavo Flaubert as his godfather, from time to time he confesses to praying the creed out loud..., but, as much as he tells me, I still persuade myself that he does not often go to mass (FEITOSA, 2023, p. 312).

The realist movement inscribes its flag with the barbarism of the good "réalisme", a French reality, advocating one of the great purposes of art, which is the study of human nature through consciousness, to investigate psychological issues. It did not consist in creating a work other than Molière or Shakespeare, but in exposing what is in the hidden human heart, revealing the most hideous desires and passions of the human being, plus the restless investigation of psychological truths.

> [...] Has he not exonerated them in the immortal figures of Juliet, Othello, Hamlet, Lady Macbeth, Richard III, and King Lear, and has he not then compelled them to manifest themselves in their most varied aspects, not letting a single one of those flashes escape which illuminate to the most intimate recesses the mysterious depths of the human soul? (FEITOSA, 2023, p. 313).

Realism dared to photograph the tragedy of everyday life, pointing to the rigid inflexibility of character, evidencing the deep psychological state in relation to stormy passions. Love becomes only an excitement of the senses, being held hostage to the violent affections of passion. Science brings knowledge of new pathologies to the domains of medicine and it is up to the arts to demonstrate scientific discoveries. In "Madame Bovary", Flaubert asserts, with a clinical eye, that man can move with pulsations that provide feverish states, driven by love or ambition.

> The adultery in Madame Bovary is indeed presented under a repellent aspect, but I did not suppose that the author found in it a high moral intention. He saw a loathsome disease and described it coldly and crudely. Emma is the sensual woman in all her brutality. Feydeau's Fanny still wins in perversion; this is the female yahou of *Gulliver's Travels* transplanted to the refinements of modern civilization. Beneath those silks, that elegant language, there are only the bestial instincts. Love in these women and men is purely physical, and it was only

> from this point of view that realists studied it. *Fanny* and *Madame Bovary* are two cases of forensic medicine (FEITOSA, 2023, p. 313).

Pinheiro Chagas criticizes Eça and defends the romantics: "They were the ones who had the audacity to scrutinize the intimate arcana of the human heart" (FEITOSA, 2023, p. 314). According to the journalist, materialist Realism reaches the sublimity of ridicule. The conclusion he reaches is that all kinds of Realism are repugnant because they lack light, moral light. He also asserts that Eça "does not let himself be blinded by the motto of the realists" (FEITOSA, 2023, p. 315), but accepts that Eça has enormous artistic-literary virtues.

Consequently, Realism proclaimed itself as an idolater of reality, and the sentiments it expressed were often false. The French writer Gustave Flaubert indicates moral education based on the impressions of a hero who hoped to love a pure and chaste woman, but a contradiction occurs that is difficult to explain. On the same side, "Eça de Queirós possesses the literary qualities most incompatible with the defects of *Realism*. He is a poet and a thinker" (FEITOSA, 2023, p. 315). The Portuguese author ponders that the habit of considering the passage of things historically makes him renounce the excessive anxiety that agitates hearts and spares disappointments. For him, consolation and hope are never lacking.

In short, Pinheiro Chagas did not intend to refute the ideas of Eça de Queirós, as he considers that this would be absurd, not least because he did not attend the conference, however, he reports that Eça adopted this flag that is fearless and has defects. He also declares that art for art's sake is a disastrous principle, because art must have the constant investigation of truth.

THE SEPTEMBER REVOLUTION OF JUNE 20

For the newspaper *A Revolução de Setembro*, of June 20, moral truths do not consist in the materialism that teaches them, nor even in the Realism that discovers them: "[...] Realism does not know passion, which for it is nothing more than the excitement of the senses. Realism knows passion, studies it, and determines the cases in which it is legitimate or false" (FEITOSA, 2023, p. 317). This delimits materialism as a propeller of moral truths. There is criticism of the ideas of Pinheiro Chagas' Realism and defense of Eça about what he said at the Fourth Casino Conference. Pinheiro Chagas acted in this way because he "professed another literary creed" (FEITOSA, 2023, p. 317), which is why he has a false idea about Realism. In Realism, the defense of the true is linked to the value given to science, to the defense of the just, linked to the value given to consciousness, and to the defense of beauty, linked to the value given (by realists) to art.

THE SEPTEMBER REVOLUTION OF JUNE 24

Again, we return to the programmatic reflections of Luciano Cordeiro, published in *A Revolução de Setembro*, of June 24, which deal with the conclusion of Eça's lecture. He states that the pamphletists of that time were anemic lyricists, who only prayed for the breviary of the "Review of the Two Worlds", subjects with thoughts entangled in a continuous dream that explain what has happened and what is about to happen. Cordeiro also remembers the rogues and hypocrites in the face of social rot and alludes to the social dissolution of France and exposes his indignation because of the "rotten Society of the Second Empire". Here the political struggle of the time is shown, the first signs of the political clash between monarchists and republicans.

> More than one guy has lately abandoned *Murtinho* in the noble resolution of writing the *History of the war*, in some neighborhood of Lisbon a *History of the Commune* is being prepared, and every day he sees one or another young man abandon with commendable abnegation his little Parisian novels to offer the men who now lead France the most salutary advice and to indicate to the world the course that should be followed (FEITOSA, 2023, p. 322).

Cordeiro also mentions the sadness of those times and says that they were happy because they had reasons to smile. The writers of this generation learned to laugh at vain joys, at passing moments, at the ideas they formed of the things of the world. They turned society inside out, photographing and denouncing ills, such as: adultery, exploitation of man by man, among other things. They felt that the movement adopted by the generation of the 70s would be the "giant of the century". They would make photographs with which they would dissect existence, that is, nothing would go unnoticed. According to them, Flaubert dissected the figure of women and went even further, but he did not do everything, since women contemporary to them were not really that way. They claim that the French writer was unaware of the passion of the serialists.

> The friend wants art to have an essentially didactic lesson, but in what does it encode its teaching? In presenting ourselves with what is, leaving it to our will, establishing a kind of free examination for what should be. Flaubert makes a kind of dissection, a novelistic attempt at psychological study, cold, severe, *realistic* they say. He puts a human mannequin on stage and describes in detail the cords and springs that move it (FEITOSA, 2023, p. 323).

Realism expresses the intimate connection of literature with science and consciousness. He works with what is natural, spontaneous and fatal. In it, art is art and, for it to be true, it must be spontaneous and natural: "The *fatum* of modern art is made of human nature, social and historical environments, institutions, science" (FEITOSA, 2023, p. 324). So, the first condition of art is spontaneity. It is believed that idealized truth has a fruitful and positive purpose.

Furthermore, Naturalism is called the last broad and positive formula, where criticism is not imposed, but sedimented. The art of Greece, medieval art, Shakespearean Naturalism and the

Realism of the idealists are criticized, in addition to the writers of the press, of the field of journalism, innovated.

> [...] We suppress history by pamphlet, we do not admit retrospection, idealization – look, I do not say idealism; –hysterical. Naturalism in the broadest sense explains the art of all epochs up to the ambiguous false art of today, and announces the positive art of the future. In Naturalism Realism fits and above all science is at ease. Not everything that is *real* is *true*, you know, but nature is the *truth* (FEITOSA, 2023, p. 324).

The divergences of worldly life were exposed, through a crudeness that consisted in the disrespect for the embellishing talent of things. It was the framing of moral deviation, explicitly based on the human search for the satisfaction of natural desires, which cause bitterness, sadness, and frivolity. In counterpoint, there is pride, vanity and arrogance. Writers did not allow themselves to go backwards, they idealized the hysterical Naturalism, they explained the art of all ages by art, which was becoming at that time ambiguous and false. They sought the positive art of the future, especially that which is at the discretion of science. They started from the conception that everything that is real is true, and nature reveals the truth. The new generation became revolutionary, proposing that literary art should approach photography, with denunciations of social problems such as deviation of character, breaking with the ultra-romantic molds.

A new artistic-literary order emerged through Realism. It is noted that "Science does not harm art" (FEITOSA, 2023, p. 324), as the Romantics thought, because art has to be spontaneous and natural to be true, with Naturalism being the last positive and broad formula: "In Naturalism Realism fits and science is at ease" (FEITOSA, 2023, p. 324 and 325), nature is what reveals the truth. At the end, Luciano Cordeiro reminds his friend Eça of "the sadness and bitterness" they feel, caused by their frivolity.

In summary, the literary "old guard" clashed head-on with the Portuguese literary avant-garde, which emerged with an inflamed ideal in favor of the new literary art, within the new mold of writing poetic art, or a work of fiction impregnated with denunciations of the "rottenness" of Portuguese society at the time, manifested in the form of adultery, blackmail, corruption, oppressors against the oppressed and so many other forms of immorality.

Young literati won the debates that lasted days, months and years, and their artistic-literary ideals endure to this day in contemporary literature, especially in Brazil today, influencing the production of novels and poems in favor of the construction of a more just, humane, liberal, understanding society, in defense of the marginal of society, of female emancipation, of society against the violence of organized crime, in defense of the environment. For example, books where the current situation of the indigenous people and the environment is clearly defended, so necessary for us to be able to know the situation of minority groups.

Finally, we must conclude with the statement of Carlos Reis (2001) regarding Realism and Naturalism, stating that Naturalism is the partial superimposition and complement of Realism, with literary Realism being an anti-romantic movement, with the tendency to describe and observe contemporary reality, submitted to a critical and reformist propensity. Naturalism, on the other hand, "[...] will seek to explain it on the basis of working methods with positivist and determinist roots" (REIS, 2001, p. 11). So, from this scientific propensity, it is noted as a result "[...] a literature that is often artificial and captive to an ideological doctrine that is too restrictive in terms of themes and literary strategies that it has consented to" (REIS, 2001, p. 11). However, the initiative promoted by the generation of 70, promoted by Antero de Quental, made Eça proclaim – at the Casino Conferences – Realism as a new form of artistic expression.

The Fourth Conference brought the light that was missing to illuminate the ideas of the literate and arts-loving public of the time. Most newspapers and journalists praised the young lecturer Eça de Queirós, and one of the exceptions was Pinheiro Chagas, who criticized Realism and Eça voraciously. The young intellectuals proposed a social epic, with significant changes in the way of thinking, manifesting the art that comprises literature, the novel, the drama, poetry with an intimate alliance with the judgments of conscience, in the development of the spirit of justice, truth, law, forming the science of conceiving contemporary art to them. They sought the intimate life, which is the matter of art, in the struggles, sufferings and works of society. They studied the social environment in the light of psychology, observing customs in a real way, even in search of self-knowledge, inciting self-improvement.

In short, Eça proposed art in general, and literary art in particular, to act as an instrument in the defense of justice and truth in the society in which it was inserted. It was literary art committed to acting with the highest ideal in defense of freedom, against the lack of morals and the excesses of some members of society who felt powerful to the point of acting without commitment to justice and truth.

CONCLUSION

Despite the prohibitions coming from the Portuguese government, the Casino Conferences of 1871 were successful. Even though only five conferences were held out of the ten planned, they had the effect of conceiving the first signs of Realism-naturalism in Portugal. The main contents of the conferences were published in newspapers, with comments from the journalists who wrote the reports. Our focus was on the Fourth Conference, which had Eça de Queirós as a speaker.

In an attempt to be succinct, we comment on some items addressed in the book "The Casino Conferences in Periodicals: Primary Sources and Literary History", a collection by Rosane

Gazolla Alves Feitosa, in order to obtain an idea of the history of the aforementioned Portuguese literary phase in which periodicals played an important role.

Several newspapers covered the event in that period, highlighting the talent of the young Eça, such as *A Revolução de Setembro*, *Jornal da Noite*, *Diário popular*, *Partido Constitunte*, *Diário de Notícias*. All sparing no praise for the young writer, an excellent orator. Luciano Cordeiro, Pinheiro Chagas and Alberto de Queirós gave their opinions, exposing their point of view in relation to the ideas defended by Eça de Queirós. Pinheiro Chagas was the most critical.

We seek to analyze the vision of Realism and Naturalism through those who remained alive in the memory of these literary moments that influenced Modernism. Through literary criticism, we comment on these literary movements that strongly marked European literature, especially because, during the Casino Conferences, they articulated on new literary expressions.

In the second half of the nineteenth century, the young people of the new generation formed an informal group of intellectuals who, leaving the universities, left for the journalistic and literary fields, seeking to analyze the society of their time with a realistic lens. The charismatic Antero de Quental headed the group that included Eça de Queirós, the speaker of the Fourth Casino Conference. According to Carlos Reis (2002), the Eça who emerged in this period was eclectic: "[...] in whom it is possible to distinguish at least three appeals: the Eça who yields to the appeal of what is decadent, morbid and even immoral" (REIS, 2002, p. 25); in addition to this, there was Eça who interpreted the rigors of Naturalism with an impressive overload of details; and there was also another Eça with a plastic bent for good and for bad, with excessive descriptions.

Therefore, this article intended to discuss the conception of Realism-naturalism made during the lecture of the writer Eça de Queirós, at the Fourth Conference of the Casino, which was analyzed through different perspectives, and published in newspapers of that time. Through the reading and analysis of texts that some journalists wrote about Queiroz's explanations, we noticed that there was an approach to the history of Portuguese Realism-naturalism. There was even a certain focus on the culture and political history of Portugal in the nineteenth century.

The relativism that seeks to explain the origin of everything, the determinism of the environment forming the individual, the foundations of rationality, all with reflections within serialized narratives, provide an essentiality that expresses the university ideal that guided the young writers of the 70's generation. They were strengthened and purified over time, bringing to Lisbon the knowledge gathered in the years of university studies.

They bowed to the exchange of ideas, with intellectual adventures from an original and new angle. The public had the opportunity to experience the sometimes unpublished contexts of life, without prejudice to the analysis of the narratives that became known to critics. Thus, Realism-naturalism was well represented by Eça de Queirós, an author with unique literary qualities.

REFERENCES

1. Assis, M. de. (1994). *Crônicas Escolhidas - Folha de S. Paulo*. São Paulo: Ática.

2. Barthes, R., Bersani, L., Hamon, P., Rifaterre, M., & Watt, I. (1984). *Literatura e Realidade (que é o realismo?)* (T. Coelho, Trad., 1ª ed.). Lisboa: Publicações Dom Quixote.

3. Cabral, A. (1945). *Eça de Queiroz: a sua vida e a sua obra* (3ª ed.). Lisboa: Bertrand.

4. Campato Jr., J. A. (2016). *Manual de Literaturas de Língua Portuguesa: Portugal, Brasil, África Lusófona e Timor-Leste*. Curitiba: CRV.

5. Feitosa, R. G. A. (2023). *As Conferências do Cassino em Periódicos Fontes Primárias e História Literária*. São Paulo: Editora Unesp Digital.

6. Franchetti, P. (2000). Eça e Machado: críticas de ultramar. *Cult*, IV(38), 48-53.

7. Grieco, A. (1959). *Machado de Assis*. Rio de Janeiro: José Olympio.

8. Mello, M. (1911). *Eça de Queirós: A obra e o homem*. Rio de Janeiro: Livraria Italiana e Tipografia Ramori & Cia.

9. Mello, M. (2020). *Vivos na memória*. São Paulo: Companhia das Letras.

10. Matos, Á. C. (2022, agosto 39). Revisitando "As farpas" de Eça de Queirós e Ramalho Ortigão. *Jornalíssimo*. Disponível em https://jornalissimo.com/historia/revisitando-as-farpas-de-eca-de-queiros-e-ramalho-ortigao-1/. Acesso em: 10 abr. 2024.

11. Moisés, M. (1975a). *A Criação Literária* (7ª ed.). São Paulo: Editora da Universidade de São Paulo (USP).

12. Moisés, M. (1975b). *A Literatura Portuguesa* (13ª ed.). São Paulo: Cultrix.

13. Queirós, E. (2016, setembro 11). Um gênio que era um santo. In A. Duarte (Ed.), *Escola Portuguesa – Leituras de Língua e Literatura* (Vol. 1, pp. 09-11). Wordpress. Disponível em https://escolapt.wordpress.com/2016/09/11/leituras-eca-de-queiroz-um-genio-que-era-um-santo/. Acesso em: 10 abr. 2024.

14. Rebelo, M. (1970). *Antologia Escolar Portuguesa* (1ª ed.). Rio de Janeiro: Editora GB.

15. Reis, C. (2000). Eça de Queirós e a Estética do Pormenor. In *Congresso de Estudos Queirosianos – IV Encontro Internacional de Queirosianos* (Vol. 1, pp. 13-30). Instituto de Língua e Literatura Portuguesas – Faculdade de Letras, Coimbra: Almedina.

16. Reis, C. (2001). *História da Literatura Portuguesa – O Realismo e o Naturalismo* (Vol. 5). Lisboa: Publicações Alfa.

17. Reis, C. (1999). *O Conhecimento da Literatura – Introdução aos Estudos Literários* (2ª ed.). Coimbra: Almedina.

18. Salgado Jr., A. (1930). *História das Conferências do Casino* [Tese de doutorado, Faculdade de Letras, Universidade do Porto]. Lisboa: Tipografia Cooperativa Militar. Disponível em

https://www.livrariaferreira.pt/livro/historia-das-conferencias-do-casino/. Acesso em: 10 abr. 2024.

19. Quental, A. (1865). *Bom senso e bom gosto – Carta ao Excelentíssimo Senhor Antônio Feliciano de Castilho*. Biblioteca Digital de Literatura de Países Lusófonos. Coimbra: Imprensa da Universidade. Disponível em https://www.literaturabrasileira.ufsc.br/documentos/?action=download&id=130209. Acesso em: 10 abr. 2024.

Foundation of a millenary civilization: Egypt and the origin of mathematical measurement systems

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ABSTRACT

The ancient civilization of Egypt left a significant mark on the evolution of mathematical concepts, which is of great importance due to its influence in this field. The ancient Egyptian mathematicians set important precedents in modern mathematics through their innovative approach to solving practical problems that for their time must have been of a high level of complexity.

In ancient Egypt, applications were based on the decimal system and mathematical techniques were fundamental in their day-to-day life. The Egyptian numeral system, which used multiples of ten and hieroglyphics, offered an efficient way to perform mathematical operations and manage resources. This non-positional approach, in which the value of a symbol did not depend on its position in the number, allowed the Egyptians to perform complex tasks related to accounting, architecture, and astronomy.

One of the main characteristics of Egyptian mathematics was its use in everyday life. In administrative management, notaries employed the ten-number system to record assets and taxes on papyrus documents, simplifying resource management and accounting. In the planning and construction of monuments such as the pyramids, Egyptian mathematics was instrumental as precise calculations were needed to measure and calculate proportions. In addition, the decimal system was used in astronomy for the tracking of astronomical cycles and the elaboration of calendars, which was essential for agriculture and religious structure.

Egypt's mathematical heritage not only had an impact on contemporary mathematical practice, but also developed the foundation for future advances in this discipline. Despite being non-positional, the Egyptian numeral system, with its base 10 and methods of calculation, impacted later numerical systems and the advancement of Greek and current mathematics. Research of Egyptian mathematical papyri, such as the Rhind Papyrus, reveals how.

Keywords: Trigonometry, Algebra, Geometry, Development, Knowledge.

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INTRODUCTION

The structural essence of this work is based on the investigation of unpublished events that support the origin of Egyptian civilization, considering its cultural development, mathematical contributions and how the path of development of this society is marked.

The foundation of a millenary civilization arises from the need to understand how our ancestors were able to adapt and create a "Decimal" system, sets of basic and complex operations that today are the basis of the great diversity of calculations that we find in mathematics.

It can be said that the main unknown for our time is how we can project mathematics in a more efficient, interactive way and with easy internalization of concepts?, It is from this collected information where we can define edges that allow us to understand concepts and have a better focus of analysis on the integral development of this civilization, that in all their splendor and walk recorded all their contributions on a natural sheet called papyrus.

Writings so valuable that, even in our times, they are the records that support the theory and concept of algebra, trigonometry, arithmetic and above all that give rise to the emergence of other exact sciences.

The study of Foundation of a Millennial Civilization focused on the decimal system seeks to publicize the positive impact of the mathematical legacy interposed by Egypt and how this civilization was able to create a system of measurements for interaction with mathematical problems that allows us to have a close relationship with a mathematics model of greater functionality and better understanding.

It is intended that this work will serve as cultural and mathematical enrichment, being used as a didactic resource in the learning process of future generations.

THEORETICAL OR CONCEPTUAL ELEMENTS

Egypt, located in northeastern Africa, flourished around 3100 B.C. until the conquest of Alexander the Great in 332 B.C. During this period, the Egyptians developed an advanced civilization with a practical focus on mathematics, geared primarily toward solving everyday and administrative problems. The need to measure land, build monuments, and manage resources encouraged the development of basic mathematical concepts.

In relation to the latter, we can see that the Egyptians were faced with the need to perform calculations and consider dimensions to, for example, carry out their constructions, a situation that challenged them to find some way to represent the quantities used. In addition, we see that they represented the figures used in papyri, giving them a use, mainly related to geometry and arithmetic.

One of the contributions that represents them the most is the base 10 system or decimal system, which means that it was based on multiples of ten. He used different symbols to represent

units (1 to 9), tens (10 to 90), and hundreds (100 to 900). This decimal base is the same as that used in most modern numbering systems, demonstrating the enduring influence of the Egyptian system.

This system influenced subsequent mathematical developments, since it allowed them to perform arithmetic, trigonometric and algebraic operations, as well as calculate areas, taxes and other types of values that were undoubtedly beneficial for them to establish their foundations as a society.

By understanding the mathematical legacy of decimal development, we can appreciate the importance and ingenuity of ancient civilizations that manage to project the development of mathematics today. America (1927)

STRUCTURE OF THE EGYPTIAN DECIMAL SYSTEM

HIEROGLYPHIC NUMBERING

The decimal system in Egypt was expressed by hieroglyphics, with specific symbols representing units, tens, hundreds, thousands, and so on. Key symbols include:

- **1**: Represented by a vertical cane (𓏺).
- **10**: Represented by a coiled rope (𓎆).
- **100**: Represented by a papyrus scroll (𓍢).
- **1,000**: Represented by a lotus (𓆼).
- **10,000**: Represented by a pointing finger (𓂭).
- **100,000**: Represented by a tadpole (𓆑).
- **1,000,000**: Represented by a man with his arms raised (𓁨).

Numbers were formed by combining these symbols, with hieroglyphs arranged repetitively to indicate multiples. For example, the number 2,345 would be written by combining two lotuses (2 x 1,000), three papyrus scrolls (3 x 100), four coiled ropes (4 x 10), and five upright sticks (5 x 1).

NON-POSITIONAL SYSTEM

A distinguishing feature of the Egyptian decimal system is its non-positional nature. Unlike the modern decimal system, where the value of a digit depends on its position, in the Egyptian system each symbol had an absolute value, regardless of its position. This means that the calculation required the sum of the values of the symbols, which made the mathematical operations more laborious and manual. Neugebauer (1969)

APPLICATIONS OF THE DECIMAL SYSTEM IN EGYPTIAN LIFE

ACCOUNTING AND ADMINISTRATION

The decimal system was central to the administration of the Egyptian state, particularly in the accounting of goods, tribute, and forced labor. Scribes used this system to record quantities of grain, livestock, and other resources in administrative papyri. This practice was so widespread that mastery of the decimal system was essential for those involved in public administration.

CONSTRUCTION AND ARCHITECTURE

The use of the decimal system was crucial in the planning and construction of monuments such as pyramids and temples. Architects and workmen used this numbering to measure and calculate proportions in structures, ensuring precision in dimensions. Documents such as the Rhind Papyrus contain mathematical problems related to geometry, reflecting the practical use of the decimal system in construction.

ASTRONOMY AND CALENDAR

The Egyptians also applied the decimal system in astronomy, particularly in the observation of astronomical cycles and the creation of calendars. They used units of measurement based on multiples of ten to calculate time and predict astronomical phenomena, which was vital for agriculture and religious organization.

DEVELOPMENT OF EGYPTIAN MATHEMATICS

MATHEMATICAL PAPYRI

The Rhind Papyrus (c. 1650 BCE) and the Moscow Papyrus are two of the most important documents showing the use of the decimal system in mathematical problems. These texts contain arithmetic and geometric problems solved by the decimal system, which evidences an advanced knowledge of mathematics on the part of the Egyptian scribes.

- **Unit Fractions**: Although the Egyptian decimal system did not use a place zero, it did use unit fractions, in which each fraction was expressed as the sum of fractions with a numerator one (e.g., 2/3 = 1/2 + 1/6). This system of fractions was fundamental in calculations related to the distribution of resources and the division of land.

CALCULATION AND GEOMETRY

The Egyptians solved geometric problems, such as the calculation of areas and volumes, using their decimal system. For example, they could calculate the area of a circle or the volume of a

cylinder by applying formulas that were derived from empirical observations and precise measurements. Neugebauer (1969b)

CULTURAL IMPACT AND LEGACY OF THE EGYPTIAN DECIMAL SYSTEM

INFLUENCE ON OTHER CULTURES

The Egyptian decimal system influenced the number systems of other ancient cultures. Through trade and conquest, elements of Egyptian numerals were passed on to neighboring civilizations, such as the Greeks and Romans. Although these systems evolved into more advanced positional systems, the decimal base and some symbols continued to be used.

LEGACY IN MODERN MATHEMATICS

Although the Egyptian decimal system did not survive in its original form, its legacy lives on in the history of mathematics. The concept of base-10 counting is a universal practice that probably originated, at least in part, in Egyptian mathematics. In addition, the calculation methods and geometric approximations developed by the Egyptians laid the foundation for Greek mathematics and, ultimately, modern mathematics. Neugebauer (1969b)

ADVANCES THANKS TO THE DECIMAL SYSTEM TODAY:

- ✓ **Advanced Mathematics:**

Calculus: The decimal system allowed the development of differential and integral calculus. Decimal notation simplified the representation of fractional and decimal numbers, making it easier to work with boundaries, derivatives, and integrals.

Algebra: The adoption of the decimal system allowed for the development and expansion of algebra. Equations and algorithms became more manageable and accurate.

- ✓ **Data Science:**

Measurement and Statistics: The ability to represent and manipulate numbers with decimal precision improved accuracy in data collection and analysis, essential for statistics and scientific research.

Computation: The decimal system is the basis for the representation of numbers in computer systems and databases, although computers operate internally in binary. Decimal to binary conversions are critical to data processing.

- ✓ **Astronomy:**

Orbit Calculation: Accurate calculations of planetary orbits and celestial motions depend on the use of the decimal system to handle large numbers and small fractions.

Observations and Measurements: Decimal notation allowed to improve the accuracy of astronomical measurements and in the representation of astronomical data.

- ✓ **Physics:**

Theory of Relativity and Quantum Mechanics: Decimal precision is crucial in the equations of modern physics, such as those of Einstein's general relativity and the equations of quantum mechanics.

Scientific Instrumentation: Accuracy in the measurement and calibration of scientific instruments benefits from decimal notation.

- ✓ **Engineering:**

Design and Construction: The decimal system allows precision in the design and construction of structures, machinery, and technology. Accurate calculations are essential for civil, electrical, and mechanical engineering.

Simulations and Models: Decimal notation facilitates the development and analysis of complex computer simulations and models.

- ✓ **Economy and Finance:**

Economic Models: Economic and financial models use the decimal system to represent and analyze economic data, perform financial calculations, and develop economic theories.

Accounting: Decimal notation is critical in accounting to perform accurate calculations and handle large volumes of financial data.

- ✓ **Chemistry:**

Concentrations and Reagents: Decimal notation is used to express concentrations of solutions, proportions of reactants, and in stoichiometry calculations.

In short, the decimal system has been essential for the advancement of science and technology. Its ability to accurately represent numbers has facilitated developments in mathematics, physics, engineering, and other scientific disciplines. Davis (2017b)

DESCRIPTION

The elaboration of this research work is based on a requirement to opt for the Bachelor's degree in Mathematics from the National University of Panama and was prepared with the participation of professors Alcibiades Medina, Eliecer Cedeño and Narciso Galástica, professors of the University of Panama. It is elaborated in chapters that represent the most relevant aspects of the Egyptian legacy in mathematical development, such as its historical evolution, decipherment of mathematical contributions made and a wide relevance to the great scientific contribution and culture of these regions to our society.

The limitations presented in the research can be referred to the lack of texts completely focused on this type of mathematical advances or mathematical epistemology.

The need to be able to expand the research as a result of the lack of translation of certain writings in papyri that undoubtedly when we reach solve we could find a greater number of contributions that will finally continue to support the value of Mathematics as the mother of all sciences.

FINAL THOUGHTS

Through the hieroglyphic writing system, the ancient Egyptians developed a set of mathematical knowledge that ranged from simple arithmetic calculations to geometry problems and advanced algebra. Their decimal numbering system, based on base-10 figures, allowed them to perform complex operations and solve practical problems of everyday life.

Mathematics in ancient Egypt was applied in various fields, such as administration, architecture, commerce, and astronomical measurements. His approach to solving problems and his determination to fix concrete concepts demonstrate a deep mastery of mathematical applications, considering a particular way of synthesizing procedure.

It is crucial to reaffirm that Egypt's mathematical legacy influenced later civilizations, such as ancient Greece, India, China, etc., and laid the foundation for the development of mathematics in the world. Concepts such as statistics, congruences, and solving systems of logarithmic and quadratic equations have their roots in the mathematical contributions of ancient Egypt.

As a general recommendation, I consider that it is necessary to highlight and at the same time expand the importance of the decimal numbering system used in educational writing and how it is applied in calculations and measurements, in addition to exploring and analyzing the content of the papyri, focusing on those that contain mathematical records that allow us to take our work as mathematicians to a didactic level full of broad methodologies in order to generate a more efficient impact in this science.

REFERENCES

1. Gillings, R. J. (1972). *Mathematics in the time of the Pharaohs*. Dover Publications.

2. Chace, A. B., Manning, L. S., & Archibald, R. C. (1927). *The Rhind Mathematical Papyrus, Free Translation and Commentary*. Mathematical Association of America.

3. Neugebauer, O. (1969). *The Exact Sciences in Antiquity*. Dover Publications.

4. Imhausen, A. (2016). *Mathematics in Ancient Egypt: A Contextual History*. Princeton University Press.

Comparison of the use of NBR 8800 and NBR 14762 for the flexural design of steel profiles

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ABSTRACT

This article presents the results of the flexural strength of rolled steel profiles with U shape and cold-formed sections of UDCS section (single plate bent U), using the procedures of the Brazilian Standards ABNT NBR 8800:2008, which deals with the design of steel structures and composite steel and concrete structures for buildings, and ABNT NBR 14762:2010, which addresses the design of steel structures consisting of cold-formed profiles. For the analysis, routines were developed in the Microsoft Excel software, which made it possible to make comparisons regarding the feasibility of using the two types of profiles. The comparisons included groups of profiles of the two types, selected based on similar cross-sectional areas and close moments of inertia, in order to establish more precise parameters for the analysis. The results indicated that, although both profiles meet specific resistance requirements, the normative procedures of the two ABNT standards applied are not directly comparable to each other, which implies the need for different considerations for each type of profile when evaluating its structural feasibility. This difference highlights the importance of a careful analysis in the choice of profiles to be used in structural projects, considering the specificities and limitations of each standard.

Keywords: Resistant bending moment, Comparison, ABNT standards.

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INTRODUCTION

Civil Construction needs technical and material knowledge that makes it more efficient, with higher quality and better performance. Metal structures have gained great prominence in recent decades because they are produced with prefabricated elements, ensuring speed and precision in the execution of the works.

Cold-formed steel profiles (PFF), also known as bent sheet profiles, are manufactured using machines, at room temperature, from flat steel sheets that are deformed into sections that are conveniently shaped and specific to the project needs.

These profiles are widely used in civil construction due to their cost-effectiveness, lightness, ease of handling and transport, especially in works that have small spans and loads. Examples of the use of these profiles are: purlins, scaffolding, ceiling frames, stringers, among others (RODRIGUES, 2000).

However, as a consequence of the large width-thickness ratio of the plane elements that compose their cross-section, these profiles are more susceptible to local buckling, which does not mean, in general, exhaustion of the resistant capacity of the profile, according to Javaroni and Gonçalves (2002). The theory of plate instability allows the prediction of critical loads, as well as the analysis of post-critical behavior, which can be done through the concept of effective width.

In particular in the case of UDCS (single sheet metal bent U) profiles, the protagonist of this article, the ABNT technical standard that governs their design and verification is NBR 14762:2010.

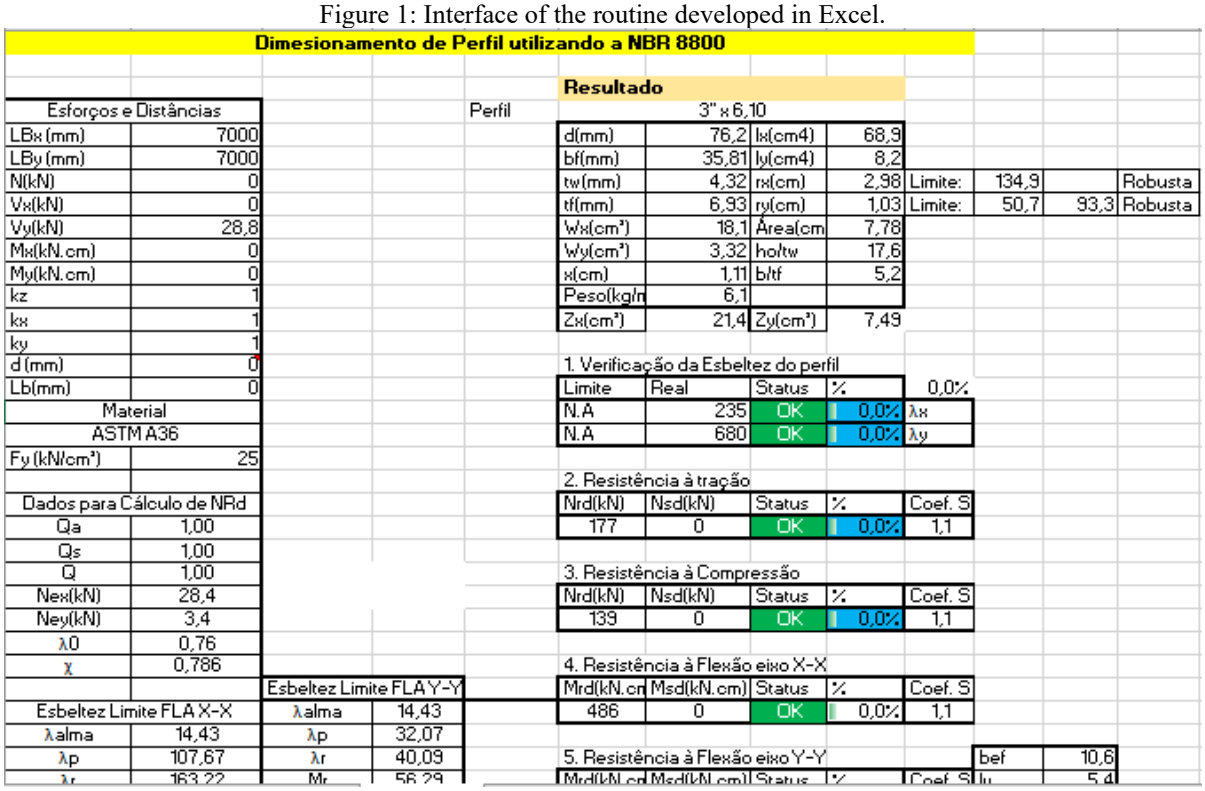
Rolled profiles are produced by rolling steel blocks, in a continuous rolling system. These profiles are parts that have great structural efficiency, mainly due to the manufacturing method and the fact that they are single pieces, without welds, with a slight inclination in the constitution of the AL elements (tables and flaps), and can be found under different geometries: H, I, U, etc. It is ideal for applications that require greater strength and robustness, being used mainly as beams, columns and bracing elements.

For this article, the profile used was the American standard, type U, whose design and verification will be governed by the ABNT NBR 8800:2008 standard.

METHODOLOGY

A routine was developed in the Excel software, with all the necessary calculation procedure to calculate the flexural strength, using the NBR 8800:2008 standard for the rolled profiles as sources. On the side of the UDCS profiles, manual calculations were performed based on NBR 14762:2010, checked with the help of the DimPerfil4.0 software. In figure 1, you can see the spreadsheet for rolled profiles.

Figure 1: Interface of the routine developed in Excel.



Dimesionamento de Perfil utilizando a NBR 8800

Esforços e Distâncias	
LBx (mm)	7000
LBy (mm)	7000
N(kN)	0
Vx(kN)	0
Vy(kN)	28,8
Mx(kN.cm)	0
My(kN.cm)	0
kz	1
kx	1
ky	1
d (mm)	0
Lb(mm)	0
Material	
ASTM A36	
Fy (kN/cm²)	25
Dados para Cálculo de NRd	
Qa	1,00
Qs	1,00
Q	1,00
Nex(kN)	28,4
Ney(kN)	3,4
λ0	0,76
χ	0,786

Esbeltez Limite FLA X-X	
λalma	14,43
λp	107,67
λr	163,22

Esbeltez Limite FLA Y-Y	
λalma	14,43
λp	32,07
λr	40,09
Mr	56,29

Resultado

Perfil: 3" x 6,10

d(mm)	76,2	Ix(cm4)	68,9				
bf(mm)	35,81	Iy(cm4)	8,2				
tw(mm)	4,32	rx(cm)	2,98	Limite:	134,9		Robusta
tf(mm)	6,93	ry(cm)	1,03	Limite:	50,7	93,3	Robusta
Wx(cm³)	18,1	Área(cm	7,78				
Wy(cm³)	3,32	ho/tw	17,6				
x(cm)	1,11	b/tf	5,2				
Peso(kg/m	6,1						
Zx(cm³)	21,4	Zy(cm³)	7,49				

1. Verificação da Esbeltez do perfil

Limite	Real	Status	%	0,0%	
N.A	235	OK	0,0%		λx
N.A	680	OK	0,0%		λy

2. Resistência à tração

Nrd(kN)	Nsd(kN)	Status	%	Coef. S
177	0	OK	0,0%	1,1

3. Resistência à Compressão

Nrd(kN)	Nsd(kN)	Status	%	Coef. S
139	0	OK	0,0%	1,1

4. Resistência à Flexão eixo X-X

Mrd(kN.cm	Msd(kN.cm)	Status	%	Coef. S
486	0	OK	0,0%	1,1

5. Resistência à Flexão eixo Y-Y

					bef	10,6
Mrd(kN.cm	Msd(kN.cm)	Status	%	Coef. S	Iy	5,4

Research source: The author.

THEORETICAL FOUNDATION

APPLICATION OF ABNT NBR 8800:2008[3] TO FLEXED PROFILES

To verify the resistant capacity of the U-laminated metal profiles to the stresses requesting bending, the following limit states were evaluated: Local Web Buckling (FLA), Local Table Buckling (FLM) and Lateral Torsional Buckling (FLT).

LOCAL BUCKLING WITH TORSION (FLT)

In this verification, the U profiles were considered to have no lateral containment. Soon we have $L_b \neq 0$, and L_b the length is unlocked.

Determination of the slenderness coefficient of the torsional profile (λ): $\lambda = \frac{L_b}{r_y}$.

This value must be compared with the slenderness value $\lambda_p = 1,76\sqrt{\frac{E}{f_y}}$ or

$\lambda_r = 1,38\frac{\sqrt{I_y J}}{r_y J \beta_1}\sqrt{1+\sqrt{1+\frac{27C_w\beta_1^2}{I_y}}}$, respectively, the slenderness at plasticizing and at the beginning of flow.

[3] The items and annexes described below refer to this standard.

Once these slenderness parameters were defined and item G.2.1 was available, it was possible to find the resistant bending moment of calculation by checking three cases:

Case 1, compact profile ($\lambda \leq \lambda_p$): $M_{Rd} = \frac{M_{pl}}{\gamma_{a1}}$, where $M_{pl} = Z.f_y$ and $Z = \int |y| dA$.

Case 2, semi-compact profile ($\lambda_p \leq \lambda \leq \lambda_r$): $M_{Rd} = \frac{C_b}{\gamma_{a1}}\left[M_{pl} - \left(M_{pl} - M_r\right)\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p}\right]$, with $M_r = \left(f_y - \sigma_r\right)\cdot W$.

Case 3, slender profile ($\lambda > \lambda_r$): $M_{Rd} = \frac{M_{cr}}{\gamma_{a1}}$, where $M_{cr} = \frac{C_b \pi^2 E I_y}{L_b^2}\sqrt{\frac{C_w}{I_y}\left(1 + 0{,}039\frac{JL_b^2}{C_w}\right)}$, $\beta_1 = \frac{\left(f_y - \sigma_r\right)\cdot W}{EJ}$ and $C_w = \frac{t_f\left(b_f - 0{,}5t_w\right)^3\left(d - t_f\right)^2}{12}\left[\frac{3\left(b_f - 0{,}5t_w\right)t_f + 2\left(d - t_f\right)t_w}{6\left(b_f - 0{,}5t_w\right)t_f + \left(d - t_f\right)t_w}\right]$

LOCAL BUCKLING OF THE SOUL (FLA)

Using table G.1, it is initially verified whether the profiles have a non-slender web, i.e., whether the local slenderness parameter λ is less than or equal to the λ_r (slenderness at the beginning of the flow), for the limit state of FLA. Otherwise, the profile would be slender and the verification would be conducted by the expressions in Annex H.

From table G.1, notes 1 and 6, and from annex H of the standard, it was possible to obtain the expressions presented below.

Determination of the coefficient of slenderness of the soul (λ): $\lambda = \frac{h}{t_w}$.

This value must be compared with the slenderness values at the plasticization and at the beginning of the flow, that is, respectively: $\lambda_p = 3{,}76\sqrt{\frac{E}{f_y}}$ or $\lambda_r = 5{,}70\sqrt{\frac{E}{f_y}}$.

Once these slenderness parameters were defined and item G.2.2 was available, it was possible to find the resistant bending moment of calculation by checking two cases[4]:

Case 1, compact profile ($\lambda \leq \lambda_p$): $M_{Rd} = \frac{M_{pl}}{\gamma_{a1}}$, where $M_{pl} = Z.f_y$ and $Z = \int |y| dA$

(LANDESMANN, 1999).

Case 2, semi-compact profile ($\lambda_p \leq \lambda \leq \lambda_r$): $M_{Rd} = \frac{1}{\gamma_{a1}}\left[M_{pl} - \left(M_{pl} - M_r\right)\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p}\right]$,

[4] For FLA, the case for slender web profiles does not apply to U-shaped sections. Item G.2.2

where $M_r = f_y \cdot W$.

LOCAL TABLE BUCKLING (FLM)

Determination of the slenderness coefficient of the table (λ): $\lambda = \frac{b}{t}$.

This value shall be compared with the appropriate slenderness values at the plasticization and at the beginning of the flow, i.e., respectively: $\lambda_p = 0,38\sqrt{\frac{E}{f_y}}$ or $\lambda_r = 0,83\sqrt{\frac{E}{(f_y - \sigma_r)}}$.

Once these slenderness parameters are defined for the table, the resistant bending moments of calculation are obtained with the same expressions of item G.2.2, presented above, plus the third case[5]:

Case 3, Slender profile ($\lambda > \lambda_r$): $M_{Rd} = \frac{M_{cr}}{\gamma_{a1}}$, where $M_{cr} = \frac{0,69E}{\lambda^2} W_c$

All the expressions mentioned above refer to the axis of greatest inertia, since this is the preponderant axis for the results.

To ensure the validity of the elastic analysis, the resisting bending moment of calculation $M_{Rd} \leq 1,5 \cdot \frac{W.f_y}{\gamma_{a1}}$, where W is the modulus of elastic resistance, given by $W = \frac{I}{y}$, where *y is* the greatest distance from the GC of the section to the most compressed or most tensile fiber.

After calculating the resistant moments by the three limit states, the smallest of them is then adopted.

APPLICATION OF ABNT NBR 14762:2010[6] TO FLEXED PROFILES

To verify the resistant capacity of the UDCS metal profiles to the stresses requesting bending, the calculations were based on two methods: the Effective Width Method (MLE), in items 9.2.2 and 9.2.3, and the Effective Section Method (MSE), in items 9.7.2.b, 9.8.2.1.b and 9.8.2.2.b. According to Silva (2008), the recommended method is that of effective widths, as it is a classic procedure used for the design of cold-formed profiles, in which each constituent element of the profile (core and tables) is analyzed separately based on the concept of effective widths.

The calculation resistant bending moment (M_{Rd}) shall be adopted as the lowest value calculated in accordance with paragraphs 9.8.2.1, 9.8.2.2 and 9.8.2.3, as presented below.

[5] For FLM, the case for slender web profiles does not apply to U-shaped sections. Item G.2.2
[6] The items and annexes described below refer to this standard.

START OF RUNOFF OF THE EFFECTIVE SECTION

$M_{Rd} = \frac{W_{ef} \cdot f_y}{\gamma}$, where W_{ef} it is calculated in the effective width method (MLE), according to 7.1.1, considering the stress σ calculated for the ultimate limit state of the start of flow of the effective section.

To calculate the $\lambda_p = \left(\frac{W \cdot f_y}{M_l} \right)^{0,5}$, it is necessary to determine the bending moment of elastic local buckling M_l, given by the following expression: $M_l = k_l \frac{\pi^2 E}{12\left(1-v^2\right)\left(\frac{b_w}{t}\right)^2} W_c$, where $k_l = \left(\frac{b_f}{b_w} \right)^{1,843}$.

LATERAL BUCKLING WITH TORSION

For the resistant bending moment of calculation referring to lateral buckling with torsion, a section between laterally contained sections is taken, and is given by the expression:

$$M_{Rd} = \frac{\chi_{FLT} \cdot W_{c,ef} \cdot f_y}{\gamma}.$$

The stress σ calculated for the ultimate limit state of lateral buckling by torsion, in the MLE, according to 5.1.1, adopts: $\sigma = \chi_{FLT} f_y$. To calculate the $\lambda_p = \left(\frac{\chi_{FLT} \cdot W \cdot f_y}{M_l} \right)^{0,5}$, it is necessary to calculate the M_l one presented above.

Since $\lambda_o = \left(\frac{W_c \cdot f_y}{M_e} \right)^{0,5}$ the slenderness index of the profile is reduced and M_e the bending moment of lateral buckling with torsion for bending around the axis of symmetry (x is the axis of symmetry), $M_e = C_b \cdot r_0 \left(N_{ey} \cdot N_{ez} \right)^{0,5}$ with C_b =1.0, when there is no guarantee of impediment to warping; the radius of rotation given by $r_o = \left[r_x^2 + r_y^2 + x_0^2 + y_0^2 \right]^{0,5}$. The axial force of global flexural elastic buckling and the axial force of global torsional elastic buckling, according to item 9.7.2.1, are obtained respectively by: $N_{ey} = \frac{\pi^2 E I_y}{\left(K_y L_y\right)^2}$ and $N_{ez} = \frac{1}{r_0^2} \left[\frac{\pi^2 E C_w}{\left(K_y L_y\right)^2} + GJ \right]$.

The transverse modulus of elasticity, *G*, was adopted as 77GPa according to the recommendations of the standard.

DISTORTIONARY MOMENT

According to NBR 14762:2010, in item 9.3 it is stated that the distortional moment for UDCS profiles does not present criticality, so this verification can be waived.

PROFILE SELECTION

The geometric properties of the cross-sections for the various rolled and cold-formed profiles used for this proposal are presented in tables 1 and 2, respectively. These properties are referred to the nominal cross-sectional dimensions of commercially available profiles.

For the calculation of some of the geometric properties of the sections, ShapeBuilder 11.0 software was used. The software easily allows the creation and customization of cross-sections, providing advanced geometric properties that are difficult to obtain manually.

The colors indicated in Tables 1 and 2 relate the groups of profiles that were compared, taking into account the similarity by area and by moment of inertia.

For example, the blue color relates the 3" x 6.10 laminated profile to 5 UDCS profiles: 100 x 40 x 2.65, 100 x 40 x 4.75, 100 x 50 x 2.25, 100 x 50 x 4.25 and 100 x 75 x 3.35.

Table 1:P Geometric properties of the laminated profiles.

Laminated Profile	A (cm^2)	I_x (cm^4)	Iy (cm^4)	It (cm^4)	xg (cm)	R_o(cm)	Cw (cm^6)
3''x6,10	7,78	68,90	8,20	0,96	1,11	14,0	65,4
4''x8,04	10,10	159,50	13,10	1,43	1,16	4,1	193,0
6''x12,20	15,50	546,00	28,80	2,74	1,30	19,0	1040,0

Research source: The author.

Table 2:P Geometric properties of UDC profiles.

UDCS Profile	A (cm²)	I_x (cm⁴)	Iy (cm⁴)	It (cm⁴)	xg (cm)	R_o(cm)	Cw (cm⁶)
U 100x40x2,65	3,88	57,7	5,84	0,06	-0,99	4,6	94,90
U 100x40x4,75	7,81	109,4	11,11	0,58	-1,1	4,5	158,80
U 100x40x6,30	10,03	133,3	13,80	1,32	-1,17	4,4	178,08
U 100x50x2,25	4,33	68,5	10,85	0,07	-1,35	5,3	175,69
U 100x50x4,25	7,91	118,9	19,09	0,47	-1,45	5,2	283,21
U 100x50x6,30	11,29	161,0	26,28	1,49	-1,55	5,1	348,67
U 100x75x3,35	8,01	136,5	47,5	0,30	-2,42	7,2	749,36
U 100x75x4,25	10,03	167,6	58,82	0,60	-2,46	7,1	897,07
U 100x75x6,30	14,44	230,3	82,41	1,90	-2,57	7,0	1153,50
U 125x50x3,35	7,17	164,6	16,68	0,27	-1,26	5,8	415,60
U 125x50x4,75	9,94	221,6	22,57	0,74	-1,32	5,7	532,16
U 125x75x6,30	16,02	388,1	89,70	2,11	-2,35	7,4	2025,90
U 150X50X8,00	17,89	518,5	36,23	3,80	-1,35	6,1	1108,60
U 150X75X6,30	17,59	595,9	95,69	2,32	-2,17	7,8	3201,50
U 200x75x4,75	15,88	924,0	81,85	1,19	-4,14	9,0	5304,40

Research source: The author.

RESULTS AND DISCUSSIONS

With the routine developed in the Excel software, the flexural strengths in the x and y axes were calculated for the chosen rolled profiles, these results are shown in Table 3.

Table 3A: Cold rolled profiles resistant moments.

Profile	MRx(kN.cm)	MRy(kN.cm)
3''x6,10	324,92	113,18
4''x8,04	526,39	157,16
6''x12,20	1913,64	278,18

Research source: The author.

To design the flexural strength of the bent sheet metal profiles, the calculations were made following the calculation procedures of the respective standard. These results are shown in Table 4.

Table 4A: Resistant moments of UDC profiles.

Profile	MRx (kN.cm)	MRy (kN.cm)
U 100x40x2,65	113,65	45,51
U 100x40x4,75	304,23	83,65
U 100x40x6,30	442,57	106,59
U 100x50x2,25	131,77	42,49
U 100x50x4,25	359,94	116,1
U 100x50x6,30	580,22	166
U 100x75x3,35	404,76	136,48
U 100x75x4,25	580,22	229,85
U 100x75x6,30	920,89	361,79
U 125x50x3,35	299,78	92,32
U 125x50x4,75	511,4	133,99
U 125x75x6,30	1195,13	380,02
U 150X50X8,00	1508,31	216,92
U 150X75X6,30	1733,63	391,56
U 200x75x4,75	1950,48	312,16

Research source: The author.

Two parameters were taken into consideration: area and moment of inertia (in relation to the axis of symmetry). Thus, for a laminated profile, three UDCS profiles were determined to have areas close to each other and two to have moments of inertia close to the respective reference laminated profile.

For the 3" x 6.10 U laminated profile, some analyses were performed. As for the area**,** Table 5 shows the preponderant results of cold-formed profiles with areas close to the laminated profile.

Table 5: Resistant moments, area and moment of inertia.

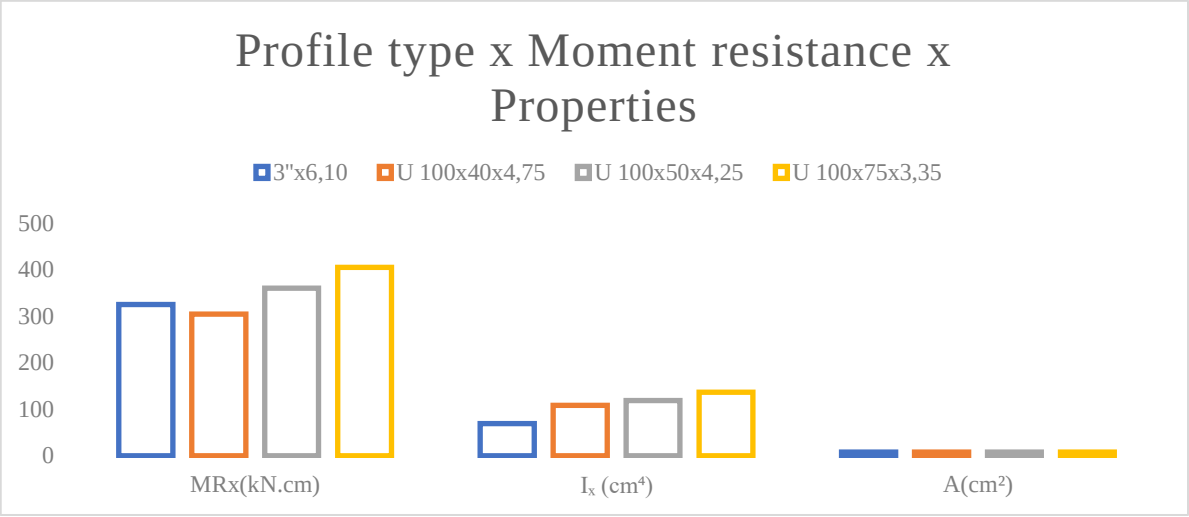
Profile Type	Profile	MRx(kN.cm)	I_x (cm⁴)	A(cm²)
Laminate	3"x6,10	324,92	68,90	7,78
Simple UDC	U 100x40x4,75	304,23	108,44	7,80
	U 100x50x4,25	359,94	118,86	7,90
	U 100x75x3,35	404,76	136,48	8,00

Research source: The author.

Analyzing the data presented in Table 5, it is noted that when with approximately equal areas, the preponderant factor for determining resistance is the moment of inertia. Thus, when the moment of inertia of this bent sheet profile is up to 40% greater than a rolled one, the rolled profile has a higher flexural strength, for all the other profiles tested values above 40% of the moment of inertia of the rolled stock, they have lower resistance of the rolled in relation to those of bent sheet.

Analyzing Figure 2, it is observed that, for nearby areas and distinct moments of inertia, there is little variation in resistance. Which leads us to question the advantage of using the laminated profile.

Figure 2: Comparison of resistant moments according to profile.



Research source: The author.

Table 6 shows that the folded sheet metal profiles have a lower cost/kg ratio when compared to the rolled sheet for very similar strength values.

Table 6: Resistant moments and cost/kg.

Guy	Profile	R$/kg	MRx(kN.cm)
Laminate	3"x6,10	5,16	324,92
Simple UDC	U 100x40x4,75	4,27	304,23
	U 100x50x4,25	4,27	359,94
	U 100x75x3,35	4,48	404,76

Research source: The author.

For the same laminated profile above, some UDCS profiles were also analyzed regarding the moment of inertia. In table 7, the results are when the moment of inertia of the rolled profile is considered to be close to the moment of the folded sheet profiles.

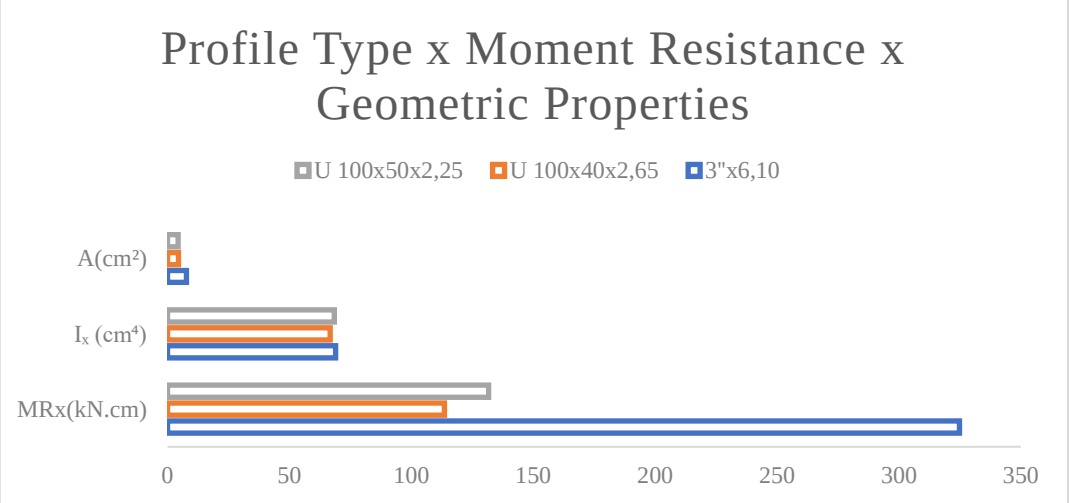
Table 7:Resistant moments, area and moment of inertia.

Profile Type	Profile	MRx(kN.cm)	I_x (cm⁴)	A(cm²)
Laminate	3"x6,10	324,92	68,90	7,78
Simple UDC	U 100x40x2,65	113,65	66,75	4,54
	U 100x50x2,25	131,77	68,47	4,33

Research source: The author.

Table 7 shows that, for profiles with close moments of inertia, the geometric properties have a significant influence, because when the cross-sectional area of the rolled profile is approximately 40% smaller, the resistance becomes about 60% smaller.

Figure 3: Comparison of resistant moments according to profile.



Research source: The author.

When evaluating nearby moments of inertia and nearby areas, the moment does not vary significantly, as shown in Figure 3. However, when the area is significantly smaller, the resistance decreases considerably, so the desired resistance is not met.

Table 8: Resistant moments and cost/kg.

Guy	Profile	R$/kg	MRx(kN.cm)
Laminate	3"x6,10	5,16	324,92
Simple UDC	U 100x40x2,65	4,60	113,65
	U 100x50x2,25	4,47	131,77

Research source: The author.

Analyzing Table 8, it can be seen that the cost and weight of bent sheet profiles are much lower than the rolled one, but as it has a much lower resistance, it could not replace a rolled profile.

For the laminated profile U 4" x 8.04, some analyses were made. As for the area, Table 9 shows the preponderant results of the cold-formed profiles with areas close to the 4" x 8.04 U laminated profile.

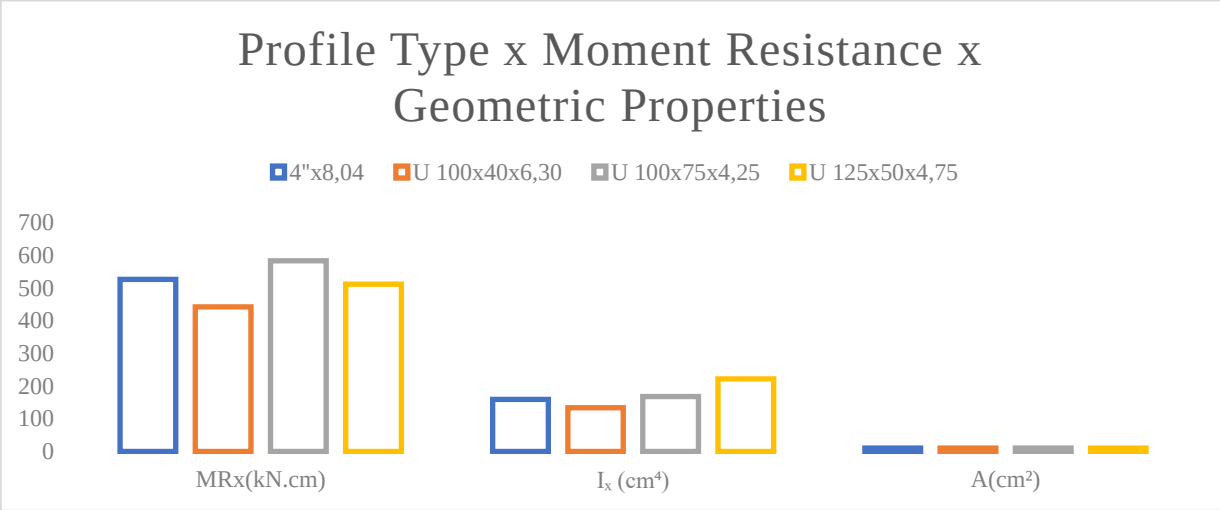
Table 9: Resistant moments, area and moment of inertia.

Profile Type	Profile	MRx(kN.cm)	I_x (cm⁴)	A(cm²)
Laminate	4"x8,04	526,39	159,50	10,10
Simple UDC	U 100x40x6,30	442,57	133,31	10,03
	U 100x75x4,25	582,75	167,60	10,03
	U 125x50x4,75	511,4	221,56	9,94

Research source: The author.

Analyzing profiles with a similar area, shown in Table 9, it is found that folded sheet metal profiles that have a lower moment of inertia have lower resistance. Thus, when the moment of inertia of this bent sheet metal profile is about 5 % higher than a rolled one, the bent sheet metal profile has a higher flexural strength. It is also noted that when there is a variation in the dimensions of the web height and the width of the table, there is a variation in the flexural strength, but this variation was not evaluated in this study.

Figure 4: Comparison of resistant moments according to profile.



Research source: The author.

Analyzing Figure 4 above, it is observed that, for nearby areas and different moments, there is little variation in resistance.

Table 10: Resistant moments and cost/kg.

Guy	Profile	R$/kg	MRx(kN.cm)
Laminate	4"x8,04	4,81	526,39
Simple UDC	U 100x40x6,30	4,18	442,57
	U 100x75x4,25	4,78	582,75
	U 125x50x4,75	5,06	511,4

Research source: The author.

Table 10 shows that only one UDCS profile can overcome the laminate strength and present a very close price/kg ratio.

Comparisons were also made with the 4"x8.04 laminated profile and some UDCS profiles, comparing them as to the moment of inertia.

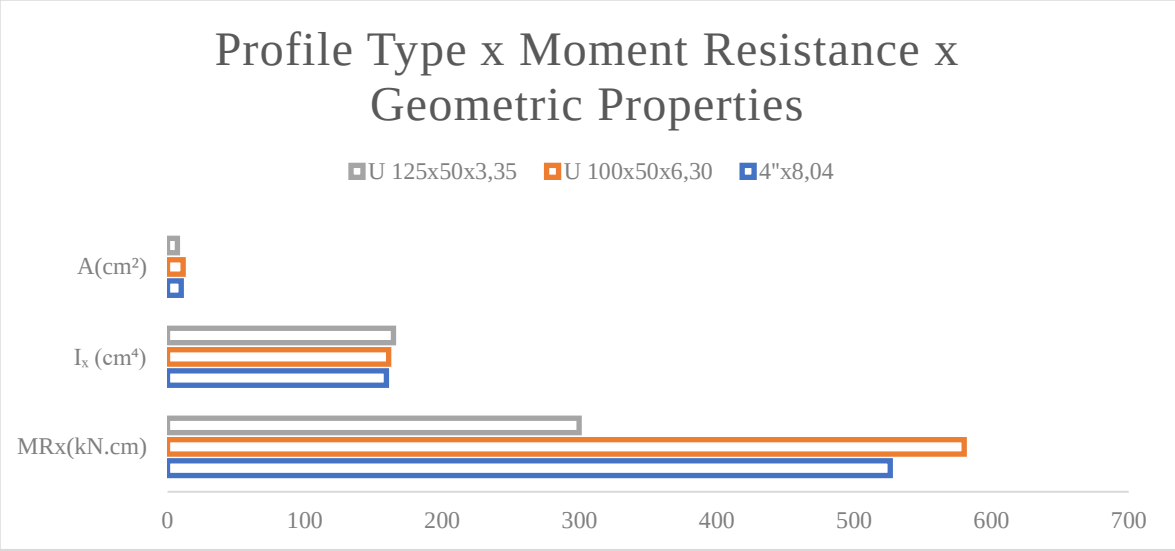
Table 11: Resistant moments, area and moment of inertia.

Profile Type	Profile	MRx(kN.cm)	I_x (cm^4)	A(cm^2)
Laminate	4"x8,04	526,39	159,50	10,10
Simple UDC	U 100x50x6,30	580,22	161,01	11,29
	U 125x50x3,35	299,78	164,58	7,20

Research source: The author.

With regard to close moments of inertia, it is noted that if the area of the UDC is smaller than that of the laminated profile, there is a lower resistance. If the area is larger, the resistance is also larger, according to Table 11.

Figure 5: Comparison of resistant moments according to profile.



Research source: The author.

In Figure 5, it can be seen that when moments of inertia close and areas are evaluated, the moment does not vary significantly, but when the area is significantly smaller, the resistance decreases considerably.

Table 12A: Resistant moments and cost/kg.

Guy	Profile	R$/kg	MRx(kN.cm)
Laminate	4"x8,04	4,81	526,39
Simple UDC	U 100x50x6,30	4,52	580,22
	U 125x50x3,35	4,46	299,78

Research source: The author.

According to Table 12, the UDCS 100 x 50 x 6.30 profile presents a better cost-benefit ratio, since it is lighter, less expensive and still has a higher resistance when compared to the laminate.

For the 6" x 12.20 U laminated profile, some analyses were made. As for the area, the data are shown in Table 13.

Table 13: Resistant moments, area and moment of inertia.

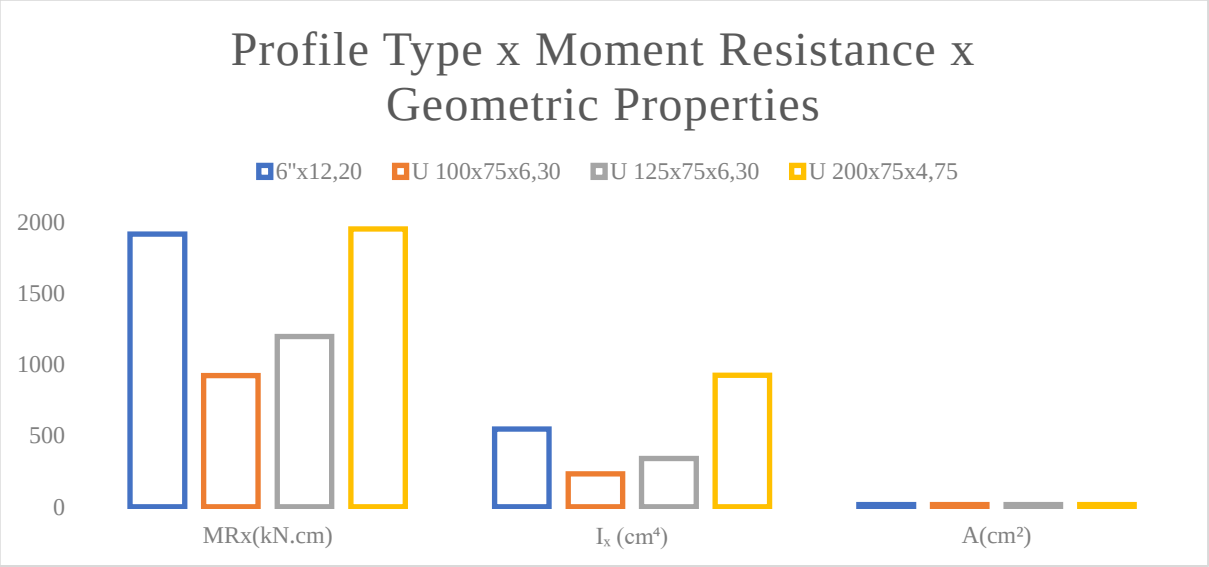
Profile Type	**Profile**	**MRx(kN.cm)**	**I_x (cm^4)**	**A(cm^2)**
Laminate	6"x12,20	1913,64	546,00	15,50
Simple UDC	U 100x75x6,30	920,89	230,25	14,44
	U 125x75x6,30	1195,13	338,06	16,02
	U 200x75x4,75	1950,48	923,97	15,88

Research source: The author.

Analyzing Table 13, it can be seen that, for areas close to the rolled profile in relation to the folded sheet profile, when the moment of inertia is lower, the resistance is also lower. The UDCS profile only overcomes the laminate strength if the moment of inertia is about 70% greater.

Observing Table 13 and Figure 6, it can be seen that the area of the profiles presents a small variation, so the U profile 200 x 75 x 4.75, which has the closest area, presents a very coherent resistance, showing that, for nearby areas and different moments, there is little variation in resistance.

Figure 6: Comparison of resistant moments according to profile.



Research source: The author.

Table 14 shows that all folded sheet metal profiles have a lower cost/kg than the rolled one, but only one reaches a similar strength.

Table 14A: Resistant moments and cost/kg.

Guy	Profile	R$/kg	MRx(kN.cm)
Laminate	6"x12,20	4,81	1913,64
Simple UDC	U 100x75x6,30	4,32	920,89
	U 125x75x6,30	4,42	1195,13
	U 200x75x4,75	4,28	1950,48

Research source: The author.

For the same laminated profile above, some UDCS profiles were also analyzed for the moment of inertia.

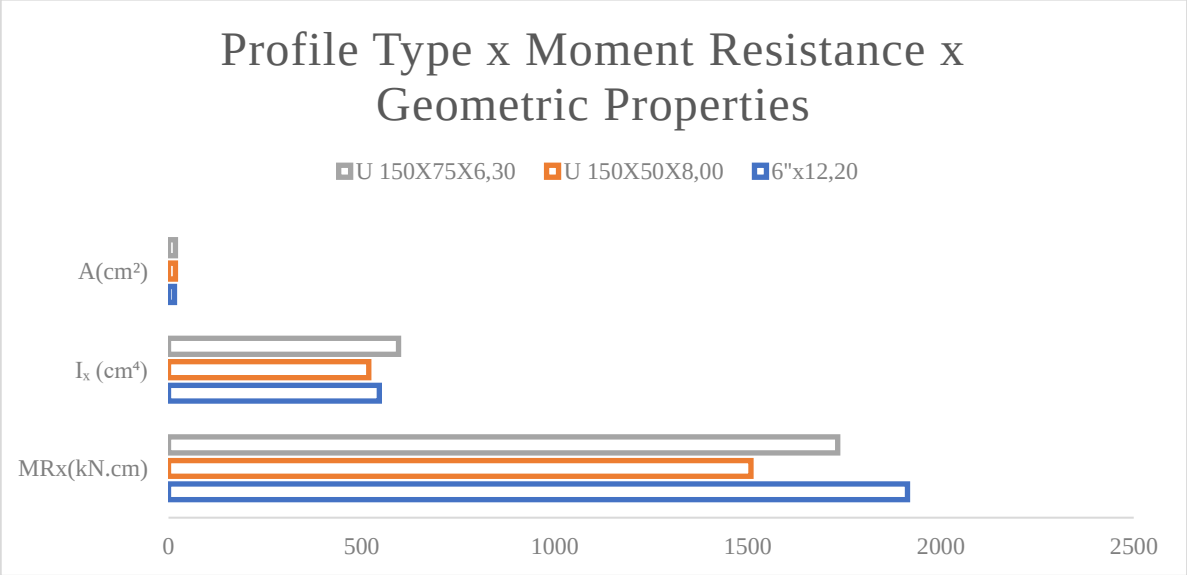
Table 15: Resistant moments, area and moment of inertia.

Profile Type	Profile	MRx(kN.cm)	$I_x(cm^4)$	$A(cm^2)$
Laminate	6"x12,20	1913,64	546,00	15,50
Simple UDC	U 150X50X8,00	1508,31	518,48	17,89
	U 150X75X6,30	1733,63	595,93	17,59

Research source: The author.

The compared areas present a reasonable proximity, as shown in table 15, indicating that when the analyzed areas are close and the moments of inertia are also close, the resistance is lower in the UDCS. However, when the moment of inertia is 8% greater, it does not have a significant influence on resistance.

Figure 7: Comparison of resistant moments according to profile.



Research source: The author.

When evaluating nearby moments of inertia and nearby areas, the moment does not vary significantly. This behavior is observed in Figure 7.

Table 16A: Resistant moments and cost/kg.

Kind	Profile	R$/kg	MRx(kN.cm)
Laminate	6" x 12,20	4,81	1913,64
Simple UDC	U 150 x 50 x 8.00	4,07	1508,31
	U 150 x 75 x 6.30	3,62	1733,63

Research source: The author.

Table 16 shows that the folded sheet profiles studied do not reach the strength of the rolled profile, but as the strengths are close depending on the use, it is possible to analyze the feasibility of its use.

Therefore, for bent sheet metal profiles with areas very close to the rolled sections, the moment of inertia is the preponderant factor, since, if the moment of inertia of the folded sheet profile is greater than that of the rolled sheet, it presents variations in the resistances that are not very discrepancies, and is therefore not so different in relation to the resistance of the laminate.

When the moment of inertia is lower, there are variations in resistance as well, but they are also not considerable.

In the case of close moments of inertia, the influencing factor is the area, and this is relevant, because the smaller the area of the folded sheet profile in relation to the laminate, the resistance of the folded sheet profile drastically reduces, a reduction in resistance that can be up to 60% lower in the folded sheet profile when the area of this is about 40% smaller in relation to the laminate.

In these cases, we can notice that the simple modifications of the geometric properties of the analyzed sections promoted a considerable increase in the final strength of the sets when submitted to simple bending.

CONCLUSION

When we analyze profiles that have close areas and moments of inertia greater than the rolled ones, the resistances are equivalent and the feasibility of using the folded sheet profile is greater, since it is lighter and has a lower cost.

It is evident that bent sheet metal profiles that have a moment of inertia equivalent to that of the rolled profile, but a much smaller area, do not reach the desired strength. Although the cost is considerably lower, it is not possible to replace it. However, it was not possible to establish a pattern of the Area x Moment of Inertia x Resistant Moment relationship.

Due to most of the folded sheet profiles studied above, they have a lower cost when compared to the laminate, in addition to the lower weight, facilitating transport and assembly *on site*, these would have made their use feasible when compared to a laminated profile that has a close resistance.

For reasonable requesting moments (about 500kN.cm), most folded sheet metal profiles have a better cost-benefit ratio to be used instead of laminate, but when analyzed at higher moments (about

1900kN.cm) the Simple UDC profiles cannot overcome the resistance of the rolled profiles, despite having a close resistance. Thus, bent sheet profiles have an excellent cost-benefit ratio in relation to the rolled profile depending on the request, making it necessary to analyze for each project whether replacement is feasible.

It is known that, according to the literature, the greater the moment of inertia, the greater the resistant moment of the profile, but in this work this finding was not made, for all the profiles studied using both 8800:2008 and 14762:2010 the profiles that presented close moments of inertia were the ones that presented the most discrepancy in the resistances. Thus, it is suggested that some more studies be carried out in order to verify if this discrepancy occurs in other cases, and if so, to suggest a change in order to make the two standards compatible.

It is thus concluded that it is inconclusive to state that one norm can be compared to another.

REFERENCES

1. Dimperfil: 4.0. (2013). [S. l.]: CBCA. Disponível em: https://dimperfil.software.informer.com/. Acesso em: 10 set. 2019.

2. Javaroni, C. E. (n.d.). *Perfis de aço formados a frio submetidos à flexão: Análise teórico-experimental* (Tese de Doutorado). Escola de Engenharia de São Carlos, Universidade de São Paulo.

3. Landesmann, A. (1999). *Análise e implementação de modelo plástico para estruturas metálicas aporticadas* (Dissertação de Mestrado). Estruturas Metálicas, Programa de Engenharia Civil/COPPE/UFRJ.

4. NBR 8800:2008 – Dimensionamento de estruturas de aço e de estruturas mistas de aço e concreto de edifícios. (2008).

5. NBR 14762:2010 – Dimensionamento de estruturas de aço constituídas por perfis formados a frio. (2010).

6. Rodrigues, F. C. (2000). *Perfis estruturais formados a frio: Comportamento e dimensionamento*. Belo Horizonte: Universidade Federal de Minas Gerais.

7. Shapebuilder: 11.0. (2019). [S. l.]: CESDb. Disponível em: https://www.iesweb.com/sb/index.html. Acesso em: 8 out. 2019.

8. Silva, E. L., & Silva, V. P. (2008). *Dimensionamento de perfis formados a frio conforme NBR 14762 e NBR 6355*. Rio de Janeiro: IBS/CBCA.

Use of assistive technologies as a communication tool in the dental care of children with ASD: Integrative literature review

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ABSTRACT

Autism Spectrum Disorder (ASD) is a set of neurodevelopmental disorders, identified from deficits in communication and social interaction, as well as restricted and repetitive behavioral patterns. The dental management of ASD requires individualization and a deep understanding of the child's behavioral profile, in which he makes use of several management techniques specific to pediatric dentistry. The lack of utensils and resources for specific care of these patients is a problem. The present study aimed to perform a narrative review of the literature regarding assistive technologies (ATs) as a tool for communication between dental

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surgeon and patient. Searches were used through the Virtual Health Library - VHL PubMed, SciElo, Lilacs and VHL databases, using the following descriptors: "Autism Spectrum Disorder", "Pediatric Dentistry", "Communication Accessibility" and "Dental Technology" and their counterparts in English and Spanish, within the period of the last 5 years. Additionally, the 2019 Guide for Oral Health Care for People with Disabilities, from the Ministry of Health, was consulted. AT ranges from a simple, low-tech device, such as a magnifying glass, to a complex high-tech device, such as a computerized communication system. The PEC's system, Picture Exchange Communication System, is a promising and very useful tool for the communication of the professional and his patient, especially non-verbal ones. There are also highly complex technologies, such as applications that facilitate communication. ED emerge as communication facilitators for people with disabilities or who have limitations in their communication with the aim of increasing independence, improving interaction and communication when used in the care of patients with ASD. Although it needs more studies in this area, assistive technologies are resources that help in the patient's comfort and communication and that, if well worked by the dentist, can offer a successful treatment.

Keywords: Autism spectrum disorder, Pediatric dentistry, Assistive technology, Social inclusion, People with disabilities.

INTRODUCTION

Autism Spectrum Disorder is a set of neurodevelopmental disorders, identified from evident deficits in social communication and social interaction and restricted patterns and repetitions in behavior and activities (Cortês, Albuquerque, 2020 apud Medeiros da Silva *et al.*, 2021, p 13).

The signs of ASD have intensities ranging from mild to severe in the domains of social communication and restrictive and repetitive behaviors instead of constituting distinct disorders (DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS, 2013 apud DA

SILVA *et al.*, 2021, p 15). According to the DSM-5 Booklet, for the diagnosis of ASD (2023) there was a standardization of global characteristics, making the diagnostic criteria homogeneous, thus facilitating the identification of autism. The following document brings the new concept of the spectrum, with the fusion of Asperger's Disorder and Pervasive Developmental Disorder, for ASD - Autism Spectrum Disorder. The signs, which were previously diagnosed separately, are a single continuum of impairments with mild to severe identities in the communication domains and restricted, repetitive behaviors.

For a long time ASD was considered rare, however, in the last century there has been a significant increase in diagnoses. (Like 2020; Almeida 2020 apud Bezerra; Assisi; Santos, 2023 p. 13157). For several current studies, autism prevails in 1 in 44 children and is present in all racial, ethnic, and socioeconomic groups. (Chanin 2023 apud Bezerra; Assisi; Santos, 2023 p. 13157).

Satisfactory dental management for a child with ASD requires individualization and an in-depth understanding of the behavioral profile of ASD, encompassing various techniques and, in addition, specific management of pediatric dentistry is used (Curado, Vieira and Leite, 2018 apud Martins, 2020, p. 12).

Children with ASD present a challenge for professionals during dental treatment, mainly due to lack of communication, socialization difficulties, great dependence on parents or caregivers and increased fear and anxiety, which leads to behaviors that dentists need to have a greater management, following an appropriate protocol. (Elmore *et al*., 2016; Myhren *et al*., 2023 apud Bezerra *et al*., 2023, p 3).

Thus, the lack of utensils for specific care of these patients is a problem in the daily life of the population. Assistive technology (AT) are resources and devices whose purpose is to maintain or improve an individual's function and independence to facilitate social participation and execution of all life functions and activities, contributing to general well-being and quality of life. (Faria de Moraes; Maia Silveira; Amado De Oliveira, 2019, p. 2)

In this context, this article aims to carry out an integrative review of the literature on the role of assistive technologies (ATs) as a tool for communication in the dental care of children with ASD.

METHODOLOGY

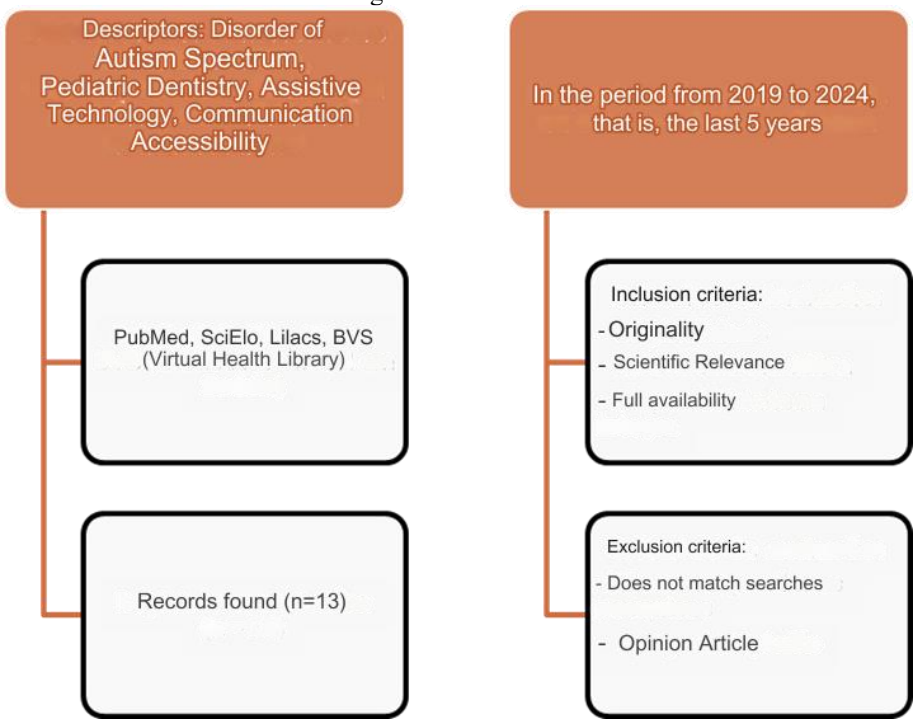
Searches were carried out through the VHL (Virtual Health Library), PubMed, LILACS and SciElo databases using the descriptors "Autism Spectrum Disorder", "Pediatric Dentistry", "Communication Accessibility" and "Assistive Technology" and the same correspondents in English and Spanish.

To select the articles to compose this work, inclusion criteria were used, such as articles in Portuguese, English, and Spanish that had relevant aspects of the main focus of the work within the period from 2019 to 2024, excluding abstracts, letters to the reader, articles that did not present full texts, and articles that did not address the main theme of the work. In addition, the 2019 Guide for Oral Health Care for People with Disabilities of the Ministry of Health was consulted to be part of this literature review.

RESULTS

According to the methodology cited for the search for information, 13 articles were selected from the PubMed, SciElo, Lilacs and VHL (Virtual Health Library) databases. In the course of the development of this integrative review, the following inclusion and exclusion criteria were used, as specified in the flowchart in Figure 1.

Figure 1. Flow chart



Source: Prepared by the authors.

DENTAL CARE FOR PATIENTS WITH ASD

The Ministry of Health (MS) advocates that all people with disabilities have equal rights in SUS care and services in their basic and specific health needs, which involve medical and dental care (BRASIL, 2013 apud Coimbra *et al.*, 2020, p. 94300). Regarding the oral health of patients with ASD, it is expected that in these patients the risk of caries, periodontal disease and malocclusions will be greater, since they have motor difficulties and also have lower facial muscle tone. In addition, caregivers often offer soft and sweet foods (Fonseca., 2018; Zink *et al.,* 2018 apud Araújo *et al*., 2021, p 4).

The author Delli (2013 apud Silva *et al.*, 2021) points out that the biggest challenge of dental treatment is the clinical characteristics of patients with ASD, such as exacerbated sensorimotor perception, attention problems, anxiety, emotional control, difficulty in understanding, and hyposensitivity or indifference to pain.

Through conditioning based on communication guidelines, trust can be established and the necessary cooperation can be built for the success of the consultation. To this end, health professionals must issue short, clear and simple commands, maintaining continuous communication during all consultations (Chandrashekhar *et al.*, 2018 apud Bezerra; Assisi; Santos, 2023 p. 13161).

The objective of dental management of patients with ASD is to increase their independence, improving interaction and communication, as well as providing assistance to caregivers. The management techniques used are similar to those of pediatric dentistry, such as: saying, show-doing, positive reinforcement, distraction, desensitization and modeling (Gandhi; Klein, 2014; Nelson *et al*., 2017 apud Santos Ramos Costa; Pereira Rocha, 2024, p. 233). In view of the barriers encountered by the professional in the dental care of children with TEA, five important points The studies observed: each patient has specific needs; communication is paramount; Specific techniques healthy Essential; incompatibility between need and resources and personal appreciation for work (Reis *et al*., 2022 apud Bezerra; Assisi; Santos, 2023, p. 13159).

ASSISTIVE TECHNOLOGIES AND COMMUNICATION DURING DENTAL CARE

PEC's System and Technological Devices

Assistive technology includes a wide range of tools, from a simple, low-tech device such as a magnifying glass to a complex high-tech device such as a computerized communication system. (Faria de Moraes; Maia Silveira; Amado De Oliveira, 2019, p. 2)

Thus, Assistive Technology (AT) is not a topic restricted to science and technology, health, industry, or education. It is a comprehensive concept, constituting a key element for the promotion of Human Rights, through which people with disabilities have the opportunity to achieve their

autonomy and independence in all aspects of their lives (BRASIL, 2009 apud Faria De Moraes; Maia Silveira; Amado De Oliveira, 2019, p. 3).

Studies show that communication by figures has been presented as a promising intervention method (Ganz *et al*., 2012 apud BRASIL, 2019, p 90). An example of this is the study by Zink *et al*. (2016), which adapted a communication facilitator for individuals who have severe communication difficulties, such as ASD, through the use of figures adapted to dentistry, between the user and the professional during dental treatment, thus facilitating care in an outpatient environment and minimizing the need to use physical restraint. (BRASIL, 2019, p 90)

Image exchange communication system by device: Some patients may have difficulty learning new things or articulate some wants and needs, which makes it necessary to use assistive communicative devices. An example is the Smart/Scan 32 Pro, a complementary device that can help these patients communicate (Chandrashekhar *et al*., 2018 apud Bezerra; Assisi; Santos, 2023, p. 13162). The PEC's System (Image Exchange Communication System) consists of an image book that allows the patient to express feelings, observations and desires visually. As the patient grows, the book evolves and more words and images are added in order to increase the ability to communicate between health care provider and patient. PEC's is indicated for non-verbal patients, with the objective of facilitating dental treatment and requiring repeated instructions for visual learners, as its adaptation improves severe speech impairments and reduces behavioral problems (Meharwade; Chandrashekha, 2018 apud Bezerra; Assisi; Santos, 2023, p. 13161).

Although still little used in dentistry, technological health resources have been shown to be effective options, which can result in improved quality of life, health promotion, prevention of disabilities and injuries, influencing practices related to rehabilitation and social inclusion of these people (Caldas Jr, França, 2013 apud Faria De Moraes; Maia Silveira; Amado De Oliveira, 2019, p.3).

The difficulty in dental treatment for people with ASD, especially children, is described in the literature, however, the adaptations to make oral hygiene possible are poorly found in the literature. Thus, alternative communication and the use of structured materials are viable possibilities for professionals and families of people with ASD in this process of facilitating oral hygiene. (Zink *et al*., 2019, p. 220).

Zink *et at* (2019) point out in their field research that oral hygiene guidance through the use of alternative communication and structured materials should be presented early to children with ASD. Patients with ASD also showed the need for support from parents and/or caregivers for correct oral hygiene, not being totally independent, although 80% of them accepted the activity. Instruction and educational activities must be present in the daily clinic to favor the prevention of diseases in people on the autistic spectrum.

DISCUSSIONS

From the bibliographic survey obtained in this integrative literature review, it was possible to observe the need for individualized care of patients with ASD by dental surgeons, as well as the use of assistive technologies (ATs) as a tool to improve dentist-patient communication.

Dental professionals are considered able to provide care to patients with ASD, as long as they have knowledge, understanding of their limitations, dedication and patience to perform the procedures (Da Costa Sant´ana *et al*., 2017 apud COIMBRA *et al.*, 2020, p.94301).

From this perspective, it is understood that Assistive Technologies are not only highly complex devices, but resources that help in the patient's comfort and communication and that, if well worked by the dentist, can offer a successful treatment. It is important to note that in some cases, the patient with ASD may have difficulty communicating, socializing, language, even fear and anxiety. It is at this point that AT emerges as a facilitator of communication in clinical care.

Based on the present literature review, several authors state that AT are still little used in dentistry, however, they have shown to be excellent options for improving the quality of life of patients and families, and their relationship with dental care.

CONCLUSION

It can be concluded that the use of Assistive Technologies is extremely important for the dental care of patients with ASD. Although studies on AT as a facilitating tool for dental care are incipient, the studies reviewed in this article point to a promising future. The PEC's system (Figure Exchange System) has gained prominence, configuring itself as one of the most cited ATs in the literature for the effective dental management of ASD.

Finally, further studies are needed to address the impacts of the application of AT during dental treatment. In this way, dental students and professionals will be able to have access to new materials, and consequently establish/create new resources, aiming to improve the care of these patients, as well as a more inclusive society.

REFERENCES

1. Araujo, F. S., et al. (2021). Pacientes com Transtorno do Espectro Autista e desafio para atendimento odontológico – revisão de literatura. *Research, Society and Development, 10*(14), e496101422317. https://doi.org/10.33448/rsd-v10i14.22317

2. Bezerra, R. C., Assis, J. A., & Santos, P. de U. (2023). O atendimento odontológico à crianças com Transtorno do Espectro Autista: uma revisão de literatura. *Brazilian Journal of Health Review, 6*(3), 13155-13171. https://doi.org/10.34119/bjhrv6n3-371

3. Bezerra, A. T. M., et al. (2023). Processamento sensorial de pacientes com transtorno do espectro do autismo (TEA) e adaptações necessárias ao atendimento odontológico: uma revisão integrativa. *E-Acadêmica, 4*(2), e1742465. https://doi.org/10.52076/eacad-v4i2.465

4. Brasil. Ministério da Saúde. Secretaria de Atenção Primária à Saúde. (2019). *Guia de Atenção à Saúde Bucal da Pessoa com Deficiência* (p.120). Brasília, DF: Ministério da Saúde. Disponível em: https://bvsms.saude.gov.br/bvs/publicacoes/guia_atencao_saude_bucal_pessoa_deficiencia.pdf

5. Coimbra, B. S., et al. (2020). Abordagem Odontológica a Pacientes Com Transtorno Do Espectro Autista (TEA): Uma Revisão da Literatura / Dental Approach To Patients With Autism Spectrum Disorder (ASD): A Literature Review. *Brazilian Journal of Development, 6*(12), 94293-94306. https://doi.org/10.34117/bjdv6n12-045

6. DSM-5 e o diagnóstico de TEA. (2023). *Programa Autismo e Realidade do Instituto PENSI*. São Paulo. Disponível em: https://institutopensi.org.br/autismo-e-realidade-lanca-nova-cartilha-dsm-5-e-o-diagnosticode-tea/

7. Faria de Moraes, A. L., Maia Silveira, F., & Amado de Oliveira, G. (2019). Tecnologias assistivas em saúde bucal para pessoas com deficiência: produção de um abridor de boca para otimizar o atendimento odontológico e a higiene bucal. In *17º Congresso Internacional de Ergonomia e Usabilidade de Interfaces Humano-Tecnologia e o 17 º Congresso Internacional de Ergonomia e Usabilidade de Interfaces e Interação Humano-Computador* (pp. 838-842). São Paulo: Editora Blucher. https://doi.org/10.5151/ergodesign2019-2.58

8. Martins, B. P. (2020). *Métodos facilitadores para o atendimento odontológico de pacientes com Transtorno do Espectro Autista-TEA* (Tese de Conclusão de Curso, Universidade do Sul de Santa Catarina, Tubarão - SC). Disponível em: https://repositorio.animaeducacao.com.br/handle/ANIMA/16515

9. Medeiros da Silva, A. C., et al. (2021). Abordagem e Manejo de Alterações Sensoriais dos Pacientes TEA no Tratamento Odontológico. *Revista Diálogos em Saúde, 4*(2), 13-24. Disponível em: https://periodicos.iesp.edu.br/dialogosemsaude/article/view/474/345

10. Santos Ramos Costa, M., & Pereira Rocha, A. (2024). Manejo Odontológico do Paciente com Transtorno do Espetro Autista uma Revisão de Literatura. *JNT Facit Business and Technology Journal, 1*(2), 230-237. Disponível em: https://revistas.faculdadefacit.edu.br/index.php/JNT/article/view/2798

11. Silva, A. C., et al. (2021). Estratégias para o condicionamento comportamental em pacientes com transtorno do espectro autista durante o atendimento odontológico. *Research, Society and Development, 10*(16), e16101623078. https://doi.org/10.33448/rsd-v10i16.23078

12. Souza, L. A. P., & Rolim, V. C. L. de B. (2022). Manejo Odontológico em Pacientes com Transtorno do Espectro Autista. *Revista Ibero-Americana de Humanidades, Ciências e Educação, 8*(5), 1562-1577. https://doi.org/10.51891/rease.v8i5.5572

13. Zink, A. G., Baeder, F., Pinho, M. Z., Pinho, M. D., & Fonseca, M. E. G. (2019). Materiais estruturados para instrução de higiene bucal de pessoas com autismo. *Revista da Associação Paulista de Cirurgiões Dentistas, 73*(3), 215-220. Disponível em: https://www.researchgate.net/publication/338817042_Materiais_estruturados_para_instrucao_de_higiene_bucal_de_pessoas_com_autismo_Structured_materials_for_oral_hygiene_instruction_of_people_with_Autism

Constitutional hemeneutics: The art of interpreting

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ABSTRACT

This article explores the concept, forms, and challenges of constitutional hermeneutics, highlighting its importance for the realization of fundamental values and principles. The different interpretative approaches are presented, such as literal, historical, teleological, systematic, according to the Constitution, evolutionary and pluralist. The methodology adopted was the literature review. The results show that constitutional interpretation is a complex activity, requiring from the interpreter not only legal knowledge, but also sensitivity, creativity and ethical commitment. It is concluded that constitutional hermeneutics is an essential science and art for the construction of a democratic and just society, guided by the ideals of freedom, equality and human dignity, allowing the interpreter to act as guardian of the Constitution and transforming agent of social reality.

Keywords: Constitutional Hermeneutics, Interpretation, Constitution.

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INTRODUCTION

The Constitution is the fundamental law of a State, which establishes the bases of political organization, defines fundamental rights and guarantees, and outlines the limits of State power. More than a legal document, the Constitution is an instrument of social transformation and the construction of national identity. As Konrad Hesse says, the Constitution is not only the expression of a being, but also of a duty to be, that is, of a given reality, but also a programme for the future.[3]

However, in order for the Constitution to fulfill its role, it must be properly interpreted and applied. Thus, constitutional hermeneutics emerges, defined by Inocêncio Mártires Coelho as the art of interpreting, applying and integrating the Constitution, with a view to solving the concrete problems of social life".[4]

Constitutional interpretation has peculiarities in relation to the interpretation of laws in general, due to the political and principled nature of the Constitution. As Luís Roberto Barroso teaches, constitutional interpretation is a modality of legal interpretation, but it differs from the interpretation of laws in general by presenting specificities and complexities that are inherent to it.[5]

Constitutional hermeneutics represents a fundamental field of study within Constitutional Law, acting as an essential mechanism for the interpretation and application of constitutional norms in a constantly evolving legal and social context. This article aims to explore the concept and explanation of constitutional hermeneutics, its various forms, and ultimately the art of interpreting the Constitution.

Through a critical analysis of hermeneutic approaches and interpretative methods, it seeks to understand how constitutional hermeneutics is positioned not only as a set of interpretative techniques, but as a true legal science that contributes to the realization of the principles and values inscribed in the Constitution. Constitutional interpretation transcends mere textual analysis, involving a complex interaction between the constitutional text and the sociopolitical reality in which it is inserted.

In this sense, constitutional hermeneutics presents itself as a field of interdisciplinary study, which dialogues with philosophy, sociology, and political theory, among other areas, to provide a richer and more contextualized understanding of constitutional norms. This article, therefore, not only addresses the traditional methods and principles of constitutional hermeneutics, but also reflects on the contemporary challenges faced by constitutional interpreters, such as the need to adapt the interpretation of the Constitution to social, political, and technological transformations, thus ensuring the relevance and effectiveness of the constitutional text in the twenty-first century.

[3] HESSE, Konrad. The Normative Force of the Constitution. Porto Alegre: Sergio Antonio Fabris Editor, 1991, p. 15.
[4] COELHO, Inocêncio Mártires. Constitutional Interpretation. 4th ed. São Paulo: Saraiva, 2011, p. 23
[5] BARROSO, Luís Roberto. Course on Contemporary Constitutional Law. 8th ed. São Paulo: Saraiva Educação, 2019, p. 321.

Constitutional hermeneutics plays a fundamental role in the study of Law, being responsible for the interpretation of constitutional norms. In this article, we will address the essential concepts of constitutional hermeneutics and their importance in the art of interpreting the Constitution.

The purpose of this article is to present a view on constitutional hermeneutics and the art of interpreting.

The methodology adopted was the bibliographic review carried out through books, articles and scientific works that deal directly or indirectly with the theme. Through a review of the specialized literature and the analysis of specific hermeneutical approaches, this article contributes to the academic debate on constitutional hermeneutics, offering *insights* into the ways in which constitutional interpretation can promote the realization of the fundamental rights and democratic objectives enshrined in the Constitution.

By exploring constitutional hermeneutics as an art of interpreting, it seeks to highlight the importance of legal sensitivity, creativity and ethical commitment of interpreters in the application of constitutional norms, reaffirming the central role of the Constitution as the foundation of the legal order and life in society.

CONCEPT OF CONSTITUTIONAL HERMENEUTICS

Interpretation can be defined as the process of attributing meaning to something, whether it is a text, a work of art, a situation, or a set of facts. In law, interpretation is essential to understand and apply legal rules to concrete cases. As Maria Helena Diniz explains[6], to interpret a legal norm is to discover or attribute a meaning to a normative text, based on certain methods and according to certain criteria.

According to Alexandre Issa Kimura[7], hermeneutics is the science that, abstractly, presents to interpretative action the methods and processes that must be observed by the interpreter. Interpretation, therefore, operates in the concrete case, giving the subject the task of extracting the real scope, the meaning of the legal norm.

In the constitutional sphere, hermeneutics acquires special relevance, given the open and principled character of constitutional norms. According to Böckenförde[8], constitutional interpretation is of decisive importance for the consolidation and preservation of the normative force of the Constitution.

[6] DINIZ, Maria Helena. Compendium of Introduction to the Science of Law. 25th ed. São Paulo: Saraiva, 2014, p. 421.
[7] KIMURA, Alexandre Issa. Hermeneutics and Constitutional Interpretation. pg 1.
[8] BÖCKENFÖRDE, Ernst-Wolfgang. Studies on the Rule of Law and Democracy. Madrid: Trotta, 2000, p. 17

Gilmar Mendes[9], in his work, Curso de Direito Constitucional (Constitutional Law Course), argues that constitutional interpretation is the activity that consists of establishing the meaning of the norms of the fundamental law – whether these norms are rules or principles, with a view to solving practical problems, if and when the simple reading of the texts does not allow, on the plane, the understanding of their meaning and scope.

In this sense, Canotilho[10] defines constitutional interpretation as the attribution of a meaning to one or more linguistic symbols written in the constitution in order to obtain a normative-constitutionally based decision on practical problems. This attribution of meaning, however, does not occur freely or arbitrarily, but must be guided by rational and controllable criteria and methods.

Häberle[11] points out that constitutional interpretation is, however, an activity that potentially concerns everyone, and is not an exclusive task of judges and courts. This is because the Constitution, as a fundamental norm of the State, radiates its effects on the whole society, demanding the participation of the various social actors in the construction of its meaning.

For Lenio Streck[12], constitutional hermeneutics is not limited to a specific method, but involves a deep understanding of constitutional norms and their application in concrete situations. The importance of finding a balance between the rules that guide the interpreter, the application of the text to concrete cases and the overcoming of false oppositions between subjectivity and objectivity in interpretation is highlighted.

Therefore, constitutional hermeneutics can be defined as a branch of Constitutional Law that is dedicated to the study and development of theories, methods, and principles for the interpretation of constitutional norms. As Barroso points out[13], legal hermeneutics is the part of the science of Law that has as its object the study and systematization of the processes applicable to determine the meaning and scope of the expressions of Law.

Constitutional hermeneutics seeks, therefore, to establish parameters for the proper understanding of the constitutional text, taking into account not only its linguistic and grammatical aspects, but also the historical, teleological and systematic elements that inform the constitutional order.

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[9] MENDES, Gilmar Ferreira; COELHO, Inocêncio Mártires; BRANCO, Paulo Gustavo Gonet. Curso de Direito Constitucional.5th ed. São Paulo: Saraiva, 2010, p.155.
[10] CANOTILHO, J. J. Gomes. Constitutional law and theory of the constitution. 7. ed. Coimbra: Almedina, 2003, p. 1210.
[11] HÄBERLE, Peter. Constitutional hermeneutics: the open society of the interpreters of the Constitution: contribution to the pluralist and "procedural" interpretation of the Constitution. Trad. Gilmar Ferreira Mendes. Porto Alegre: Sergio Antonio Fabris, 1997, p. 13.
[12] STRECK, Lenio. Constitutional Hermeneutics. *In* Enciclopédia Jurídica da PUCSP, tome II (electronic resource): administrative and constitutional law / coord. Vidal Serrano Nunes Jr. [et al.] - São Paulo: Pontifical Catholic University of São Paulo, 2017, p. 3, 5.
[13] BARROSO, Luís Roberto. Course on contemporary constitutional law. São Paulo: Saraiva, 2009, p. 291.

Thus, constitutional hermeneutics presents itself as a complex and challenging field of study, which seeks to provide theoretical and practical instruments for the proper interpretation of constitutional norms, always with a view to the realization of fundamental rights and the preservation of the democratic order.

Likewise, the interpretation of constitutional clauses requires a comprehensive knowledge not only of the fundamental principles of constitutional hermeneutics (considered true guiding principles of the system of political-legal values of the Constitution), but also of the so-called constitutional precepts that are found in the context of the normative structure of the Constitution.[14]

For this specific reason, the interpretation of constitutional provisions requires a broad knowledge not only of the guiding principles of constitutional hermeneutics (as authentic governing principles of the political-legal valuation system of the Constitutional Text), as well as of the so-called constitutional precepts present in the scope of the systemic standardization of the Constitution.

This fundamental concept highlights the importance of constitutional hermeneutics as a field of study dedicated to understanding constitutional provisions.

Constitutional hermeneutics seeks to go beyond the simple literal reading of constitutional norms. It recognizes that the Constitution is a complex and multifaceted document, which requires careful interpretation to determine its true meaning and scope. In this sense, constitutional hermeneutics involves the application of methods and techniques that allow the interpreter to fully understand the meaning of constitutional norms.

Therefore, the concept of constitutional hermeneutics highlights its nature as a discipline dedicated to the interpretation of constitutional norms, with the aim of fully understanding their meaning and scope. Through this understanding, interpreters can correctly apply constitutional provisions and ensure their effectiveness within the legal system.

FORMS OF CONSTITUTIONAL HERMENEUTICS

Constitutional hermeneutics, as a field of study dedicated to the interpretation of constitutional norms, presents different forms and methods to achieve its objective. These forms of interpretation seek to unveil the meaning and scope of constitutional provisions, taking into account not only the normative text, but also the historical, social, and political context in which the Constitution is inserted.

The Constitution, therefore, is not just a set of rules to be followed, but a living text that must be constantly interpreted and reinterpreted by all citizens. This interpretation can occur at various levels, including the Legislative, through the elaboration of complementary laws or interpretative rules; the Executive, in the use of its power to sanction or veto laws; and the Judiciary, through

[14] FRIEDE, Reis. Constitutional Hermeneutics. Revista da SJRJ, Rio de Janeiro, v. 23, n. 47, p. 13-32, nov.19/fev.20, p.15.

decisions in direct actions of unconstitutionality or declaratory of constitutionality, thus exercising repressive control of constitutionality.

There are different approaches and forms of constitutional hermeneutics, which can be applied according to the purpose of the interpretation. Among the classic forms of constitutional hermeneutics, literal or grammatical interpretation, historical interpretation, teleological interpretation, and systematic interpretation stand out.

In addition to these classic forms of constitutional interpretation, contemporary doctrine has developed new hermeneutical approaches, which seek to adapt the interpretation of the Constitution to the challenges and complexities of today's society. Among these new perspectives, interpretation in accordance with the Constitution, evolutionary interpretation, and pluralist interpretation stand out.

HERMENÊUTICA LITERAL

Literal interpretation, also known as grammatical, verbal, textual, semantic, or philological, is the starting point of the interpretive process. In this approach, the interpreter focuses on the literal meaning of the normative text, analyzing the lexical meaning and syntactic structure of the language used.[15] The objective is to understand the meaning of each word, phrase or period, taking into account the external form of the legal text. The most evident meaning of the text is sought, considering the syntactic structure and the immediate context.

By employing the grammatical method, the interpreter seeks to unveil the meaning of the law from the written text, from the letter of the law itself. This analysis of the words of the law (*verba legis*) constitutes the initial stage of interpretation, since the interpretative process always begins with the understanding of the literal meaning of the terms used by the legislator.[16] It seeks to understand the common and ordinary meaning of the terms used, without delving into extratextual considerations.[17]

To correctly interpret a legal text by the grammatical method, Iara Menezes Lima[18] argues that it is necessary to understand both the common language and the legal language used. The interpreter must prioritize the technical meaning of the terms used, since in the legal context words have a specific meaning. This approach is fundamental for the interpretation of laws in general, except for constitutional norms, since the terms used in the Constitution must be understood in their

[15] MENDES, Gilmar Ferreira; BRANCO, Paulo Gustavo Gonet. Course on constitutional law. 13. ed. São Paulo: Saraiva, 2018, p. 93.
[16] SILVA, José Afonso da. Course on positive constitutional law. 25. ed. São Paulo: Malheiros, 2005, p. 118.
[17] BASTOS, Celso Ribeiro. Hermeneutics and constitutional interpretation. 2. ed. São Paulo: Celso Bastos Editor, 1999, p. 57.
[18] LIMA, Iara Menezes. Classical Methods of Interpretation in Constitutional Law. Brazilian Journal of Political Studies. p. 67.

common, ordinary (vulgar) sense, and not in the technical-legal sense, and can only be done if this was the unequivocal intention of the constituent legislator. This is because the Constitution is a creation of the people and must be accessible to them.

Although it is an important starting point for constitutional interpretation, literal interpretation cannot be considered sufficient, since constitutional norms often have an open and principled character, requiring a more comprehensive analysis.

HISTORICAL HERMENEUTICS

The historical interpretation takes into account the historical context in which the Constitution was drafted and the circumstances that motivated the inclusion of certain provisions. As Bonavides explains[19], historical interpretation is made through the reconstruction of the thought of the constituent legislator, in order to accurately reach the meaning and scope of the constitutional norm. This form of interpretation is especially relevant to understand the original intention of the constituents and the values that guided the elaboration of the Magna Carta.

For Barroso[20] , it is an important tool to understand the meaning and scope of constitutional norms, taking into account the historical, social and political context in which they were elaborated. This method seeks to identify the ideas, feelings and interests dominant at the time of the creation of the law (*occasio legis*), revealing the will of the constituent legislator.[21]

When applying the historical method, the interpreter makes use of several elements, such as the preparatory work for the creation of the law and legislative precedents, when they exist. Preparatory work includes parliamentary discussions, proposed amendments, justifications presented and reports prepared during the legislative process. These documents provide valuable insights into the intentions and motivations of constituents when drafting the constitutional text.[22]

Legislative precedents, in turn, are previous laws and norms that dealt with the same or related subjects. The analysis of these precedents allows the interpreter to understand the historical evolution of the legal treatment given to the matter and to identify possible changes in understanding over time.[23]

However, it is essential to emphasize that the historical method should not be used in isolation or absolutely. Constitutional interpretation must be carried out in a systematic manner, considering other interpretative methods and taking into account the evolution of society and

[19]BONAVIDES, Paulo. Course on constitutional law. 15. ed. São Paulo: Malheiros, 2004, p. 437.
[20] BARROSO, Luís Roberto. Course on contemporary constitutional law. São Paulo: Saraiva, 2009, p. 292.
[21] LIMA, Iara Menezes. Classical Methods of Interpretation in Constitutional Law. Brazilian Journal of Political Studies. p. 77
[22] MENDES, Gilmar Ferreira; BRANCO, Paulo Gustavo Gonet. Course on constitutional law. 13. ed. São Paulo: Saraiva, 2018, p. 93.
[23] SILVA, José Afonso da. Course on positive constitutional law. 25. ed. São Paulo: Malheiros, 2005, p. 119.

constitutional values. The will of the constituent legislator, although relevant, cannot be the only criterion for understanding constitutional norms, under penalty of adopting a static and anachronistic view of the Constitution.[24]

TELEOLOGICAL HERMENEUTICS

Teleological hermeneutics, also known as finalistic interpretation, seeks to identify the purpose of the normative precept, the reason for its creation, and then determine its real meaning and scope. This method is based on the investigation of the *ratio legis*, that is, the reason that justifies and grounds the existence of the norm.[25]

This reason is closely linked to the human need that the norm aims to support, its practical purpose. After all, every legal norm is created with a purpose, a justification, and it is this reason that allows its true meaning and scope to be revealed. In other words, teleological interpretation consists of inquiring the "why" of the legal norm, that is, the purpose for which it is intended.[26]

In the constitutional sphere, teleological hermeneutics gains special relevance, since the Constitution is a political-legal document that establishes the foundations and objectives of the State. As Inocêncio Mártires Coelho teaches, the interpretation of any norm of the Constitution imposes on the interpreter, always, in any circumstance, to walk along the path that is projected from it – from the norm – to the Constitution.[27]

Thus, when interpreting a constitutional norm, the hermeneutic must seek not only its literal meaning, but mainly its purpose, the values and principles that it aims to protect. In this sense, Konrad Hesse[28] points out that constitutional interpretation is subject to the principle of optimal implementation of the norm, that is, the interpretation that best achieves the constitutional purposes and values must be sought.

This understanding is shared by Luís Roberto Barroso[29], who states: "The teleological method consists of the search for the end of the norm, the value or legal good aimed at by the legal system with the edition of a given precept. [...] In the final analysis, the ultimate goal of every constitutional norm is the protection and promotion of human dignity."

[24] BARROSO, Luís Roberto. Course on contemporary constitutional law. São Paulo: Saraiva, 2009, p. 292.
[25] LIMA, Iara Menezes. Classical Methods of Interpretation in Constitutional Law. Brazilian Journal of Political Studies, p. 82.
[26] Op. cit. p. 82
[27] COELHO, Inocêncio Mártires. Constitutional interpretation. 4. ed. São Paulo: Saraiva, 2011, p. 131.
[28] HESSE, Konrad. The normative force of the constitution. Trad. Gilmar Ferreira Mendes. Porto Alegre: Sergio Antonio Fabris, 1991, p. 22.
[29] BARROSO, Luís Roberto. Course on contemporary constitutional law. São Paulo: Saraiva, 2009, p. 292.

An example of the application of teleological hermeneutics in Constitutional Law is the interpretation of the principle of equality. As Gilmar Ferreira Mendes explains[30], the application of the principle of equality necessarily implies the consideration of the purpose of the rule, in order to verify whether the differentiation or equivalence promoted has a reason that justifies it.

Teleological hermeneutics is an essential instrument for the achievement of constitutional values and objectives, allowing norms to be interpreted in a way that promotes justice, human dignity and fundamental rights.

SYSTEMATIC HERMENEUTICS

Systematic hermeneutics is a method of interpretation that considers the Constitution as an integrated and coherent normative system, in which norms and principles must be understood in their interrelation and unity. As J. J. Gomes Canotilho explains[31], the principle of the unity of the constitution gains autonomous relevance as an interpretative principle when it is meant that the constitution must be interpreted in such a way as to avoid contradictions (antinomies, antagonisms) between its norms, so that the interpreter must always consider constitutional norms not as isolated and dispersed norms. but rather as precepts integrated into a unitary internal system of norms and principles.

In this sense, systematic interpretation seeks to harmonize constitutional norms, avoiding conflicts and contradictions. According to Luís Roberto Barroso[32], the idea of system translates into the notion that constitutional norms should be interpreted in terms of each other, and not in isolation. Thus, the content of a given constitutional norm is arrived at by comparing it with other norms and by its integration into the system as a whole.

In other words, the interpretation considers the legal system as a coherent and organized whole, in which the norms are interconnected and hierarchically structured, and the norms of lower hierarchy must conform to the norms of higher hierarchy.[33]

One of the fundamental principles of systematic hermeneutics is the principle of practical agreement or harmonization. As Inocêncio Mártires Coelho teaches[34], with this principle – which looks more like a postulate – what is meant is that none of the constitutional norms can be interpreted in isolation, outside the context of the other norms of the Constitution.

[30] MENDES, Gilmar Ferreira; BRANCO, Paulo Gustavo Gonet. Course on constitutional law. 13. ed. São Paulo: Saraiva, 2018, p. 213.
[31] CANOTILHO, J. J. Gomes. Constitutional law and theory of the constitution. 7. ed. Coimbra: Almedina, 2003, p. 1223.
[32] BARROSO, Luís Roberto. Course on contemporary constitutional law. São Paulo: Saraiva, 2009, p. 299.
[33] LIMA, Iara Menezes. Classical Methods of Interpretation in Constitutional Law. Brazilian Journal of Political Studies, p. 79.
[34] COELHO, Inocêncio Mártires. Constitutional interpretation. 4. ed. São Paulo: Saraiva, 2011, p. 142.

It should be said that systematic hermeneutics analyzes each constitutional statement in its articulation with the entire text, seeking a harmonious interpretation that avoids antinomies. The Constitution is taken into account as a structured whole, interpreting each part in the light of the general context.

In this context, when two constitutional norms appear to be in conflict, the interpreter must seek a solution that harmonizes them, preserving the effectiveness of both as much as possible. In the words of Gilmar Ferreira Mendes[35], in case of visible conflict between constitutional norms, one must adopt the interpretation that reconciles them, preserving, as much as possible, the normative force of all of them.

An example of the application of systematic hermeneutics is the interpretation of fundamental rights. As Ingo Wolfgang Sarlet explains[36], fundamental rights, due to their normative structure and their function in the constitutional system, are subject to a logic of competition and weighting, requiring a systematic and harmonizing interpretation.

Thus, systematic hermeneutics is an essential method for understanding the Constitution as a unitary and coherent whole, allowing the harmonization of its norms and principles and the realization of fundamental rights.

HERMENEUTICS ACCORDING TO THE CONSTITUTION

Interpretation in accordance with the Constitution is a hermeneutical principle that seeks to ensure the unity and coherence of the legal system.

As José Afonso da Silva teaches[37], interpretation in accordance with the Constitution is a principle that is within the scope of the control of constitutionality, and not just a rule of interpretation. This interpretative method is based on the premise that infra-constitutional norms must be understood and applied in accordance with the precepts and values enshrined in the Constitution. This means that, by using this method, the interpreter is not only seeking the most appropriate meaning of the infra-constitutional rule, but also making a judgment of compatibility between it and the Constitution.

Interpretation in accordance with the Constitution gains special relevance when an infra-constitutional norm admits multiple interpretations, some of which may be incompatible with the Magna Carta. In these situations, the interpreter must prefer the interpretation that is in accordance with the Constitution, ruling out those that violate its fundamental precepts.

[35] MENDES, Gilmar Ferreira; BRANCO, Paulo Gustavo Gonet. Course on constitutional law. 13. ed. São Paulo: Saraiva, 2018, p. 93.
[36] SARLET, Ingo Wolfgang. Course on constitutional law. 7. ed. São Paulo: Saraiva, 2018, p. 223.
[37] SILVA, José Afonso da. Course on positive constitutional law. 25. ed. São Paulo: Malheiros, 2005, p. 227.

Luís Roberto Barroso[38] points out that interpretation in accordance with the Constitution can involve three types of situation: (a) interpretation in accordance with text reduction; (b) the conforming interpretation without text reduction; and (c) the conforming interpretation without pronouncement of nullity, but with a change in the meaning of the rule.

In the interpretation in accordance with text reduction, the interpreter excludes from the scope of the infra-constitutional rule certain hypotheses of application that would be incompatible with the Constitution. In the case of conforming interpretation without text reduction, the interpreter adopts a restrictive interpretation of the rule, making it compatible with the Constitution without changing its text. Finally, in the case of conforming interpretation without pronouncing nullity, but with a change in the meaning of the rule, the interpreter modifies the original meaning of the rule, adapting it to the constitutional precepts.[39]

It is important to emphasize that interpretation in accordance with the Constitution finds limits in the text of the infra-constitutional rule itself. As Gilmar Mendes and Paulo Branco warn[40], the interpretation in conformity with the Constitution is only legitimate when it does not contradict the literal meaning of the text, does not alter the meaning of the normative text, with a radical change in the original conception of the legislator.

In addition, interpretation in accordance with the Constitution cannot be used as an instrument of judicial creation of the Law, replacing the legislative function. The interpreter must respect the separation of powers and the limits of his or her performance, always seeking to achieve constitutional values without exceeding the limits of the normative text.[41]

Interpretation in accordance with the Constitution is a valuable hermeneutic method that aims to guarantee the supremacy and normative force of the Constitution, harmonizing the legal system and removing unconstitutional interpretations of infra-constitutional norms. It seeks to preserve the unity of the legal system and the coherence between the different normative levels, always having as a guide the values and principles enshrined in the Magna Carta.[42]

EVOLUTIONARY HERMENÊUTICA

Evolutionary interpretation is a hermeneutic method that seeks to adapt the meaning of constitutional norms to the social, political, and economic changes that occur over time. This approach is based on the premise that the Constitution is a living document, which must be understood and applied dynamically, following the evolution of society.

[38] BARROSO, Luís Roberto. Course on contemporary constitutional law. São Paulo: Saraiva, 2009, p. 301.
[39] Op. Cit., p. 301-302.
[40] MENDES, Gilmar Ferreira; BRANCO, Paulo Gustavo Gonet. Course on constitutional law. 13. ed. São Paulo: Saraiva, 2018, p. 93.
[41] Op. Cit., p. 93-94.
[42] SILVA, José Afonso da. Course on positive constitutional law. 25. ed. São Paulo: Malheiros, 2005, p. 227-228.

As Konrad Hesse teaches[43], constitutional interpretation is subject to the principle of optimal implementation of the norm, which means that the interpreter must seek the meaning that best corresponds to contemporary needs and values, without neglecting the essence of the constitutional norm.

Evolutionary interpretation gains special relevance when it comes to constitutional norms with an open texture, such as indeterminate legal principles and concepts. In these cases, the interpreter has greater freedom to adapt the meaning of the rule to the new realities, as long as it preserves its essential core and its original purpose.[44]

An example of evolutionary interpretation is the application of the principle of equality. As Gilmar Mendes and Paulo Branco point out[45], equality has had its content redesigned over time, with a striking example being the evolution of the role of women in society. Thus, an evolutionary interpretation of the principle of equality must consider historical achievements and current demands for greater equality of gender, race, and sexual orientation.

Another fertile field for evolutionary interpretation is that of fundamental rights. With technological advancement and changes in social relations, new dimensions and challenges arise for the protection of human dignity. In this context, the interpreter must use an evolutionary approach to ensure the effectiveness of fundamental rights, such as the right to privacy, freedom of expression, and a balanced environment.[46]

However, evolutionary interpretation cannot be used in an unrestricted or arbitrary way. As Inocêncio Mártires Coelho warns[47], evolutionary interpretation has limits, and cannot cross the boundary between the application of law and the creation of law. The interpreter must respect the constitutional parameters and the fundamental choices of the constituent, avoiding distorting the original meaning of the rule under the pretext of updating it.

In addition, the evolutionary interpretation must be used with caution and transparency, always substantiating the reasons that justify the change in the meaning of the constitutional rule. The interpreter must demonstrate that the new interpretation is compatible with the constitutional system as a whole and that it meets the legitimate desires of society.[48] It is an important hermeneutic method that allows the updating of the meaning of constitutional norms, adapting them to social transformations and the new challenges of contemporaneity.

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[43] HESSE, Konrad. The normative force of the constitution. Trad. Gilmar Ferreira Mendes. Porto Alegre: Sergio Antonio Fabris, 1991, p. 22.
[44] BARROSO, Luís Roberto. Course on contemporary constitutional law. São Paulo: Saraiva, 2009, p. 292.
[45] MENDES, Gilmar Ferreira; BRANCO, Paulo Gustavo Gonet. Course on constitutional law. 13. ed. São Paulo: Saraiva, 2018, p. 178.
[46] SARLET, Ingo Wolfgang. The effectiveness of fundamental rights: a general theory of fundamental rights in the constitutional perspective. 13. ed. Porto Alegre: Livraria do Advogado, 2018, p. 67.
[47] COELHO, Inocêncio Mártires. Constitutional interpretation. 4. ed. São Paulo: Saraiva, 2011, p. 115.
[48] BARROSO, Luís Roberto. Course on contemporary constitutional law. São Paulo: Saraiva, 2009, p. 293.

PLURALISTIC HERMENEUTICS

Pluralist interpretation is a hermeneutic approach that recognizes and values the diversity of perspectives and actors in the construction of the meaning of constitutional norms. This conception is based on the idea that the Constitution is an open and dynamic document, which must be interpreted in the light of the different views and experiences present in society.

As Peter Häberle points out[49], in the process of constitutional interpretation, all state organs, all public powers, all citizens and groups are potentially bound, and it is not possible to establish a closed or fixed list of interpreters of the Constitution with *numerus clausus*. Thus, pluralist interpretation seeks to broaden the circle of interpreters, including not only judges and courts, but also the legislator, the public administration, organized civil society, and citizens in general.

This perspective recognizes that the Constitution is a collective project, which must be built and rebuilt continuously through dialogue and democratic participation. As Konrad Hesse states[50], constitutional interpretation is in reality one more element of the open society" and "all public powers, material participants in the social process, are involved in it.

Pluralistic interpretation values the diversity of voices and experiences in society, seeking to incorporate the perspectives of historically marginalized and vulnerable groups. As Jane Reis Gonçalves Pereira points out[51], constitutional interpretation must be sensitive to the demands of stigmatized groups and to the demands for recognition and social inclusion. Thus, a pluralistic approach must be attentive to issues of gender, race, ethnicity, sexual orientation, disability, among others, seeking to promote equality and respect for difference.

In addition, the pluralist interpretation values the role of democratic institutions and the public sphere in the construction of constitutional meaning. As Cláudio Pereira de Souza Neto points out[52], constitutional interpretation cannot be monopolized by the Judiciary, but must be shared with the Legislature and civil society. In this sense, mechanisms such as public hearings, *amicus curiae* and collective actions are important instruments to expand social participation and democratic control over constitutional interpretation.

However, pluralistic interpretation also faces challenges and limits. As Gilmar Mendes warns[53], "openness of constitutional interpretation cannot lead to a 'judicial populism', in which

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[49] HÄBERLE, Peter. Constitutional hermeneutics: the open society of the interpreters of the Constitution: contribution to the pluralist and "procedural" interpretation of the Constitution. Trad. Gilmar Ferreira Mendes. Porto Alegre: Sergio Antonio Fabris, 2002, p. 13.
[50] HESSE, Konrad. The normative force of the constitution. Trad. Gilmar Ferreira Mendes. Porto Alegre: Sergio Antonio Fabris, 1991, p. 22.
[51] PEREIRA, Jane Reis Gonçalves. Constitutional interpretation and fundamental rights. 2. ed. São Paulo: Saraiva, 2018, p. 217.
[52] SOUZA NETO, Cláudio Pereira de. Constitutional theory and deliberative democracy: a study on the role of law in guaranteeing the conditions for cooperation in democratic deliberation. Rio de Janeiro: Renovar, 2006, p. 5.
[53] MENDES, Gilmar Ferreira. Fundamental rights and control of constitutionality: studies of constitutional law. 4. ed. São Paulo: Saraiva, 2008, p. 1.

popular pressure overrides legal rationality". It is necessary to find a balance between democratic legitimacy and the preservation of constitutional values, preventing pluralist interpretation from resulting in arbitrary or counter-majoritarian decisions.

In addition, pluralistic interpretation requires a posture of dialogue and openness on the part of official interpreters, especially judges and courts. As Inocêncio Mártires Coelho points out[54], the new constitutional hermeneutics requires from the law enforcers an open, dialogical and reflective posture, which is capable of recognizing and valuing the plurality of perspectives and experiences present in society. This implies developing listening, empathy and intercultural translation skills, seeking to understand and incorporate different social views and demands.

Pluralist interpretation is a hermeneutic approach that seeks to expand and democratize the process of constructing constitutional meaning, recognizing and valuing the diversity of actors and perspectives present in society. Through dialogue and social participation, it seeks to promote a more legitimate and inclusive interpretation of the Constitution, capable of responding to the desires and challenges of contemporaneity. As Peter Häberle points out[55], "the pluralist interpretation of the Constitution is the appropriate response to the pluralistic society of our time".

Thus, constitutional hermeneutics is an art of interpreting that transcends the mechanical application of methods, engaging with the essence of the Constitution and its fundamental role in society. It reflects the tension and the solution between comprehensibility and comprehensibility, highlighting the universality and importance of the hermeneutic problem in the context of the human sciences and, by extension, in constitutional law.

These methods are not exclusive, but complementary, and must be used in an integrated and thoughtful manner by the constitutional interpreter. As Konrad Hesse teaches, "the different methods of interpretation have no autonomous meaning; they only acquire meaning in the context of interpretive activity as a whole."[56]

THE ART OF INTERPRETING

Constitutional interpretation is a complex and challenging activity, which requires from the interpreter not only solid legal knowledge, but also sensitivity, creativity and ethical commitment. More than a mere technique, constitutional interpretation is a true art, which requires specific skills and a reflective and critical posture.

[54] COELHO, Inocêncio Mártires. Constitutional interpretation. 4. ed. São Paulo: Saraiva, 2011, p. 159.
[55] HÄBERLE, Peter. Constitutional hermeneutics: the open society of the interpreters of the Constitution: contribution to the pluralist and "procedural" interpretation of the Constitution. Trad. Gilmar Ferreira Mendes. Porto Alegre: Sergio Antonio Fabris, 2002, p. 18.
[56] HESSE, Konrad. Elementos de direito constitucional do República Federal da Germany. Translated by Luís Afonso Heck. Porto Alegre: Sergio Antonio Fabris, 1998, p. 65.

CONSTITUTIONAL HERMENEUTICS AS A SCIENCE

Constitutional interpretation is a scientific activity, guided by rational and controllable methods and principles. As Inocêncio Mártires Coelho points out[57], "the interpretation of the Constitution, as a scientific activity, must be rational and objective, in the sense that its results can be justified and controlled intersubjectively".

This means that the constitutional interpreter must follow methodological rigor, basing his interpretative choices on consistent and transparent legal arguments. Constitutional interpretation cannot be an act of pure discretion or arbitrariness, but rather a rational and controllable process.

In this sense, constitutional interpretation cannot be an act of pure discretion or arbitrariness, but rather a rational and controllable process. The interpreter is not free to attribute any meaning he wishes to constitutional norms, but must base his choices on solid and coherent legal arguments. This requires from the interpreter a deep knowledge not only of the constitutional text, but also of the theory of interpretation and legal argumentation.

The interpreter must, therefore, use these methods in a judicious and justified manner, always seeking the best possible understanding of the constitutional text and the realization of fundamental rights and principles. As Konrad Hesse points out, "constitutional interpretation is subject to the principle of the optimal implementation of the norm",[58] which means that the interpreter must always seek the maximum effectiveness of constitutional norms, within the limits of their democratic legitimacy and their adequacy to concrete cases.

In addition, constitutional hermeneutics must take into account the peculiar nature of the Constitution, which is a political and legal document that establishes the fundamental guidelines of the State and society. For this reason, constitutional interpretation cannot be limited to a formalistic or strictly legalistic analysis of the text, but must also consider the values, principles and objectives that give meaning and unity to the constitutional order.[59]

Another important aspect of constitutional hermeneutics as a science is the need to substantiate interpretative decisions. The interpreter cannot simply state what the meaning of the constitutional rule is, but must present the reasons and arguments that support its interpretation. This reasoning must be clear, coherent and rational, allowing other interpreters to understand and critically evaluate the choices made. Only in this way will it be possible to establish a true dialogue between interpreters and society, ensuring the legitimacy and acceptability of interpretative decisions.

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[57] COELHO, Inocêncio Mártires. Constitutional interpretation. 4. ed. São Paulo: Saraiva, 2011, p. 115.
[58] HESSE, Konrad. The normative force of the Constitution. Translated by Gilmar Ferreira Mendes. Porto Alegre: Sergio Antonio Fabris Editor, 1991, p. 22.
[59] BARROSO, Luís Roberto. Interpretation and application of the Constitution: foundations of a transformative constitutional dogmatics. 7. ed. São Paulo: Saraiva, 2009, p. 296-297.

In this sense, constitutional hermeneutics as a science seeks to overcome the idea that interpretation is a purely subjective or discretionary activity, subject only to the will of the interpreter. On the contrary, it affirms the need for objective and controllable criteria, which can guide the interpretative process and guarantee the rationality and legitimacy of decisions. Only in this way will it be possible to build a true "science of constitutional interpretation", capable of facing the challenges and complexities of contemporary society.

PRINCIPLES OF CONSTITUTIONAL HERMENEUTICS

Constitutional interpretation is guided by specific principles, which guide the interpreter in the search for the meaning and scope of constitutional norms. Among these principles, the following stand out:

a) Principle of the unity of the Constitution: "the constitutional interpretation must be carried out in such a way as to avoid contradictions between its norms".[60] The interpreter must seek a systematic and coherent reading of the Constitution, harmonizing its provisions and principles.

b) Principle of practical agreement or harmonization: "the constitutionally protected legal assets must be coordinated in such a way that, in the solution of the problem, all preserve their identity".[61] Faced with tensions between constitutional norms, the interpreter must seek a solution that optimizes the realization of the conflicting values, without completely sacrificing any of them.

c) Principle of proportionality: "restrictions on fundamental rights, in order to be legitimate, must be adequate, necessary and proportionate in the strict sense".[62] The interpreter must assess whether the limitations imposed on fundamental rights are justifiable and compatible with the Constitution, avoiding excesses and arbitrariness.

CHALLENGES OF CONSTITUTIONAL HERMENEUTICS

Constitutional interpretation faces several challenges in contemporary times, which require the interpreter to have a critical and reflective posture. Among these challenges, the following stand out:

a) The complexity and dynamism of social reality: "constitutional interpretation must be able to adapt to social changes, without losing sight of the fundamental values and

[60] BARROSO, Luís Roberto. Course in contemporary constitutional law: the fundamental concepts and the construction of the new model. São Paulo: Saraiva, 2009, p. 302.
[61] HESSE, Konrad. Elementos de direito constitucional do República Federal da Germany. Translated by Luís Afonso Heck. Porto Alegre: Sergio Antonio Fabris, 1998, p. 66.
[62] MENDES, Gilmar Ferreira; BRANCO, Paulo Gustavo Gonet. Course on constitutional law. 13. ed. São Paulo: Saraiva, 2018, p. 185.

principles of the Constitution".[63] The interpreter must be attentive to changes in society and adapt the reading of the Constitution to new contexts and demands.

b) The tension between democracy and constitutionalism: "constitutional jurisdiction well exercised is a guarantee for democracy rather than a risk".[64] The interpreter must seek a balance between the protection of fundamental rights and respect for popular sovereignty and the separation of powers.

c) The need for dialogue and legitimacy: "constitutional interpretation, in order to legitimize itself democratically, must be open to the participation and criticism of civil society".[65] The interpreter must be open to the participation and criticism of society, seeking to build legitimate and consensual solutions to constitutional conflicts.

d) The risk of judicial activism: "judicial activism, understood as the expansion of the Judiciary to the detriment of the other branches, can lead to a 'supremocracy' and a 'juristocracy'".[66] The interpreter must be open to the participation and criticism of society, seeking to build legitimate and consensual solutions to constitutional conflicts.

In the face of these challenges, constitutional interpretation requires from the interpreter a solid legal background, a broad humanistic culture and a keen ethical and political sensitivity. More than a technician, the constitutional interpreter must be an artist, capable of combining methodological rigor and creativity, tradition and innovation, reason and sensitivity.

As Inocêncio Mártires Coelho states[67], "to interpret the Constitution is, therefore, to choose a mode of political and social coexistence, it is to opt for a project of society, for a model of institutional organization". The art of interpreting the Constitution is, therefore, an art of commitment and responsibility, which seeks to materialize the ideals of justice, freedom and equality enshrined in our Higher Law.

FINAL CONSIDERATIONS

Constitutional hermeneutics is an essential discipline for the understanding and application of constitutional norms, seeking to unveil their meaning and scope through different interpretative methods. More than a mere technique, constitutional interpretation is a true art, which requires from the interpreter not only solid legal knowledge, but also sensitivity, creativity and ethical

[63] BARROSO, Luís Roberto. Course in contemporary constitutional law: the fundamental concepts and the construction of the new model. São Paulo: Saraiva, 2009, p. 306.
[64] op. cit. p. 343.
[65] HÄBERLE, Peter. Constitutional hermeneutics: the open society of the interpreters of the Constitution: contribution to the pluralist and "procedural" interpretation of the Constitution. Translated by Gilmar Ferreira Mendes. Porto Alegre: Sergio Antonio Fabris, 2002, p. 33.
[66] VIEIRA, Oscar Vilhena. The battle of powers: from democratic transition to constitutional malaise. São Paulo: Companhia das Letras, 2018, p. 179.
[67] COELHO, Inocêncio Mártires. Constitutional interpretation. 4. ed. São Paulo: Saraiva, 2011, p. 163.

commitment. Throughout this article, the fundamental concepts of constitutional hermeneutics, its various forms, and the challenges faced by interpreters in contemporary times have been explored. It became evident that constitutional interpretation transcends simple textual analysis, involving a complex interaction between the normative text and the sociopolitical reality in which it is inserted.

In this sense, constitutional hermeneutics presents itself as a field of interdisciplinary study, which dialogues with various areas of knowledge to provide a richer and more contextualized understanding of constitutional norms. Through the application of principles such as the unity of the Constitution, practical agreement and proportionality, it seeks to harmonize the values and objectives inscribed in the Magna Carta.

Faced with the challenges imposed by the complexity and dynamism of social reality, the tension between democracy and constitutionalism, the need for dialogue and legitimacy, and the risk of judicial activism, the constitutional interpreter must adopt a reflective and critical posture, combining methodological rigor and creativity. Ultimately, the art of interpreting the Constitution is an art of commitment and responsibility, which seeks to realize the ideals of justice, freedom, and equality enshrined in our Higher Law. Based on constitutional hermeneutics, the interpreter assumes the role of guardian of the Constitution and of transforming agent of social reality, contributing to the construction of a more just, democratic and solidary society.

Legal practitioners need to be prepared to deal with emerging legal complexities, combining academic rigor and social sensitivity. This requires constant updating and improvement, as well as a critical and reflective posture in the face of constitutional norms. Only in this way will it be possible to build a more just, egalitarian and democratic society, in which fundamental rights are effectively respected and promoted.

REFERENCES

1. Barroso, L. R. (2009). *Curso de direito constitucional contemporâneo*. São Paulo: Saraiva.

2. Barroso, L. R. (2009). *Curso de direito constitucional contemporâneo: Os conceitos fundamentais e a construção do novo modelo*. São Paulo: Saraiva.

3. Barroso, L. R. (2019). *Curso de direito constitucional contemporâneo* (8ª ed.). São Paulo: Saraiva Educação.

4. Bastos, C. R. (1999). *Hermenêutica e interpretação constitucional* (2. ed.). São Paulo: Celso Bastos Editor.

5. Böckenförde, E.-W. (2000). *Estudios sobre el Estado de Derecho y la democracia*. Madrid: Trotta.

6. Bonavides, P. (2004). *Curso de direito constitucional* (15. ed.). São Paulo: Malheiros.

7. Canotilho, J. J. G. (2003). *Direito constitucional e teoria da constituição* (7. ed.). Coimbra: Almedina.

8. Coelho, I. M. (2011). *Interpretação constitucional* (4. ed.). São Paulo: Saraiva.

9. Diniz, M. H. (2014). *Compêndio de introdução à ciência do direito* (25ª ed.). São Paulo: Saraiva.

10. Friede, R. F. (2019-2020). Hermenêutica constitucional. *Revista da SJRJ, 23*(47), 13-32.

11. Häberle, P. (1997). *Hermenêutica constitucional: A sociedade aberta dos intérpretes da constituição: Contribuição para a interpretação pluralista e "procedimental" da constituição* (G. F. Mendes, Trad.). Porto Alegre: Sergio Antonio Fabris.

12. Häberle, P. (2002). *Hermenêutica constitucional: A sociedade aberta dos intérpretes da constituição: Contribuição para a interpretação pluralista e "procedimental" da constituição* (G. F. Mendes, Trad.). Porto Alegre: Sergio Antonio Fabris.

13. Hesse, K. (1991). *A força normativa da constituição* (G. F. Mendes, Trad.). Porto Alegre: Sergio Antonio Fabris.

14. Hesse, K. (1998). *Elementos de direito constitucional da República Federal da Alemanha* (L. A. Heck, Trad.). Porto Alegre: Sergio Antonio Fabris.

15. Kimura, A. I. *Hermenêutica e interpretação constitucional*.

16. Lima, I. M. *Métodos clássicos de interpretação no direito constitucional*. *Revista Brasileira de Estudos Políticos*.

17. Mendes, G. F. (2008). *Direitos fundamentais e controle de constitucionalidade: Estudos de direito constitucional* (4. ed.). São Paulo: Saraiva.

18. Mendes, G. F., & Branco, P. G. G. (2018). *Curso de direito constitucional* (13. ed.). São Paulo: Saraiva.

19. Mendes, G. F., Coelho, I. M., & Branco, P. G. G. (2010). *Curso de direito constitucional* (5ª ed.). São Paulo: Saraiva.

20. Pereira, J. R. G. (2018). *Interpretação constitucional e direitos fundamentais* (2. ed.). São Paulo: Saraiva.

21. Sarlet, I. W. (2018). *A eficácia dos direitos fundamentais: Uma teoria geral dos direitos fundamentais na perspectiva constitucional* (13. ed.). Porto Alegre: Livraria do Advogado.

22. Sarlet, I. W. (2018). *Curso de direito constitucional* (7. ed.). São Paulo: Saraiva.

23. Silva, J. A. da. (2005). *Curso de direito constitucional positivo* (25. ed.). São Paulo: Malheiros.

24. Souza Neto, C. P. de. (2006). *Teoria constitucional e democracia deliberativa: Um estudo sobre o papel do direito na garantia das condições para a cooperação na deliberação democrática*. Rio de Janeiro: Renovar.

25. Streck, L. (2017). Hermenêutica constitucional. In *Enciclopédia Jurídica da PUCSP, tomo II: Direito administrativo e constitucional* (recurso eletrônico). São Paulo: Pontifícia Universidade Católica de São Paulo.

Olympic values education: The historical evolution of a pedagogy, review of Binder's 2012 article

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ABSTRACT

The article "Olympic Values Education: Evolution of a Pedagogy" by Deanna L. Binder (2012) explores the evolution of Olympic values pedagogy through three distinct curricular projects. The main focus of the research is the effective integration of Olympic values into formal education and the enhancement of associated pedagogical practices. The goal is to analyze how theoretical principles shape pedagogical practice and how these principles were applied in the creation of the International Olympic Committee's (IOC) Olympic Values Education Program (OVEP). The methodology used in the article is historical and descriptive, involving a detailed literature review and analysis of specific case studies. Binder argues that the pedagogical practices discussed provide a robust theoretical foundation for Olympic values education, highlighting the creation of the OVEP toolkit that guides the practical implementation of these values. The results indicate that the approach focused on the "lifeworld," which integrates Olympic values into students' daily experiences, is the most effective. However, the research points to the need for additional empirical data and a more critical analysis of the cultural challenges faced. The study concludes that, while Binder's work offers a significant contribution to the pedagogy of Olympic educational values (joy of effort; fair play; respect for others; pursuit of excellence; and balance between body, will, and mind), the addition of empirical data and a more critical analysis of cultural difficulties could strengthen the research. Critiques of the Olympic ideal and reflections on the paradoxes of Olympic values are also addressed, offering a critical and enriching perspective.

Keywords: Olympic pedagogy, Values education, Curriculum, Educational theory.

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INTRODUCTION

The critical review is an essential tool for the dissemination and analysis of scientific knowledge, allowing for the evaluation and in-depth discussion of academic works (Machado, 1997). We present a critical review of the article "Olympic Values Education: Evolution of a Pedagogy," by Deanna L. Binder, published in 2012, which explores the evolution of the pedagogy of Olympic values, highlighting the importance of integrating these principles into educational projects. Binder argues that the legacy of Olympic education should serve as a bridge between the pursuit of excellence by elite athletes and the dreams of children.

This critical review aims to analyze the main points of the article and reflect on the contributions and limitations presented by Binder. The text is divided into sections that offer a chronological view of the evolution of Olympic values education programs, allowing the reader to follow the author's argumentative logic.

The methodology used by Binder is historical and descriptive, reviewing existing literature and analyzing specific case studies. An expanded empirical view of educators and program participants would provide a deeper perspective on the effectiveness of the pedagogical practices discussed.

The main contribution of the article is its ability to synthesize and analyze the evolution of the pedagogy of Olympic values. The author proposes that Olympic education should operate in the "lifeworld" of students, fostering positive transformations in their trajectories. Binder suggests that collective contributions to curriculum development have the potential to promote a robust theoretical foundation.

The article highlights the creation of the "toolkit" for the Olympic Values Education Program (OVEP) of the International Olympic Committee (IOC), which aims to guide educators in the practical implementation of Olympic values. This practical proposal is one of the most relevant aspects of the work, demonstrating the applicability of the concepts discussed.

Among the limitations raised by the author is the approach to cultural difficulties in educational communication, highlighting differences in European values in other geographic regions, religious beliefs, political impositions, and subjective issues. The author emphasizes that the Olympic educational theme of "respect for others" has been widely accepted globally, finding equivalents in other cultures, such as the concept of "ubuntu" in Africa.

The author also discusses how Olympic values can be interpreted and adapted in different cultural contexts. For example, representatives of the South African committee related Olympic values to the concept of "ubuntu," while Chinese Olympic educators associated these values with the concept of 和 合 (hé hé), which means peace, kindness, integration, and reconciliation.

Binder explores several pedagogical approaches to Olympic values education:

Knowledge-oriented approach: Focuses on the history and educational legacy of the Olympic Games, including information about the Ancient, Modern, and Contemporary Games, and emphasizes names, dates, and facts.

Experience-oriented approach: Provides experiences in "Olympic" festivals and competitions, promoting cooperation and international communication between educational institutions.

Physical achievements-oriented approach: Emphasizes individual and personal development through physical efforts and competitions, promoting systematic physical practices and training.

Lifeworld-oriented approach: Connects the social experiences of children and young people with sport, interpreting Olympic ideals as motivation for learning in all aspects of their lives.

The choice of the lifeworld-oriented approach (Naul, 2008) reflects Binder's pedagogical perception of the need to teach not only "what" should be learned but also "how" to teach these values meaningfully to students.

THEORETICAL FRAMEWORK

Binder adopts the concept of understanding, interpretation, and reflection proposed by Gadamer (1989), suggesting that practical application co-determines understanding. According to Gadamer, understanding is a process that involves interpretation and reflection, where practical application plays a crucial role.

Hans-Georg Gadamer's philosophical hermeneutics offers a profound perspective on the interpretation of texts and human understanding. In his major work, Truth and Method, Gadamer criticizes the objectivist and methodological approaches that predominated in traditional hermeneutics, proposing an approach that values dialogue, historicity, and the fusion of horizons between the interpreter and the text.

For Gadamer, understanding is not a merely technical process but a dynamic and participatory encounter between the reader and the text, where meaning emerges from the interaction between different temporal and contextual perspectives.

The examples addressed by Binder can be interpreted in light of Gadamerian hermeneutics to explore how the concepts and practices discussed reflect the fusion of horizons proposed by Gadamer. The curriculum projects can be analyzed through the following hermeneutical principles:

Historicity and Context: Gadamer emphasizes that understanding is shaped by the historical and cultural context of both the text and the interpreter. In Binder's work, the analysis of the context in which practices and theories are presented allows us to understand how these elements reflect and are influenced by specific historical and cultural times. Thus, historicity plays a crucial role in the

interpretation of the concepts.

Fusion of Horizons: Gadamer's idea that understanding occurs at the intersection of the horizons of the reader and the text is central to the analysis. The research should explore how the horizons of the author and the interpreter meet and influence each other. This may involve identifying how Binder's ideas engage with contemporary and earlier theoretical currents, as well as with the perspectives of readers or researchers.

Dialectic of Questioning: Gadamer values the dialectical process of continuous questioning in the pursuit of understanding. Binder's work can be seen as a space for critical and reflective questioning, where the analysis of the presented practices and theories not only answers questions but also raises new ones. This hermeneutical aspect allows for a richer evaluation of Binder's contributions to the field.

Applying Gadamerian hermeneutics provides a deeper insight into the practices and theories discussed, highlighting the importance of the interaction between the author and the interpretive context. The analysis should consider how the fusion of horizons and historicity influence the understanding of the presented concepts. Furthermore, the dialectical approach proposed by Gadamer offers a framework for the ongoing critical evaluation of the work, recognizing that understanding is an open and constantly evolving process.

The author argues that the personal subjective significance of Olympic values involves ethical choices and practical actions, integrating theory and practice in a dialectical manner, thus aligning with the theoretical framework chosen.

METHODOLOGY

The methodology employed in the critical review of "Olympic Values Education: Evolution of a Pedagogy" by Deanna L. Binder (2012) follows a detailed analysis framework that aligns with the theoretical guidelines for organizing and producing critical reviews, as discussed by Machado (1997). To ensure a critical and systematic evaluation of the work, the adopted methodology encompasses the following aspects:

- **Structural Analysis of the Text:** The review begins with identifying the essential elements of Binder's article, including the objectives, the methodology used, the main findings, and the conclusions. The methodological approach is based on a critical review of the content and structure of the original article. The analysis considers how Binder presents the evolution of the pedagogy of Olympic values and the practical application of the discussed concepts.
- **Literature Review:** The methodology includes an extensive review of the relevant literature to contextualize Binder's work within the field of Olympic pedagogy. This

involves consulting academic and theoretical works that address related themes, such as the evolution of Olympic values, pedagogical approaches, and critiques of the Olympic ideal. This review is essential to place Binder's article within the broader academic debate and to identify possible gaps and significant contributions.

- **Review Structure:** Following Machado's (1997) guidelines, the critical review is structured to highlight the main sections of the article and provide a critical analysis of each. The methodology involves organizing the text into sections corresponding to: (a) Introduction and Contextualization; (b) Analysis of the Article's Methodology; (c) Discussion of Results and Conclusions; and (d) Criticisms and Suggestions for Improvements. Each section is addressed according to Machado's proposed sequence, emphasizing clarity and organization in presenting content.
- **Critique and Reflection:** The critical analysis of the article is conducted based on a reflection on the contributions and limitations of Binder's work. This includes a discussion of the adequacy of the historical and descriptive methodology used, the importance of including empirical data, and the relevance of the cultural critiques addressed. The critique section also incorporates analysis from other scholars, such as Wamsley and Heine (1996) and Parry (2003), to enrich the discussion and offer a more comprehensive perspective.
- **Philosophical and Theoretical Aspects:** The methodology includes a reflection on the philosophical implications of Olympic values, drawing on Gadamer's (1989) ideas on understanding and interpretation. The analysis considers how the concepts discussed by Binder are applied in pedagogical practice and how they can be interpreted in different cultural contexts.

The employed methodology aims to ensure a comprehensive and well-founded critical review that not only evaluates the quality and relevance of Binder's work but also contributes to the academic discussion on the pedagogy of Olympic values.

RESULTS AND DISCUSSIONS

We present the summaries of the three projects developed and their culmination in the Olympic Education Toolkit proposed by the International Olympic Committee:

1. **"Come Together: The Olympics and You" (1987)** Developed for the 1988 Calgary Winter Olympics, this project aimed to create educational materials about the Olympic Games for all primary schools in Canada. Funded by the organizing committee, the project included teacher workshops and a school outreach program. Created in response

to a lack of knowledge about the Olympic Games beyond hockey, it sought to integrate Olympic information with existing school curricula.

- **Objective:** To increase understanding of the Olympic Games among Canadian children, particularly in Calgary, by providing an Olympic experience in schools.
- **Target Audience:** School-age children in Alberta and across Canada.
- **Main Issues:** How best to present the philosophy, history, and traditions of the Olympics to children? Alignment with Alberta Ministry of Education's policy for flexible integration of Olympic themes.
- **Theoretical Framework:** Based on Pierre de Coubertin's ideas to promote physical and moral qualities through sport and Howard Gardner's Multiple Intelligences pedagogical model.
- **Application:** Materials distributed before the Games allowed for the integration of Olympic themes into school plans, including festivals and school projects.
- **Critique:** While it received positive feedback from teachers and involved the Ministry of Education, the project was criticized for not emphasizing sports and physical activity, with criticisms about the superficiality of the approach to Olympic principles.

2. **"Fair Play for Kids: A Handbook of Activities for Teaching Fair Play" (1988)**
Developed by the Canadian Commission for Fair Play and distributed by the Canadian government, this handbook aims to promote values of fairness and fair play among children aged 8 to 12. The project emerged after the 1988 Olympics doping scandal, with the goal of encouraging the development of ethical values in sports and everyday life.

- **Objective:** To address the issue of doping and promote fair play; directed not only for physical education classes but also for other subjects.
- **Target Audience:** Canadian children aged 8 to 12.
- **Issues and Theoretical Approach:** Uses Kohlberg's theory of moral development to stimulate the resolution of moral conflicts and the understanding of ethical values.
- **Structure:** Organized into four themes: discussion of dilemmas, practical games and activities, historical exploration, and application of fair play in various areas.
- **Results and Critique:** Studies showed that the program improves children's moral development, but the handbook presents theoretical limitations, being criticized for not incorporating more comprehensive approaches to values education.

3. **"Be a Champion in Life: An International Teacher's Resource Manual" (2000)**
Developed by the Athens Foundation of Olympic and Sport Education (FOSE), this global manual aims to promote Olympic values through five main themes: physical activity, fair play, multiculturalism, pursuit of excellence, and the Olympic context.

Launched at the foot of Mount Olympus, the project aimed to reach children aged 8 to 12 in schools worldwide.

- **Issues and Theoretical Approach:** Challenges related to the relevance of Olympic values in non-Euro-American cultural contexts and the adequacy of proposed methodologies.
- **Application and Methodology:** Includes activities and themes to promote Olympic values, but faced difficulties in implementation due to a lack of an effective promotion plan and criticism over the lack of encouragement for critical thinking.
- **Critique:** Revealed tensions between Western pedagogies and local cultural traditions, highlighting the need to adapt educational resources to local cultural and educational realities.

4. **"Teaching Values: An Olympic Education Toolkit" (2007)** This manual from the International Olympic Committee (IOC) is part of the Olympic Values Education Program (OVEP). Developed to provide educational resources to developing countries, the toolkit is based on "Be a Champion in Life" and includes exclusive Olympic materials and photographs from the IOC archives.

- **Development:** Created after a meeting of experts in 2005, the toolkit focuses on five Olympic educational values: joy of effort; fair play; respect for others; pursuit of excellence; and balance between body, will, and mind. It aims to maintain young people's interest in sports and the adoption of the educational values of Olympism.
- **Target Audience and Challenges:** Expanded to include youth aged 8 to 18, the toolkit faced challenges in integrating Olympic values into diverse school curricula, with a flexible approach for primary and secondary schools.
- **Structure:** Includes sections on the introduction to Olympic values, celebration through symbols and ceremonies, sharing values in sports, and implementation tools.
- **Critique:** It was criticized for its difficulty of use without adequate training and for not fully aligning with the traditional emphasis on sport, but was praised for its positive impact on active learning methodologies.

INTERRELATIONSHIPS

The four projects share a common goal of promoting Olympic and educational values through pedagogical resources, but differ in their approaches and contexts of application.

"Come Together" and "Fair Play for Kids" focus on educating children about Olympic values and fair play, respectively. However, "Come Together" prioritizes integrating these values with

school curricula, while "Fair Play for Kids" emphasizes general moral development through diverse activities.

"Be a Champion in Life" and "Teaching Values" expand the focus to a global approach, promoting Olympic values in diverse cultural contexts. The former faces challenges related to cultural relevance and lack of promotion, while the latter offers flexibility for local adaptation but also faces criticism regarding the integration of values with pedagogical and sports practice.

These projects demonstrate an evolution in how Olympic values are presented and applied, with "Teaching Values" seeking to integrate previous experiences and provide a more comprehensive and adaptable approach to local needs.

GENERAL CRITICISMS:

Binder acknowledges the criticisms received by Olympic education projects and uses them as a basis for future improvements. One major criticism is the idea that promoting the Olympic ideal can be seen as an "ideological inscription" (Wamsley & Heine, 1996), educating citizens for a pre-arranged future. However, the author argues that negative aspects can serve as a foundation for proposing improvements, as in the case of the "Fair Play for Kids" project, which was inspired by negative events at the Olympic Games.

The author also addresses the difficulties encountered in exporting the Olympic education model to different global realities. Individualistic concepts of Western pedagogy, such as the "pursuit of excellence," were not well received in Asian and African cultural traditions, where humility and community responsibility are more valued.

An interesting point to correlate with the review is Parry's (2003) analysis of the paradoxes of Olympic values. Parry argues that, to be universal, the principles of Olympism must be immutable but, at the same time, different everywhere and reflective of social changes. According to Parry, there are fundamental differences between the Ancient and Modern Games, and between Coubertin's revivalist ideas and current ones. Social ideas, embedded in social practices, depend on a specific social order for their meaning to be fully exemplified.

Parry suggests that the concept of Olympism should be understood at a general level, allowing for various interpretations. Thus, promoting Olympic values should be seen as an educational task, where sport is a means to achieve international cooperation, mutual respect, and the peaceful resolution of conflicts. Multicultural education becomes essential to promote understanding and respect between different cultures, reflecting the idea that Olympic values can be adapted to specific cultural contexts, as highlighted by Binder.

Wamsley and Heine (1996) provide an incisive critique of the Olympic ideal, arguing that the codes of consumption established by the International Olympic Committee (IOC) and its supporters

manage a standardized and strategic cultural production. They highlight how Olympic ideologies are constantly adjusted to fit dominant political currents, creating a categorical structure of "circular ideas." This approach does not allow for an in-depth critique of the concepts and promotes a standardized meaning in events and tertiary programs.

The authors also address the reproduction of particular worldviews by the IOC and sports federations, perpetuating gender distinctions, patriarchal hierarchies, and the quantification of human efforts at the expense of health and safety. The legitimation of corporate ideologies and practices is obscured by a dominant discourse that invokes global harmony. Public resistance to these aspects, as in the case of the protest by the Lubicon Cree native peoples against the "The Spirit Sings" exhibition at the Glenbow Museum, during the preparations for the 1988 Winter Olympics, illustrates the tension between symbolic representation and the oppressive reality of cultural relations in Canada.

Wamsley and Heine argue that the Olympic experience is pre-constructed, from volunteers to the host community, through an intense educational program of Olympic discourse. This process of saturation with Olympic information transforms the perception of the event into a pre-designed ideology, obscuring contradictions and promoting homogeneous cultural consumption.

CONCLUSION

Deanna Binder, in her article "Olympic Values Education: Evolution of a Pedagogy," makes a significant contribution to the field of Olympic values pedagogy by providing a deep and well-founded analysis of the evolution and application of these values in an educational context. Binder effectively articulates the importance of Olympic values and how they have been incorporated into various educational projects over time. Binder's research not only sheds light on the historical development of these projects but also offers a critical analysis of the pedagogical approaches adopted, enriching the understanding of the role of Olympic values in education.

However, the analysis could be further strengthened with the inclusion of more robust empirical data, which would provide a more concrete view of the real impacts of these projects on educational practices and student behavior. The lack of an in-depth empirical analysis limits the ability to assess the practical effectiveness of the pedagogical methods discussed. The integration of case studies and qualitative and quantitative data could enhance Binder's analysis, offering more tangible evidence of the contributions and challenges encountered in implementing Olympic values in various educational contexts.

The critique by Wamsley and Heine (1996) adds an essential critical layer to Binder's discussion, highlighting the inherent contradictions and the phenomenon of standardized cultural consumption promoted by the International Olympic Committee (IOC). Wamsley and Heine's perspective underscores how the Olympic ideology is often shaped and adjusted to fit dominant

political and cultural currents, leading to a form of "circular ideas" that does not allow for an in-depth critique of the underlying concepts. The critique also emphasizes how Olympic ideologies are often adjusted to meet the needs and interests of the IOC and its sponsors, perpetuating specific worldviews and social hierarchies.

Additionally, Parry's (2003) analysis of the paradoxes of Olympic values provides an enriching philosophical perspective. Parry argues that for Olympic values to be truly universal, they must be both immutable and adaptable to social and cultural changes. This duality highlights the complexity of promoting Olympic values in a diverse global context. Parry suggests that Olympic values should be understood at a general level that allows for multiple interpretations and that promoting these values should be an educational task that seeks international cooperation, mutual respect, and the peaceful resolution of conflicts. This philosophical perspective complements Binder's discussion, emphasizing the need for an educational approach that is sensitive and adaptable to specific cultural contexts.

Therefore, Binder's work represents a significant step in analyzing the educational values of Olympism but also points to the need for ongoing and in-depth research on how these values can be effectively integrated and applied in various educational contexts.

REFERENCES

1. Binder, D. L. (2012). Olympic values education: Evolution of a pedagogy. *Educational Review*, 275-302.

2. Gadamer, H. G. (1989). *Truth and method* (2nd ed.). New York: The Crossroad Publishing Corporation.

3. Naul, R. (2008). *Olympic education*. Aachen: Meyer & Meyer Verlag.

4. Parry, J. (n.d.). Olympism for the 21st century. Available from https://www.researchgate.net/publication/228506316_Olympism_for_the_21st_century [accessed Aug 05, 2024].

5. Machado, A. R. (1997). A organização sequencial da resenha crítica. *The ESPecialist*, 17(2), 133-149.

6. Wamsley, K., & Heine, M. (1996). Tradition, modernity, and the construction of civic identity: The Calgary Olympics. *Olympika: The International Journal of Olympic Studies*, 5, 81–90.

The profession of sociologist-sociology: The theoretical-practical precepts, the technical practices and the professional procedures of knowledge of the human world

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ABSTRACT

In the nineteenth century, with the constitution of the capitalist system, social life coexisted with a situation of crisis and social pathologies that put at risk the very sociability of the political system in evidence. At this time, philosophical and naturalist thinkers and intellectuals considered the need for a field of scientific study that would study the causes and origins of social disturbances and problems: sociology emerges – the science of the direction and orientation of society. Its institutionalization process resulted in the professionalization of the sociologist or social scientist and in the school constitution of vast areas of teaching and research. Today, the training of the sociologist is outdated for the resolution of contemporary problems, mainly due to some theoretical-methodological inconsistencies that have not yet been diagnosed or defined with greater precision and methodical systematicity, such as, for example. the theme of subjectivity that has brought all kinds of forms of erratic perceptions and left social science at the mercy of all kinds of antagonism, oppositions and ambiguities of divergent interests and points of view. With the use of the hypothetical-deductive-inductive method of social science and procedures of methods and techniques of investigation, it was identified that social science was constituted on solid bases of scientific foundations that go back to ancient Greek thought, and as Auguste Comte had announced, when he defined the dimension of the social as an objective unit of sociology, conferring to its objectivity the maximum degree, even going so far as to call sociology – the science of the direction and organization of society – as social physics and social mathematics due to its high level of sociological precision of its scientific procedures, in line with the interpretations and explanations of the course of events, facts or phenomena of life in society.

Keywords: Social science, Sociology, Rationality.

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INTRODUCTION

Political systems are directed in a progressive or regressive trend according to the historical context, the relationship with the natural environment and the human world, and according to human action and its meaning attributed to its orientations. In its tendency, it contains the factorial filaments of people that are detached in relation to these mentioned aspects, configuring themselves in territories and expressing themselves in the most varied forms of social categories, professions, professionalizing strata to meet the needs of the evolutionary process that such a political system demands. Political systems, therefore, express the characteristics and factorial compositions of people in their six fundamental factors – the political, the economic, the religious, the cultural, the conscious, the social – and are distributed according to the needs of the moment, the historical context, the relationship with the natural and social environment to ensure their progressive tendency to attend to the substantive needs of this same system. This dimension of the social that directs and guides political systems as an expression of the factorizations of the person contains as the main aspect of its tendency a psychic character that characterizes human consciousness – the notion of human progress – which, as a psychic procedure, is responsible for providing the factorial processes and expressing them through their concrete conditions in the configuration of the political territory and its social composition through the most varied forms of professionalization and social more varied forms of social and technical procedures that guarantee the stability of social relations and their interdependencies of their groups, their estates, their professional categories, their technical segments with the objective of guaranteeing the stability of the social order and their performance of human development in a tendency of equilibrium and/or imbalance.

The contemporary situation of the political systems that were defined in the nineteenth century, presenting their most defined configuration in the scientific sense, was expressed with the constitution of sociology as a science of orientation and direction of societies. Sociology arises with the purpose of identifying and defining the causal laws of human progress that direct the forms of sociability, with the purpose of guiding and directing the tendencies of political systems through the scientific perception that, at that time of the emergence of the capitalist system, lived in a situation of chaos. The main precursors were Saint-Simon (1760-1825), Hegel (1770-1830), David Ricard (1772-1823), Charles-Louis Secondat Baron de Montestquieu (1690-1755) and the main founders Auguste Comte (1798-1826), Karl Marx (1818-1883), with Emile Durkheim considered the professional leader of sociology to its disciplinarization, standardization and academic autonomy in 1950 (MUCHIELLI, 2001)

In the developing countries of Europe and the USA in the 1950s, social science is already in its established phases. In the text by Evaristo Morais Filho (1980) *Regula da Profissão de Sociologist*

, the author mentions the International Classification of Types of Profession, published in 1958, in which the profession of sociological is defined as follows (free tradition):

> Sociologist – the professional who researches the origin, evolution and way of life and social relations of human groups, interpretation of scientific information concerning collectivity, social customs, the family, and other social phenomena, the intention of administrators, educators, legislators and other groups and/or institutions to change and solve social problems. A particular branch of sociology is a set of disciplines: criminology, demography, the study of penitentiary regimes, social ecology, social pathology, rural society, urban or industrial society (MORAES FILHO p. 63-64)

In Brazil, social science was institutionalized with the creation in the city of São Paulo of the School of Sociology and Politics in 1933; in 1934, the Faculty of Philosophy, Sciences and Letters; the departments of Sociology and Anthropology created in 1947. In 1935, the Brazilian Society of Sociology (SBS) was created, linked to the International Sociological Association since 1950. In 1954, the first seminar and symposium on Sociology was organized in the city of São Paulo and in 1954 in Belo Horizonte with the theme development and social change (MORAIS FILHO, 1980).

In this process of constitution of sociology as a science and of the sociologist or social scientist as a professional of science, of the study of human actions and their organizational forms of existence, of their process of progressive development and of the modalities of social practices oriented towards the objective procedures of the professions and professional practices of their respective professions, some problems of incompatibility in sociological training in the contemporary period were registered and require an evaluation process for the improvement of the sociologist's own professional training processes:

i) there was a different treatment of the training of the bachelor's and the licentiate; ii) importance was given to theoretical issues to the detriment of sociological practices for preparation for the non-academic labor market; iii) there is also a gap in the general training of the sociologist that does not include didactic and pedagogical disciplines in the areas of bachelor's degree and even in graduate studies. Baltar and Baltar (2017) observed that the training of the graduate in sociology or social science and the bachelor's degree insofar as the bachelor's degree is the sociologist professional who works in the field of institutions of the political system and not in schools or universities. He needs better and more expanded professional and technical skills on the sociological profession that prepares him for the job market in the various spaces in which he works. The predominance of the intellectual aspect over the operational aspect of the profession in non-academic institutions, as well as the absence of pedagogical didactic skills and contents, constitute the various problems currently mentioned by academic works. In this sense, this research work seeks to investigate the various problems related to the profession of the sociologist and the competencies that the current context requires for this scientific and professional field to adapt to the demands of the context and the professional competencies for the attention of professional, technical and intellectual action in a form

of coexistence in this contemporary period that is very different from the sociology of the nineteenth century.

GENERAL OBJECTIVE

The general objective of this research is to investigate the trajectory of social science – sociology – and the formation of the sociologist, its process of institutionalization and standardization and its academic and professional competences in order to verify its correspondence with the contexts of contemporary political systems.

SPECIFIC OBJECTIVES

1. To investigate the process of constitution of social science – sociology – the constitution of the profession of sociologist, its professional delimitation, its technical and professional attributions and its tasks, and the methodological bases of its scientific and technical rationality.

METHODOLOGY OR MATERIAL AND METHOD

The methodology of this synthetic research proposal is guided by the hypothetical-deductive-inductive method that considers that the analysis and judgment of the empirical aspects of the objective reality is presented to the intelligible perception of the observer through a formulation of a probabilistic theoretical-practical-observational-empirical statement that guides him based on the recurrent experiential experience of the constant past, considering the selection of a thematic event with its phenomenal facts to start of the investigation examination of him a posteriori through a survey of material and empirical sources to verify the validity of his initial postulation or to redefine his premises that informed the data collected. In other words, the investigation of a phenomenal reality presupposes an initial formulation that guides documentary and material research, which, in turn, validates or requires a reformulation of its initial questions, in terms of objectivity, to conclusive findings. In this sense, the methodology thus defined in this research postulates the basic principle of sociology that social action is constituted of rational meaning (Weber, 2005) and that agents act based on the fact that there is a reason for them to do what they do (BOURDIEU, 1987; 2004) and that the process of development for this reason in the stage of the evolutionary phase in which it is in the present moment contains in reality that the environment It presents the unfolding of a deliberate, planned, intentional procedure, which followed the definition of objectives and desired goals of directions that need constant evaluations and diagnoses to redefine the interventions that guarantee their progressive tendency of development from this analytical understanding because scientific research postulates that in addition to the agents acting rationally, they leave marks in the territorial

contexts of the political regimes where they operate allowing the correspondence between political system and social action in order to allow a mapping of the causal relationship between science and political regime and the effects of these relations (social, pathological problems or normal practices) as a result of the implementation of the of human development policies. In this sense, the applied technical method that will guide this investigation, which aims to identify and qualify the profession of the sociologist – or the social scientist – through the relationship of an investigation on the professional conditions of social science – the formation of the sociologist, will be instrumentalized with scientific information, scientific texts (theses, dissertations, academic books, etc.) for situational mapping of the profession of the sociologist – social scientist – the levels of knowledge available in their professional competencies in academic institutions and in non-academic activities in social science and their respective sociological understandings for summative combinations of the intersections of causality and effects between science or progressive professional practices and the processes of adaptation of the profession of the sociologist or social scientist. This stage of research will be accompanied by a mapping of the social problems of adaptation of the profession of the sociologist, of his processes of constitution as a professional of social science – which deals with social problems and studies – from the collection of documentary, statistical, journalistic material, observation, on the problem conditions and promising conditions of these environments researched on the condition of the sociologist. These stages will allow the production of a thematic design of the relationship between social science and the sociologist's profession and the historical context of the profession, its adaptation or non-adaptation – effects of this relationship with synthetic results to support the intervention strategies for the adaptive professionalization of the sociologist in the contemporary context of the sociologist. market and institutional systems of contemporary political systems with the objective of promoting the prosperity and social progress of the State of Acre.

EXPECTED OUTCOMES

1. Conducting a bibliographic survey on social science – sociology – and the profession of sociologist with the objective of identifying the process of constitution and institutionalization of this disciplinary field of sociology and the bases of its scientific and technical rationality.

RESULTS AND DISCUSSIONS

TEXT SUMMARY OF THE PROBLEMATIC OF THE PROJECT THE PROFESSION OF THE SOCIOLOGIST: THE CONSTITUTION OF SOCIOLOGY AS A PROFESSION.

Political systems move in a tendency of equilibrium or imbalances, or in an asymmetrical or symmetrical way, depending on the procedures that guide the actions of social agents, whether

rational or irrational, whether of forms of cooperation or of selfish forms. Political systems follow trends of equilibrium or imbalance, considering the historical context, the natural contextual conditions and the knowledge available for the survival of the political system and its different social groups, which are constituted by the social division of labor, which gradually differentiates itself due to the need to divide tasks and daily tasks into the different modalities of productive and economic activities. the tasks of residential, administrative, organizational, artisanal, commercial, industrial tasks, through extractive and productive forms of food supply, animal husbandry, associated with forms of social protection of shelter of clothing, and cooperative social relationships consistent with the possibilities of social organization that provide stability and social organicity. In this process of survival and constitution of the political system or the search for forms of survival and organization of the political system, its search for organization and functionality structuring with its normative forms and administrative procedures consistent with the modalities of mutual coexistence in its geographical and administrative configuration that were defined in groups, in villages, in communities, in cities and states in empires with their geographical configuration of the division of rural and urban – in which the urban environment constituted administrative, governmental, industrial and commercial activities and urban services and the rural environment was configured as a space of production of the primary sector of productive, extractive activities, animal husbandry and agricultural production and in living and living space – this is how the political systems that came to its modern condition of contemporary times definitively defined in geographical and administrative terms and in its most varied associative forms with the separation of two world geopolitical systems – the systems of socialist and cooperative tendencies and the systems of capitalist tendencies: *egoistic*. Nowadays, these two profiles of social systems coexist with variations of other social systems as mixed possibilities of these and with differentiated characteristics of opposing interests and distinct antagonistic social disputes. In this context of opposition of interests, antagonisms and processes of cooperation, the forms of social knowledge – social science – varied and gained greater or lesser importance in these two profiles of social systems and, although social science has been recognized and constituted theoretically and methodologically as the science of the study of the human world since the end of the nineteenth century – with its legacy formulated by the pre-Socratics from the twelfth century onwards b.c. – in a legitimate way the Its intervention in the decision-making processes of the development of social political systems has not yet gained the importance of its scientific status.

The entire organizational and functional dynamics structuring political systems – and their professional labor categories – with their moral precepts and ethical principles of mutual coexistence, obeyed this dynamic trend in such a way that the professionalizing activities, the daily work, the tasks necessary for the survival and supply of the political system and its dynamic organization were

gradually constituted, configured by the needs of the context, of the available knowledge, of the favorable geographical and natural conditions for the adaptive and evolutionary processes of the human condition administratively organized in a normative way with the conditions of sociability of social and human relations necessary for the processes of crystallization of the modalities of practices consistent with the productive and formal social activities of sociability to guarantee the collective coexistence of the different professionalizing social groups in the conditions of dynamic antagonism. In the combination of relations and contacts of cooperative and egoistic forms, the modalities of forms of sociability obeyed in multiple situations the conditions of social conflicts that drove the different forms of disputes – of political and economic power – even in the context of the establishment of the professionalizing social categories necessary for the maintenance and functionality of the social system for the professional production of objects, goods or products necessary to supply the political system. If we had to demarcate the forms of opposition of interests and the structuring of the groups of political power that have reached the contemporary period in this same antagonistic dynamic that have directed the Western social system of tendency of imbalance, we could define it as the establishment of the Roman Empire since the death of Alexander in 323 B.C. C. until the conquest of the Hellenized world by the Romans in the year 30 BC. C. (GUINER, 1982).

THE SOCIAL DIMENSION – THE SOCIAL KNOWLEDGE OF THE HUMAN WORLD

All modern scientific knowledge of the natural world and the human world was created in ancient Greece (PROENÇA ROSA, 2012) of the approximate period that comprises the twelfth century a. C. and especially from the eighth century a. C. com the productions of Hesiod and Herodotus, for example (GINER, 1982). The origin of rational scientific thought or the search for understanding the natural and human world in a rational way through the use of cognitive and knowable intelligence and its various intellectual resources such as evaluation, analysis, diagnosis, synthesis, judgment, judgment, intuition is related to a way of thinking that did not make use of theological or mythological arguments from that period of time in archaic Greece, a way of thinking that could understand phenomena, social facts, events, happenings from their concrete and material evidences that are expressed in phenomena and in natural and human life according to their logics of realization and seeking to identify their regularities, their recurrences, in a word, the invariable laws of the natural world and the social human world. In this sense, the knowledge of the social philosophy of that Greek period had as its first disciplinary field of social science: History. Historical science was the first form of social knowledge that preceded the knowledge of social science – sociology – because it was in this science that one could seek the understanding of the recurrences and developments of phenomena, events and happenings as they happened and of their logic and

inherent meaning present in them as well as of their institutional structures that supported them. In that period, it was considered that the most efficient or most productive way for the process of producing knowledge of the human world would be to resort to the past in search of the regularities of social events and phenomena and their constancies and recurrences, their processes of changes and transformations and the ways in which they proceeded throughout historical time, seeking to identify the mental structures of social agents and material structures – trying to identify its invariable laws that gave it orders, its instabilities and/or stability, and that chained its institutional actions and material social actions – which simultaneously and coexistingly constituted and weaved social institutions with their prescriptive and objective character from the meanings attributed to concrete and pragmatic actions, objectified in artifacts and institutionalities and in social relations in a crystallized way in procedures and modalities of social practices that followed and obeyed the prescriptions of the orientations and the intended meanings that the social structures attributed to them with their causalities and effects related to the impulses that stimulated and preceded them.

With these investigations and preliminary findings of that historical period, the conclusion was reached, in modern and contemporary times, that the dimension of the social contains ontological attributions and attributes that guide them according to the configurations of consciousness, of their available disciplinary aspects and properties and of their institutional material structures that guide them, which detach the processes of socialization and rationalization from the worlds – natural and social – through the cognitive and rational mechanisms of the intellect that, in contact with the natural and social environment and with the pressing needs of the existence of the life that contains them, for the existential maintenance of survival and material well-being, which allow intellectible mechanisms to face the challenges present in historical contexts, for the search for the progressive process of development of the social groups in evidence.

In this process of development of rationality – of the natural and social world – the law of human progress or the law of human regression gained conceptual and pragmatic importance due to historical observations of both the ancient Greek world from the twelfth century to the twelfth century. C. in which its following four centuries produced a period known as the period of darkness due to some deregulation and social pathology, there was a regressive process of the forms of social life with the precariousness of the forms of languages, writing and even technological performance, having its phase of progressive ascension again from the eighth century a. C., as well as the period considered medieval in which for practically X centuries, from the fifth century to the fifteenth century of our historical era, we lived with a theological orientation that marked an era of great, obscurantism, conservatism, misery and social exploitation with the return and instabilities of many ways of life, including the procedures of blocking rational development, that only from the end of the fourteenth century with the Renaissance (PROENÇA ROSA, 2012) and from the period

considered modern – from the fifteenth century onwards – with the scientific discoveries and productions of philosophy and social philosophy with Francis Bacon (1561-1626), Galilei Galileo (1564-1642), Rene Descartes (1596-1650), Isaac Newton (1642-1727), Charles Lois Montesquieu (1689-1755), John Locke (1632-1704), Jean Jacques Rousseau (1712-1778), Thomas Hobbes (1588-1679), René Descartes (1596-1650), Immanuel Kant (1721-1804), Jean Antoine Condorcet (1743-1794), Jean Le Rond D'Alembert (1717-1783), etc., brought the phase of human progress to the period we know as modernity and the contemporary period. With these scientific movements and these movements of new forms of perceptions and ideas that began with the Renaissance, Humanism, Enlightenment, modern studies (PROENÇA ROSA, 2012; BARRY, 1971) about the law of human progress and its process of rational development found that through historical observations and the study of the past of ancient societies, especially Greek and Roman society, the law of progress could be considered progressive or regressive – progressive when guided by human reason – regressive when guided by irrational mechanisms or of a theological and/or monarchical nature theological (theocracy) with irrational principles Dogmatic. With these scientific findings, the need for a dogmatic departure from the obscurantist theological thought of the medieval period was considered and the possibility of the human being achieving an advance towards the social perfection of society through overcoming the irrational aspects of the egoistic system and achieving a continuous process of evolution of the human condition based on the precepts of rationality as a guide and guide for social actions using the same precepts and laws of natural science - constituted of invariable laws - and adopting this same procedure for social science - the human world that is also constituted of invariable laws - as had already been proven by the thinkers of the Encyclopedia, Illustration such as Condorced, Vico, Kant in which they suggested that through the identification of these invariable laws it would be possible to identify the causes of social problems and to modify such problems social for the establishment of sociability through the correction of social institutions, legislative procedures and through the use of educational processes of equality, it would be possible to improve the access of the different social classes so that education could reach the social strata of workers and the practical, pragmatic and utilitarian mentality could be part of people's social consciences so that they could visualize the liberating effects of ways of thinking based on rational intelligence.

In this general context of the Renaissance period, Ilustração, of the Encyclopedia that opens the contemporary modernity we know today, which began in the fifteenth century, John Bary (1971) in his book **The Idea of Progress** and Salvador Giner (1982) in The **History of Social Thought** take stock of the problematic issues of that historical period marked by obscurantism, dogmatism and theological and theocratic conservatism bringing the aspects of a social philosophy, the most relevant for the understanding of the theme of knowledge of the social world – and of the natural world that preceded it – and its implications about the possibilities of modifications and alterations in the course

of events at that moment when the social situation presented itself as one of the most precarious possible. In this medieval period – which we can locate in a didactic way as a definition of the important events in history that define the course of the human world in the period that includes the fall of the Roman Empire in the fifth century until the capture of Constantinople by Turkey in 1453 – its most important and prominent feature consisted in the predominance of Judeo-Christian thought of the Hebrew culture that came from the 12 Hebrew tribes living in Palestine. Its main characteristics, in addition to Judeo-Christian thought, consisted of a political system based on the use of land by relations of vassalage-person/family dependence – called the feudal system – and the political power of this same social system was divided between the monarch-emperor and the pope (GUINER, 1982). This medieval period was considered by many authors – especially the period of the 5th-8th-9th century – as a period of chaos, confusion, obscurantism, dogmatism and blockage of rational and scientific thought, a dogmatic period, therefore irrational. In the economic sense, the medieval world was a world based on servile labor and the existence of feudal latifundia. The productive activity was agriculture and animal husbandry, especially for the subsistence of its different fiefdoms, which had varying sizes, as they obeyed a title relationship of the feudal lords. The mental structures and forms of perceptions of this medieval Judeo-Christian environment guided by a theology that guided actions and forms of behavior found their explanations in a theology that justified its social structures that articulated from the peasant-serfs, the workers of the guilds' trades, merchants, feudal lords, monarchs and clerical chiefs. In the set of mental structures and mentalities that populate the forms of people's consciences and that gave unity and structured the power relations of the feudal system, the *notion of original sin deserves to be highlighted*, which explained a series of situations that were part of the system as the justification of the forms of social inequalities that organized the medieval structure and from it also came the justification of *human* degradationwhich guaranteed the possibility of the feudal social system producing prejudices, social injustices and all forms of precariousness of the lives of those who were considered inferior, such as serfs and enslaved people, in which in the context of this social system, *priests*, *clerics* and people of monarchical lineage were considered superior and positioned in the strata of the superior social structure of the medieval structure. This way of thinking, which guided and guided the whole of medieval social action, proposed an appreciation of the *spiritual world* and a devaluation of life in *the earthly world*, imposing restrictions and limits on scientific technological processes. In this medieval period we can see that their trajectory in the process of human development was regressive in many situations and that these theological aspects that guided them justified their classification as an obscurantist period – *for five centuries, from the fifth to the tenth century, the power of the pope dominated the monarchical power and this entire period was dominated by the dogmatic thought of clerical theology with its injustices and corruption*. However, the medieval period is not a homogeneous

period, but marked by power disputes, mainly over the definition of the delimitation of domains and the nature of the domains of earthly power – of the human world – and spiritual power – of spiritual life, divided between the powers of the monarch and the clerical leaders. These two spheres of power marked the entire trend of the medieval world in terms of their dynamics of inclinations, whether more regressive or more progressive, because associated with the power of monarchs, of the human world, was linked to the notion of rational of the human, science, technique and spiritual power, the devaluation of this earthly world and the valorization of the spiritual world, and therefore, the detachment from this world in relation to the processes of economic and productive development, for example. One of the results of this dogmatic way of thinking is the devaluation and condemnation of usury, progress and material wealth. The medieval world was a world that devalued earthly human life and forms of life from this period we can see from the accounts of scientific historical texts that it was a world focused on productive subsistence activities based on very rudimentary ways. This form of abnegation of the earthly world, associated with the notion of original sin with the justification leading to the necessary character of human degradation, caused the consequences that were propitious to them for the maintenance of a spiritual power in the human world without many limits and regulations – although there was a dispute for the power of the domains of these two worlds between monarchs and ecclesiastics – having as one of the results the devaluation of manual and technical work and the characterization of them as degrading, justifications that allowed the processes of domination of clerical power over social groups considered inferior or degrading and the support of dominant monarchical clerical groups of lineages considered deified – each person would have his or her position according to his or her birth in the social space (GUINER, 1982). All these characteristics were generalized throughout the medieval period and they sustained its entire structure of social inequalities and exclusions justified in a natural way through these dogmatic and irrational precepts.

The resurgence of the cities – in the Renaissance period – took into account all these mental aspects that populated the mentalities of the people who lived in the medieval period with greater or lesser intensity of convictions. The notion of renaissance is associated with the period considered to be of great decadence and historical regression and the first signs of signs of stability and constant progress that begins from the tenth and eleventh centuries, with the structuring of the towns of the principalities and ecclesiastical citades, administrative and military centers, with judicial and financial authorities that, through the encouragement of productive activities – after their borders garrisoned and out of the dangers of the suggested invasions, They began to have a stability of social functioning, with regular fairs that allowed the maintenance of the principalities and ecclesiastical cites that divided the government of the resident population within the human and spiritual world. With these activities of regular fairs and economic exchanges that began to foster the collections and

activities of the peasantry in the vicinity of these settlements of towns and cites, the configuration of the political-religious system (theocracy) of the feudal system without the presence of the enemies who had previously adorned them showed its first signs of rebirth with the commercial activities internal to their territorial circuits through the realization of these fairs that They boosted industrial activities and allowed the flourishing of medieval cities again in the same places as the old cities, in their surroundings and in the vicinity of the cites and towns, but under conditions extremely different from the former, in the first place, because the municipal organizations came to exist as their own organizations, detached from the feudal system and its relationship of personal interdependence of subordination-domination, and constituted themselves as an independent form of municipal government that had as its main concern the protection of citizens and the people who lived there; At this time, a system of rights was elaborated, a legality of mercantile activities, merchants began to enjoy commercial freedoms, having free work as a behavioral ethic that would guide productive activities and allow social mobility and material prosperity through professional effort and dedication in the various activities of commercial, labor, industrial, agricultural trades. An ethic of wealth was created that did not threaten and did not contain any kind of prejudice against material prosperity or against religious dogmatisms condemning the material improvement of social life of the different social strata and not only of the social groups of the nobility or the clergy. In this sense, there was an appreciation of the earthly human world guided by human natural reason, the person also began to obtain civil rights that allowed them greater rights and freedoms in the cities. This renaissance through the commercial and industrial flourishing in the circuits of medieval cities from the tenth century onwards had as its main emerging social group, social class, *the bourgeoisie*. The bourgeois and the bourgeois cities found their most definitive and most typical-ideal form to use a Weberian category in Italy, in the cities of Venice, Florence, Genoa (GUINER, 1982; PIRENNE, 1972) representing the initial process of secularization of the Western world that would take place in the distant future of what was its starting point, in the fifteenth century – the beginning of the modernity of the rational human world.

THE CONSTITUTION AND INSTITUTIONALIZATION OF SOCIOLOGY – THE RATIONAL KNOWLEDGE OF THE HUMAN WORLD – AND THE PROFESSIONALIZATION OF THE SOCIOLOGIST

All the antecedent aspects of social philosophy that date back to the Greek period and that emerged as an emergence of material and moral conditions in the final period of the Middle Ages, at that moment considered the first of the Renaissance movement, from the tenth and eleventh centuries, due to the social needs that arose with the emergence of the commercial and industrial bourgeoisie with its new mental forms of perception of the human world and the valorization of the

The material world that culminated in the Industrial Revolution and the French Revolution of the nineteenth century brought the demand for a new disciplinary field that could be able to explain that situation of chaos, crisis, anarchy, disorder that at that time coexisted with social transformations – new emerging social classes, social conflicts, urban violence, unstructured traditional institutions, industrial productivity – happening at the same time with negative and positive effects for the population as a whole.

The science of society – sociology – was then created by Auguste Comte in 1839 – with the publication of his Course on Positive Philosophy – when for the first time the word sociology was used to refer to a disciplinary field to study social phenomena, that is, a field of investigation to seek to identify the invariable laws that govern the existence of social groupings, constituting itself as the science of the human whole, fact and phenomenon, of the totality of the human, because every human phenomenon is sociological (GUINER 1982; HOSTOS, 1904). The historical context of the nineteenth century presented a series of questions and foundations that were the foundations for the constitution of sociology as a social science. One of the first fundamental aspects that stimulated the ways of thinking at that time was the debate on the revision of the human tendency, in which the law of progress and the law of regression were identified as invariable laws of human nature, through comparative studies of past times and in the face of the medieval period, which present a situation of decadence. The preceding theme that allowed the consideration of the law of progress and regression was related to the nature of natural science, which had identified that in nature there were invariable laws that regulated the nature of natural phenomena and events, and that in these laws there were the characteristics and properties of natural objects through which the description and identification of them allowed human reason to transform this nature into commodities, objects, in technology, in their favor for the enjoyment of humanity. So we have that social science, from the review of the historical trend of the human condition, it was possible to identify that also in human and social life there were invariable laws that regulated the social nature and political systems. One of the first invariable laws identified was the *law of progress and regression*. This law of progress was, in turn, associated with human rationality and its moral precepts and principles of social justice, and from the combination of these aspects, material and moral performance could be achieved in the evolutionary process of the human condition, through a temporal identification of time, past, present and future, in which the overcoming of old irrationalities could be modified by changes in institutional forms and rationally identified moral precepts. The law of human regression, in turn, was linked to irrational and dogmatic values linked to irrational religious precepts that, with the devaluation of the earthly world and its many moral prejudices, produced a moral decadence of the human being and its scientific and technological processes: this was the situation of the Middle Ages, especially from the fifth century to the tenth century The foundation for the constitution of sociology as a science of the

human: the human condition is evolutionary and progress is the inherent aspect that is associated with its progressive evolutionary form in moral, political, economic, technical, scientific and material terms. Considering social science and its constitution containing the same characteristics as the science of nature that proceeded with it, that is, that human and social nature is evolutionary and is constituted by invariable laws and that one of its main invariable laws is the law of human progress that depends on a combination of precepts and moral values of social justice as a whole and levels of accumulative knowledge that give off more evolutionary forms of social thinking and doing, its founder Auguste Comte, through his various writings on the systematization of knowledge of social philosophy, defined the precepts and indicated the methodological possibilities of this social science, defined by him as mathematical physics or social physics – *sociology*. Considering the situation of the nineteenth century, perceived by everyone at the time as chaotic and crisis, he identified that the main objective of positive science was to identify the invariable laws of modern society – industrial-capitalist – for the reestablishment of social order, social cohesion, and social stability. He identified as the main characteristics of modern societies of that early period a situation of social anomie – absence of rules – due to the process of individualization resulting from the transition from organic societies to mechanical societies, due to the increasingly stratified and specialized social division of labor tending to favor the processes of individualization and constitute a threat to collectivized and socialized life. This individualization was also related to the decay of irrational dogmatic values that were no longer able – due to their degree of corruption and dogmatic prejudices and irrationalities – to guide people's conduct as happened during the feudal period. In this sense, he identified that in the historical course of human trajectory there have been three forms of knowledge that have directed the condition of societies and that defined their nature – whether progressive or regressive – depending on the combination of what Auguste Comte called the law of the three states – the theological (inventive), the metaphysical (abstract), and the positive (the scientific). These three stages have been present since the beginning of time and have combined in different ways and forms with the predominance and dominance of one over the other or one over the other, and the modern period is characterized by the positive state – science. Since human nature has chosen the positive state for the direction of human societies because the laws of progressive progress depend on the reasons of science for its evolutionary process to be cumulative of material, social and moral prosperity for the population as a whole, the founder of sociological science considered – due to his evolutionist influences of Charles Darwin – that social life – society – is a social phenomenon and that it can be compared to a living organism because the origin of human life comes from the animal kingdom through the hominids, primates, lineage, to constitute themselves as humans with a natural unit characterized by *invariable laws*. This organic society used as a methodological resource – made up

of invariable laws – of analysis considers that this same society is characterized by two aspects that are intrinsic to it:

a) social statics (institutions responsible for order; b) social dynamics (the successive stages of the historical becoming of social progress. Social statics (social order), the consideration of society as constituted by several parts that make up a whole, a social totality, regulated by invariable laws, characterized by objective structures in which in the most modern terms the main institution corresponds: the State. Social dynamics (social progress) would then be responsible for the processes of evolution of social, political, economic, technical, technological and moral mechanisms – the law of the three states would be the fundamental law of human development (GUINER, 1982; HOSTOS, 1904).

This organic condition of natural unity of these human biological beings not only refers to the invariable natural law for these types of beings of the lineage of the australopithecus hominids of the human condition because they originate from the natural world – which is constituted of invariable natural laws of nature – but above all and mainly because the human condition as a condition of social being by nature biological and natural is composed of a *rationality that defines the nature of consciousness* – consciousness is a reason for rational equilibrium – that integrates it with intellectual properties whose main magnitude is its progressive nature – progress or regression – depending on the circuit of the social system or the social condition to which it is linked: *whether it is a selfish social being or an affective* social being. Karl Marx and Friedrich Hegel define in their book The Dialectic of Nature in the part The Humanization of the Monkey through Work as an integral part of the ontology of the human in which such ontological attribution defined the very process of humanization of the human to the extent that work consists in the very survival and existence of the person who seeks as a concrete existent being the fulfillment of his material needs – drinking, eating, sheltering, protecting, clothing – and later the satisfaction of their needs for social well-being and living comforts, that is, human existence itself is progressive by natural and social nature, but it can be progressive or regressive by the profile of the social being in evidence: whether affective social system or egoistic social system.

This ontological dimension of the human being, in which work is part of its process of social and existential existence, is composed of three other aspects that characterize the social life of the person and of political systems, and that structure the pragmatic life of the social being as objective and structuring forms. The social person is composed of three constituent parts: *i) sexuality; ii) affection; iii) and consciousness*. And of six social factors: *i) the political; ii) the economic; iii) the religious; iv) the cultural; v) conscience; vi) the social*.

THE THREE ASPECTS OF THE SOCIAL AND THE FACTORS OF THE PERSON AND POLITICAL SYSTEMS: THE STRUCTURING ONTOLOGY OF THE SOCIAL

The misunderstandings leave this social area and its professionals on the defensive in the face of the natural sciences, constituting in the context of science as a kind of entertainment literature that is not very useful for guiding political systems due to its lack of scientific objectivity. The difficulty in defining the social dimension of the human condition lies in these mentioned aspects, since the uncertainties and subjectivities that populate sociological writings fluctuate in non-objective digressions that leave room for questioning their veracity in terms of science, in addition to the existing social problems that do not find resolution in sociological precepts. These difficulties have unfocused on the phenomenon that the social dimension contains an ontology of the social that constitutes a rational logic that guides human action in terms of objectivity, and it is not possible to digress about the pragmatic and utilitarian character of the social practices that guide them. This ontology of the social contains inherent aspects that guide the human condition in its most diverse forms of social action. The social or the social dimension has its explanation very simple and general, in the first place, the word social, in addition to its associative and interaction etymology, is defined by the natural fact that the person is the product of a relationship of sexuality between two people. It is precisely because the natural fact of the person being the production of a relationship of sexuality between two people that the human condition of the person is a social condition by nature natural and biological. This social condition is explained by the natural condition of biological sexuality itself. The social dimension of this biological sexuality, therefore, is presented by the social lineage of the family context in which such a person was generated or of the relationship of sexuality from which this person was produced in the sense that he or she is part of this social class or social class or social group or social category. This is the general explanation of the origin of the social dimension of the human condition. The social dimension of the human condition, in turn, contains other characteristics that define it in terms of this social situation. The main one is the affective character of the person's conscience. Affectivity in terms of properties is the aspect that constitutes the social condition of the person and that interferes in an evident way in the cognitive capacities of the objectivity of the rationality of the person. The social person, constituted of affectivity and objective rational consciousness, defines the human condition of the person and the procedures of intelligence and rationality, due to the fact that affection is what guarantees the best modalities of objective practices, since its objective procedures consist of seeking utilitarian ways of pragmatism to ensure the best confection of material and social things, so that they have the best possible use to produce the good to guarantee life. The human condition of the person is defined by affective rationality in terms of objectivity due to the person's consciousness being rational. An example of this situation can be observed in the treatment of a creation. In a specific sense, a child and beings in general raised at

their childhood ages constitute the most dependent beings for their living existence on social protection care. This social protection that characterizes the social condition of the person in terms of sociability requires social protection procedures only from the affective procedures that can guarantee, with the care with the treatment of food, the domestic environment for their protection and rest. These related aspects constitute the social condition of the person that can be summarized by the mathematical formula:

MATHEMATICAL FORMULA OF SOCIAL SCIENCE I:

The social is defined: i) sexuality; ii) affection; iii) consciousness.

Social=consciousness+affection+rationality+person=life

This mathematical formula is what defines the human condition of the person in the process of rationality and social action due to science is related to the maintenance and protection of the person's life in social existence. The structure of affect and affectivity constitute the structure of weights of extreme radicality that organizes in a concordant way the factors of the person and his social condition that throughout human evolution have been outlined. In Plato's text, Apology of Socrates and The Symposium, published by Martins Claret, (2009), we have a mythological indication of the ancient cosmology of the Greeks who postulated the implacable harshness of affective structures as properties attributed to the essentiality of the human condition. According to Plato, when Zeus decided to provide the creation of the human, he engendered the possibility that a certain species of biological organic beings could walk upright on two legs and to free them from the possible debauchery of other animal species, he decided to make their biological and procreative conception mean the extension of their progenitors into new gestated bodies in such a way that the new beings engendered or conceived were seen as better half of their parents, and the conceived ones, in turn, would take themselves as parts of the former, establishing a bond and link between the parents and their pregnancies bonds of complementarity that would awaken the inseparable desire to intend to live together with each other for an indefinite time among themselves: "(...) therefore, for a long time, it has been the affection, an adjective of love, for one another – parents and children – innate to men and restorer of their ancient nature, trying to reestablish unity and restore human nature (...) men are fond of women (...) and the same is true of women, they are fond of men" (p. 90). Thus, the desire that maintains this search for unity and integrity that initially links the family units and extends to the others is the affective structure of the esteem of love, because the human conception, by making memorable and immortalizing the inheritance of the parents in time and space through a generational and gestational lineage of its genealogical descent, acquires the divine properties of immortality and eternity characteristic of the human person to the extent that the structures of affectivity have esteem as proper to their nature and therefore seek in what can immortalize it,

transforming the mortal character of the human into perenniality when it always seeks to exist and be immortal, and procreation is the only possible means because it always leaves a new being in place of the old and through it, Not only does immortality extend in time and space, but it also defines the main human condition: affection. The structures of affection that define the social dimension, therefore, have as their main objective the maintenance and preservation of human life on the earth's plain. If the Platonic and Socratic texts and those of the various philosophers of his contemporaneity defended the good manners and behaviors of the social practices that elevated the human condition in terms of divinization and immortality, they are not sufficient in the face of the social frameworks of modern and contemporary societies cut by the extreme conflicts and violence of social life. Without disregarding that passions and debauchery flourished particularly in the period of modernity in exponentially significant geometric advances, leading us to see that the social sphere also began to be polluted by selfishness and dominating and exploitative individualism, motivated by greed and ambition, which would suggest taking into account and saying that the social dimension contains in its own interior and core oppositions and antagonism at the same level and degree that Marxist theories expose Trying to reduce and limit the possibilities that human life since its beginnings has always been characterized by exploitation, violence and the most extreme modalities of selfish behavior and domination of the human by the human, our research could agree in part with these assertions, but only in a very small and particularly small part of life in society. in terms of these empirically proven postulates for contemporary periods and for some epochs even more distant from the one we currently live in, but we would have to completely reject these mental frameworks of sedimentation of the social dimension under strictly antagonistic aspects of an extremely egoistic nature, since the subterranean bases that have shaped the *psychophysiological-social* conductof group life and even of later life, which include the period of Villages, Communities and even City-States of ancient Greece and the entire ancient world up to the Greek period, developed primarily based on modalities of practices of human sociability established and provided by the structures of weights of affectivities and affective mechanisms, in which the preservation of human life until its maximum cycle of living existence on the earth plain could be ensured with the most adjusted possibilities of material and social structures in accordance with a development process that would promote and guarantee dignified conditions of social well-being for the existence of the human condition with the maximum of fullness, although in a punctual and sporadic way, not being structural or generalized, the egoistic forces prevailed in remote moments of the fifteenth century B.C. C. com the dispute between the Persians and the Trojans and later during the fourth centuries, from the XII-VIII (FINLEY, 1984; 2007), when starting with the thought of the pre-Socratics, the political systems began to be guided by the tendency of equilibrium. The veracity of egoistic properties figured emblematically as characteristic forces of the human condition in the period of modernity,

specifically of high modernity, to use the terminology of Anthony Giddens (1991), being valid only for the times that followed, especially after the nineteenth century, with the guerrillas and killings in France and England, and the subsequent developments of world conflicts with the first and second world wars. The dimension of affection, an adjective of love, the main property of the soul, was the aspect that stimulated and stimulated the biological leap – added to all the other evolutions of hominids – that allowed the condition of consciousness of hominids of the first generation of humans. Ancient texts by philosophers such as Montaigne report that the first generation of humans awakened among their hominid progenitors original structures of affection when they saw their offspring with more advanced features, body structure cleaner of hair, facial structure outlined in a more affectionate way, which caused an astonishment of joy among their progenitors when they generated such beautiful creatures, which made them open the eyes of consciousness by an invisible touch and realize their life among a band of other carnivorous hominids and ferocious cannibals, as well as other groups of ferocious animals in the environment in which they found themselves. The six groups of hominids that gave birth to the first generation of humans had no choice but to seek another environment far from those primitive primates. The consciousness of the person that constitutes the human condition is affective by biological and social nature for the simple reason that consciousness is what participates in the dimension of the cognitive processes of Intelligence and in the principles that guard the dimension of the person's life in terms of existence, that is why consciousness is affective rationality by cognitive and intellectual nature. Consciousness, in terms of cranial structure, contains the neurons of creativity of the person's intelligence, which safeguard the maintenance and protection of life, since intelligence is related to knowledge, which, in other words, is defined by the concept of the divine. The word divine, which expresses the cosmic environment or the universe of the immaterial and incorporeal being, is synthesized simply by intelligence, because this immaterial and incorporeal being has intelligence as one of its characteristics. If there is something that we call divine, it is for the simple fact that this word means intelligence. The consciousness, therefore, of the human person, if it has anything divine, it is because its cranial structure and its cognitive processes of perception contain the objective elements of intelligent rationality for the understanding and knowledge of facts and phenomena and of material and social objects. These first ontological characteristics of the social dimension of the human person expressed in this mathematical formula are responsible for the processes of knowledge and material and social development of contemporary political systems that have been constituted in the evolutionary process of the human condition of the person and of political systems. But many of the incongruities and obstacles of incomprehension would not be made explicit if only these aspects were in evidence in the contemporary period as heir to the historical past that it constituted. This is because the human condition, as we have said, has as its main characteristic the affective condition of the person in terms of rationality and intelligence for

the knowledge of things and the political system, but in the process of formation of the human condition in the times of the hominids, as we have already mentioned in previous works, adverse processes were also unleashed that were unwrapped by selfish procedures. The egoistic condition therefore accounts for the problems and procedures of privileges, prejudices, social exclusion, domination, subjugation and all kinds of procedures that lead to death and the precariousness of the person and of political systems, in such a way that the social condition of the person in ontological terms by the scope of the egoism of the contemporary period that responds to the historical processes of the human condition in erratic terms can be expressed by the following sociological formulation of the Mathematical formula:

MATHEMATICAL FORMULA OF SOCIAL SCIENCE II:

The social is defined: i) sexuality; ii) selfishness; iii) consciousness.

Social Selfishness=exploitation+domination+inequalities+injustices=death

The social conditions of the political systems we have today are the product of these two types of social systems that act in mixed and varied ways in the political systems responsible for the current conditions of the material and social life of the human condition. The second ontological dimension of the social dimension of the human condition is constituted by the factorizations of the person. There are six factors: i) Political – State ii) Economic – Market iii) Religious – moral precepts, Religious institutions iv) Cultural – peoples, nations, communities v) Consciousness educational vi) Social – inter, environment, human sociability The social dimension of the human condition in its two operational models of action of the affective system and the egoistic system act through the six social factors of the person that are the same as those of political systems. These factorizations of people according to the system they operate give off factorial properties relative to the type of system they are part of, whether egoistic or affective. The disciplinary properties of the person are responsible for producing the characteristics and disciplinary properties of the person in terms of talent, tendency, and professional inclinations, to account for the material and social conditions that the natural and social environment requires. The disciplinary properties of the person that operate by the type of system in evidence of the current person according to the need for material existence for the maintenance and protection of life – eating, sheltering, cloaking, protecting oneself – conferring the characteristics and procedures for the social action of the person in terms of objective responses to deal with natural and social nature and respond by paying attention to the substantive needs that social existence requires. The procedures of the consciousness of the ontology of the condition of the social operate in terms of tendency, that is, the ontology of the social is composed of the factorizations that give off disciplinary properties to act on the natural and social

nature for the maintenance and protection of the existential life of the person and of political systems. They contain the cognitive processes and perception procedures for the realization of objective and rational diagnoses to relate to material nature, producing objects and food, protection and shelter and dealing with the social environment, guiding the procedures of the modalities of practices that are necessary for existential life in groups, in communities, in city-states, in empires, in national states, in order to guarantee the maintenance and protection of the life of political systems in material conditions of satisfactory existence and material and social well-being. The social dimension of the human condition is oriented in terms of the tendency of equilibrium or imbalance depending on the type of system in which the disciplinary properties of the person are detached in their various modalities of practices. These forms of tendencies explore in clean terms the various possible forms of modalities of objective practices in terms of the subjectivity of the person responding to the procedures of freedom and the individual subjective rationality of the collectivized and socialized person. The human person and the evolutionary process of the human condition are conducted in a clean way in an open field with the challenges that the natural and social context imposes according to the conditions and the type of system in which the group and the person operate. Consciousness contains the necessary elements to respond objectively to all the inclement weather or obstacles or difficulties that the person may encounter on the path of his material and social existence in which he lives with his group or community, in the city and in the countryside, in such a way that the configuration we have today of political systems refers to the configuration that the types of social systems have allowed in terms of conditions of human action. This configuration of the National States that we have today, of the configuration of the rural and the urban, of the various types of professions necessary for the existence of the contemporary period were the political configurations that were defined according to the evolutionary trends and the necessary disciplinary properties that operated in terms of objective needs to meet the processes of material objectivities in their horizons and objectified utopias that were made over time historic. The evolutionary trend that configured political systems in territorial terms of defining urban perimeters with industrial, commercial, administrative and service functions and rural territories with their productive and experiential function with their most varied spatial characteristics, housing, environmental and experiential aggregates. This tendency also configured the ontological filaments of the social dimension of the human condition from the period of group life to the configuration of the public sphere and more or less the definition of the private sphere, although cave life was still somewhat a kind of group life, even considering that pairs of couples lived far from each other. This intimate sphere of private life is only defined in the life of the villages when tents are built for each pair of couples where they have come to live with their companions. At this moment, with the constitution of a private wait, the intimate sphere of the environment of the house or backyard and the public sphere in the open space

of group life, the other elements of the ontology of the social were defined as properties of the person, with its other spheres of the factorization of the person, the religious sphere with the religious institutionality with institutional memory of those past times and with the memories of the environment of celestial space, the spheres of the market with the communities with the exchange relations that establish the associative processes of the interrelations of productive activities and exchange of goods in the environments of the public markets that are constituted to meet the needs of goods of the communities, with the emergence of currency in the period of the city-states. In this same period, the characteristics of peoples and communities are defined in terms of race and ethnicities and geographical and natural characteristics, depending on the climatic and natural environment with the practices and modalities of food practices, clothing, shelter, coexistence that gradually define the cultural and disciplinary characteristics according to natural and social environments. In the open space of the evolution of the human condition, the dimension of social life also constituted the reference of the socialized individual and of public social life. The social dimension of the individual as an objective unit of the person does not contradict the social reference of social life, since the individual as a socialized person, although he is social by biological and social nature, is an individual person in terms of objective unity. In this sense, Norbert Elias' text is quite coherent with his approaches. The social factorization, the interrelation, the environment, what connects one individual to another in terms of association and human interaction is what allows the mutual coexistence between one and the other and that requires the modalities of socially defined practices in terms of collectivized coexistence correspond to those ways that are socially consistent with the forms of social relations that have been defined as acceptable for the modalities of social practices that are practiced in the public sphere and deprived of collectivized and socialized life. In the situation we have today, these material and social conditions that arise from these two types of systems tend to maintain a balance with imbalance and very precarious and asymmetrical conditions that cannot reach the social balance of political systems due to the properties of material practices not being renewed in terms of intelligent creativity, since unregulated disciplinary aspects and properties are maintained, which do not alter the situation of the systems. The disciplinary properties available in these two models of systems in mixed situations tend to promote degenerative procedures that the current conditions do not manifest any situation of alteration of the general precarious conditions that populate contemporary political systems. In terms of tendency, disciplinary properties, without manifesting alterations and, on the contrary, conferring tendencies of imbalances, tend to make the conditions of affective political systems precarious, due to the collectivized and socialized contacts that social practices allow, and, above all, through television procedures that disseminate the procedures and modalities of precarious practices that are visualized on a planetary scale. This happens because the person in the context, for example, of the egoistic system unfolds into

disciplinary properties of indiscipline, corruption, dishonesty, miseducation, laziness, and a series of other unregulated properties. These properties that make up the person direct the social action of the same, and it is not possible under normal conditions for this person to act in terms of honesty, due to his mentality and conscience being guided by selfish disciplinary properties that, even having the influence of regulated aspects of the affective system, tend to unbalance the disciplined social practices, leading them to pathological procedures that gradually deregulate the procedures of the affective system and at the same time having the affective system is influenced by unregulated social practices that in the set of social conditions tend to lead the political system to an imbalance with unresolved social problems due to social action not containing the objective disciplinary properties capable of solving the simplest problems that still exist today, such as poverty, for instance. The factorizations of the person and the disciplinary characteristics in contact with the natural and social environment gradually shaped the geographical, social and professionalizing configurations of social systems in terms of the developments and tendency to which they were destined to reveal or be produced from the first formation of political systems with the group life of hominids, primates, australopithecines who lived in caves in conditions of nomadism. Group life was the first formation of the political system: the group.

Knowledge – Human Science – Social World – Subjective

Cecília Minayo (2001), in reference to sociological conversations, states that subjectivity is the very particular trait that defines the human condition of the person and that, for this reason, social science had acquired a certain reference of less science in comparison with natural science, because it deals with an object of study that varies in terms of social action and diversified perception of a thinking subject that moves from conjectures produced by his own consideration of what is found in him as the internal subject of his own thought and action. That is, the fact that the object of study of social science has an internal character that induces the person's own human action implied a greater methodological effort to achieve an understanding of the social action of the human author of his own works and actions in the social world. But the subjective character of the human condition has opened space for discrepant findings that have hindered the advancement of social knowledge due to ignorance of the specificities of this specific aspect that defines the human condition and its subsequent irrational effects: *subjectivity*. The theme of subjectivity in synthesis left room for the association of understanding with forms of perception that would go beyond intellectual understanding, such as the sphere of feeling, for example, which for a long time was seen as irrational and its passions resulting from uncontrolled impulses. It was not without reason that women suffered from this prejudice for a long time, being even considered less rational than men because they were perceived as very sentimental due to their organic and biological function of

supplying the reproductive function of the human. The antagonistic opposition of erratic perceptions was also legitimized by the subjectivist character that served as a panacea to guarantee levels of veracity of the points of view about the objects referred to even if these points of view were unfocused from the points. The degree of objectivity of social science was also reached or questioned due to the variety of opinions about the same phenomenal facts being very discrepant in relation to each other, making the levels of accuracy of sociology diagnoses questionable, due to these misunderstandings of understanding about the dimension of subjectivity and its consequent effects, questioning, for example, its objectivity.

The intellectual particle – rational, cognitive – is the particle responsible for the process of knowledge; knowledge is part of the existence of the intellectual particle – of reason – science or scientific knowledge being only there in this particle and nowhere else. All of us, all humans, share and participate in knowledge because their own human structure contains in its intellect character rational participation. The dimension of the intellect that defines the human condition – the rational consciousness – as distinct from the animal kingdom refers to this intellectual structure that organizes the brain structure and allows the process of knowledge. The intellectual dimension of the human being – consciousness – only concerns the possibility of its knowledge. The term subjective refers to what belongs to the person, what defines the person as a social being: what defines the person as a social being is the rational consciousness. In this sense, the only meaning that the term subjective holds and contains is: rational consciousness. Nothing more than that, simply that. Subjective is the character of rational and intellectual knowledge that is present in the person in terms of professionalizing tendency, making him a knowing person by his rational and intellectual professionalizing capacity to allow the knowledge of things. Rationality is in the person, not in the objects. Objects contain characteristics and properties that are inherent to them that are imposed on the person through the mechanisms of perception. Neither the person nor the objects distort the facts or phenomena. What distorts the facts or phenomena is the person's understanding of himself and his cognitive capacity and the variation of the distortion happens due to the condition of the social being: *being social affective or being social egoistic*. From the nineteenth century onwards, with the constitution of the capitalist system – due to the recovery of ancient Greek texts that had been used since the fourteenth century with the invasion of the Persians in the Greek environment – there was a lot of adulteration and manipulation of content to make precarious and distort the original senses and meanings of the concrete and historical contexts of the ancient times of primitive Greece, which had experienced and formatted a social system in a tendency to balance with the many material, technical, institutional, social advances and the configuration of a political system of social justice.

The notion of subject was never used before this period of the capitalist system and some of the material produced in this period from the philosophical manuscripts of Socrates, Plato, or

Aristotle was intentionally tampered with. They never used the term subject or subjective to refer to the human, they always said person. **The word person is a Persian or Turkish word, and means the one** who is, is the being just as he is, there is nothing of a mask or reference to the theatrical language of the actor who stages a performance on the stage of life, as mentioned intentionally and wrongly by Ralf Dahrendorf (1969) in his book *Homo sociologicus* and many authors. The theatrical language was specific to the theater, and if the term actor was used, it was to refer to that person who performed a play and to only himself as the theatrical artist, a kind of professional category in the field of this activity. If it has come to mix the person, the one who is, with the theatrical actor who interprets a performance, confusing the person's social life with the literary environment constituted by imagination and unreal phenomena, no matter how much literature imitates life, not everything that happens in the theater happens or has reference, strictly speaking, in reality. This erratic confusion blurred the person's reference and suggested the notion of subjectivity or subjective as people's performance, being variable in relation to each other by their interpretative preferences of their plot as a stage of life. The actors on stage, generated like puppets by the script that guided them, gave images to the questioning of the force that the Catholic Church of the capitalist system blocked the creativity of the subject, denying his subjective essence, which was understood as of an arbitrary character, of being able to do anything without being guided by religious precepts. Life participation gains in the capitalist context a negation of the subject that cannot manifest itself in its creativity because it is guided as a puppet, on the stage of life, like theatrical actors. It is good to say that the field of technical development has never been blocked by this understanding. The question of the subject and the litigation of the subject and its connection with the divine reference concerns simply the questions of morality and promiscuity. Taking moral procedures out of the game has become a reference in the person's life. The notion of freedom that such a mantra suggests, taking humans away from the desiderata of progressive rationality and moral precepts, does not find any ancient reference in what we understand today as subjective freedom of the subject. The notion of freedom never existed among the Persians (those we know as the Greeks) and the Trojans, the Ancient Roman Empire, not this one of capitalism, the Ancient Empire, before the fifteenth century or even the fifteenth century. Even a writer of talent and Hannah Arendt's statutes was wrong about this. Perhaps not intentionally, because as a post-war survivor I was no longer afraid of his words, but because he accessed all this totally adulterated old reminiscence without any basis for counterargument. The idea of subjectivity that claims a certain amount of freedom from the human subject is a modern invention of the capitalist system and it concerns only and exclusively the unimpeded and uninhibited action of promiscuous sexual practice, without rebutting on any side, the scientific advance of science in its natural area, because on the side of social science in its social area such an argumentative resource was already a strategy of the erratic nature of this branch of knowledge that they constituted very

swampy and shifting foundations of lies and hypocrisy. It was part of the very negotiation of the system, natural science would be the science par excellence, and social science arranged the ways for the promiscuous functioning of the system, until a strong legitimation of promiscuity was established, and then a little understanding proceeded here and there, without much seriousness until something really serious happened capable of revising this situation. The war within the same Roman Empire, between the English and the French in the twenty-fourth century (which we know as the French revolution of the nineteenth century) indicated the promiscuity that the social area was missing and that it would be necessary to produce science more seriously. The three greatest thinkers Marx, Durkheim, and Weber are from this time, they lived together practically in the same period, they are contemporaries, with small time lags between one and the other. They got to know the works of their peers and interlocutors and produced science. Of course, imperfect science, with erratic levels, but science, and from them social science advanced and also gained the status of a scientific field of knowledge. We are doing now the same as they did in that period, with even greater rigor, but nothing more than what they did. The three were at the service of the same group but linked to people positioned in antagonistic poles of power; his science suffered by the very nature of the system, it could not be otherwise. We are in a higher stage, we cannot suffer from the same mistakes as them, because we already know. Knowledge does not advance by leaps and bounds, it is cumulative. It is a characteristic of the rational system of the human, it appropriates everything previously produced and adding its contribution, it always advances, having these milestones of creativity as a kind of evolutionary leaps in the process of knowledge, just as the first generation of humans indicated in a biological leap, no matter if with children so beautiful, or with those of ugliness, astonishment or astonishment.

The theme of subjectivity is, therefore, a false theme, of maneuver, of manipulation, of falsehood, of the production of promiscuity of social knowledge so that this disciplinary field of knowledge of the human world would be deprived of the rational precepts of moral values and intellectual ethical principles and would be held hostage to arbitrations and free will so that conversations about facts and social phenomena would be conversations that would lead nowhere and would not reach the thing No.

The notion of subjective only indicates that in the context of the human consciousness of the person there is a characteristic that is inherent to him and that defines him: the rational conscience, the intellect, the knowledge, the judgment, the reason, the understanding. This is the only accurate notion about the term subjective. The term subjective indicates only the condition that the person, the subject, contains rational and intellectual knowledge as the ultimate part of his human consciousness, and as part of his own human condition: *the human condition is rational and intellectual by nature*. The subjective simply refers to the intellect. The subjective character includes a series of other

aspects and characteristic attributions, but none of them is related to manipulation, falsification, fraud, adulteration of information and the characteristic aspects of facts or phenomena. Falsification, manipulation, fraud, hypocrisy, pretense, dissimulation, perfidy, disloyalty, adulteration have motives other than subjectivity. Subjectivity simply means that the person is a knowing subject, that knowledge is in the person of the subject and not in the object. The person's perception varies for several reasons, perceptions vary by age, area of knowledge, graduation of training, social context. The person is considered subjective in the sense of the rationality in which we are defining – in the scientific sense: knowing, intellectual, rational – *due to the complexity of natural and social life*. The person is, therefore, considered subjective – intelligent – in terms of tendency, propensity, characteristics, professionalizing and technical-scientific aspects. This characteristic of consciousness is inherent to the rationality of the person in his professionalizing tendency. The tendency of the person is professionalizing and diversified, varied, in different modalities of professionalizing intellectual tendencies due to the complexity of the natural and social world so that there are people to be bakers, carpenters, carpenters, blacksmiths, bricklayers, plumbers, merchants, industrialists, farmers, various liberal professionals, so that in the field of the social world there is a person with a tendency, inclinations, professionalizing propensities to be a geographer, historians, philosophers, sociologists, literati, so that in the field of the natural world there are people with inclinations and tendencies to be physicists, chemists, geochemists, geologists, astrologers, biologists, doctors. The tendency of the rationalizing person is varied, and is, therefore, subjective in terms of the professionalizing tendency so that there is a diversified technical-scientific and professional capacity to account for the needs of the material conditions of existence that the historical contexts suggest for the progress of the political system and of the person. If we do not confuse the pragmatic and utilitarian, technical-scientific and methodologically systematic meanings, we can use the term subjective to refer to these professionalizing and thematic tendencies and inclinations of the person, as long as we do not fall into the error of confusing vulgar opinions or generalized common senses and associating the word subjective. The word subjective, as we have said, simply means consciousness and reason. In this sense, there is a subjectivity – rationalized, intellect – of the person in the sense that people have professionalizing tendencies to attend to the most varied material forms and the existence of social experience.

The variation of perception, as we have said, obeys other aspects and motives – age, education, degree of education, historical context – other than the error of false use and ignorance of the word subjectivity. The variation of perception, therefore, at the first level, refers to the adequacy of the intellectual capacity to account for the variety of the world in general terms, that is, the human dimension is constituted by a subjective intelligence in terms of the tendency of differentiated thematic properties to confer the possibility of understanding the distinct multiplicity of the world,

having absolutely no connotation with ignorance, that is, not being an aspect that justifies or alleviates error because perception is considered to be subjective – the subjective is exactly the possibility of rationality of the world. In this sense, the perception of the same phenomenal fact observed also varies for some objective reasons that are inherent to the essence of the tangential nature of natural or social facts and phenomena. Even in the sense of the rational intellect, the perception of the same observed phenomenon can vary for reasons of age group, for example, the perception of a child and an adult about the same phenomenon; by degree of educational and technical-scientific training, the perception of a high school student and a graduate on the same subject; it may vary due to thematic variations in the training of an electrical engineer issuing an opinion on a social event with the perception of a graduate in social science on the same topic; It can also vary due to the exact incomprehension of the questioning referred to the observed phenomenon, which can cause two technicians of the same training to clash on the subject in question. In any case, the variation of perception has no connection with falsification or manipulation or with deliberate or planned or intentional error of slander. In technical terms, the variation in perception is not linked to any form of falsification. In general, the perception tends to vary initially in relation to the same object under the study of a disciplinary team that investigates a certain phenomenon because the tangentiality of the intelligible properties also meets the inclinations and talents of the imperceptible variations of professionals from the same thematic areas of investigation who probably manifest levels of understanding and knowledge about specific filaments about the phenomena observed differently. The antagonism or opposition of perception about the same phenomena by professionals infallibly means an error of perception and indicates procedures of manipulation and falsification of information stimulated by some erratic property of selfishness such as greed or avarice, envy or resentment, lust or vanity, aspects that excite modalities of perception of exploitation, power disputes for money, corruption, lies, these are punished by many situations of technical-scientific cover-up. Very little has been said, for this reason, about the notion of subjectivity. Subjectivity, a characteristic aspect of the condition of the human person, corresponds to the reference of the intellect that lies inherent in the interior of the braincase, indicating that element trait that is specific to the human and that inhabits the internal or interior environment of the person, the intellectual cortex, that is, the subjective aspect, that is, what is inside the subject, What defines the human person: *conscience*. Subjectivity in this sense makes no reference to non-rationality or to passionate opinion linked to feelings and forms of vociferation that vary by the differentiation of people in terms of social and material conditions of life, indicating a less objective condition: the subjective is not opposed to what is objective, the objective only defines that objectivity is the product of the investigation and analysis of the subject who acts intellectually from rational mechanisms of intelligence indicating the objective properties and attributes of the observed facts and phenomena. Subjectivity refers

exclusively and simply to the certain fact that the human being is constituted by a cognitive and intellectual capacity that defines his subjectivity as a person modulated by rationalizing tendencies and inclinations, nothing more than that. Subjectivity certainly has a correspondence with the quantity and variety of rationalities. It is important to make it very evident that subjectivity has a necessary connection with intelligence and reason, this is its most preponderant foundation. As for its connection with the quantity and variety of different forms of perception of thinking subjects, it no longer has to do with false opinions, but with the multiplicity of talents, tendencies, inclinations, predispositions, motivations and attitudes that are also variable in degrees and in specific filaments and much more in aspects that do not concern their professionalizing or technical-scientific or professional actions but that concern different themes of life that escape from their professional training. This is because the multiplicity of the world's reality suggests and would require a multiplicity of talents and differentiated training to handle all of them. Thus, the variety of people in their multiple individualized particularities corresponds to the needs of social and natural requirements to face the understanding of the varieties of things in the natural and social world simultaneously, in such a way that the forms of perception vary at this first moment and are variable because they apply to distinct and differentiated issues and objects and involve people from their respective professional fields and people with forms of perceptions of other fields or areas of practical knowledge or training on topics other than those in which they work. In the closer scope, perceptions also vary about the same objects for several pertinent reasons: i) they vary due to the person's age; ii) vary due to the person's education and level of graduation; iii) vary due to the configuration of the object, which may have different filaments in extension; iv) vary due to the understanding of the question under investigation about the precision of the aspect to which one wants or intends to conjecture; v) the perception varies in terms of access to more or less information; vi) the forms of perception tend to be equated by the enclosure of the object and the equalization of the pertinent issues referred to it. The perception of objects in terms of rationality does not work at all with respect to points of view and antagonisms about the same phenomenal facts observed. Rationalizing knowledge works in terms of the logic of correspondence and complementarity of adequacy and adjustment in relation to facts and objects. Perception works as an open field in historical and contextual terms, and people's social action is carried out to meet their natural and social needs, for their material and social well-being, using rational and objective modes and cognitive procedures to make the best goods and find the best modalities of practices to make the political system develop in an evolutionary process with a tendency to balance to achieve the purpose for which it is intended in terms of the human condition, making use of the creativity of the population as a whole in its most diverse forms of professionalizing knowledge. The various modalities of creative combinations in the open process of the historical context respond to the

attention of the needs of the political and social system and it finds its most diverse forms of combinations and social actions to function in the evolutionary development of the human condition.

Although we have not carried out the description and systematics of all levels of how forms of perceptions work, but only their main guidelines, we can take a concrete example about the perception of a professional in social science, for example, sociology in particular, in order to be aware and understand how the cognitive procedures of perception about natural and social reality are carried out if it is confused with no form of perception. point of view. A sociologist with a doctorate degree or a postdoctoral degree, for example, when he makes a diagnosis, when he makes an opinion, although this sociologist doctor is a person, a numerical unit, referring to the person who speaks, his perception of the fact or phenomenon analyzed or investigated refers to all his accumulated knowledge in the area of social science – sociology – from the Greeks to the contemporary period available in a systematic way, coherent, guided by an epistemology, by all his studies and training, this sociologist when he speaks of his diagnosis, when he mentions his perception, he speaks with his entire base of scientific, technical-methodological knowledge: understand, it is not a point of view, he is not speaking alone, although he is an individual person, a numerical person, he is speaking in the name of the available and systematized sociological knowledge of social science.

Social Science – epistemology – interdisciplinarity – thematic axes = scientific knowledge: contemporary methodological updates for the social sciences

The social science of the social system is an advanced science. It is the most complex and most advanced human understanding than all the previous phases. Social science, in its nature of rational consciousness of knowledge, always begins and advances referenced to the points of origin of the understanding of things, facts or phenomena, from which the mind can understand its bases and theoretical formulations, as well as the multiple connections intrinsic to its two broad spheres of cognition: the social area and the natural area. The process of scientific research, from now on, has to follow an epistemological profile of research, that is, it has to catalogue from thematic axes, lines of indication of horizons, and go back and forth, along this methodological line. Epistemology is this form of approach that will allow us to recover, from selected themes, all the accumulated knowledge already produced to date, going through, in a zigzag style with a coating effect, apparently antagonistic authors and joining from a thin seam, like a patchwork quilt, and recovering, covering all the angles of connections of their evolutionary dynamics and demarcating interdisciplinary contributions. Thus, in this way it will be possible to recover all the production of the previous system, and the material prior to the capitalist system, redoing, as a kind of analytical bibliographic review of everything that has already been produced, from thematic axes. The separation of the

sciences is a disease that only produces confusion. The person, we already know, is composed of six factors:

Person Factorizations	Disciplinary Properties of Factorizations	Factorial-disciplinary properties of the Political System
First. The Politician	The political is the direction, the path the orientation of the horizon	The political has its institutional expression in the structure of the State
2nd. The Economic	The economic is work for survival and material well-being	The economic has its institutional expression in the structure of the Market
Third. The Religious	The religious are the ethical and moral precepts and principles that guide conduct and behavior	The religious has its institutional structure expressed in the Churches
4th. The Cultural	The cutlural are the adaptive processes and adjustment to the natural environment (geography, climate, food, etc.) and social (social types, social groups)	The cultural has its structure expressed in Peoples, Nations, Communities
5th. The Conscience	Consciousness is rationality, it is scholastic	Consciousness has its structure expressed in the institutional era of the School
6th. The Social	The social is the inter, the middle, and open space between one and the other	The social has its structure expressed by social relations, by interactions Human.

The social factors of the person account for the associative and organizational characteristics of the processes of sociability and human interaction, as well as for the scope of the organization of material and productive life and of all the infrastructure, logistics and improvements to support the material levels of satisfaction of well-being. The first factor, the political one. Politics refers to the organization of the institutional, administrative-legal order of normativity of the social system. It is up to it to define the characteristic properties-components of the social system based on the structure of its political order (whether Group, Village, Community, City-States, Empires, or Nation-States). And in conformity and consonance with such a system is the formulation of its directive principles, of formulating the path to follow, the horizon to be traveled and where one wants to arrive, which, to use Hannah Arendt's expression contained in her works *What is Politics and the Human Condition* , which synthesize a large part of ancient knowledge up to the city-states, The author defines that the main function and objective of politics is human liberation and the maintenance of life at levels of dignity of human plenitude. The second factor, the economic, the market, is the infantry and the material base that, instrumentalized by the characteristic properties of the components of the directive system, have as their main function to guarantee satisfaction and material resources in the form of

products or commodities for the material satisfaction of life, having as the main means of producing wealth and improving the conditions of existence the activity of work, the sub-factor par excellence of the economic factorization of the market and its relations of exchange and production. The third factor, the religious one. The religious phenomenon or the phenomenology of religion is not only defined during the evolutionary process of social existence as the recognition of a divine existence of providence of human life by its gifts and provisions, but also consecrates the very existence of the human condition to an immemorial memory of eternalization and immortality of generational beings, family members and social friendships who, since their ancestry of ancestry, have sustained the guiding principles responsible for the existence of current generations through their work, efforts and dedication for the existence of life. Furthermore, religion as a religious institution of religiosity of celebration and praise of graces and offerings aims to promote and stimulate the modalities of practices of the component properties of the systems of behavior and social orientations of people through the manifestation of the exemplary character of their pastors and ecclesiastics, for the strengthening of the spirit and spirit of will to realize life in the daily plan of existence in the world. The fourth factor, culture. The cultural factor of an adaptive nature and adjustment of the natural and social environment accounts for the differences that the environment of geographical and climatic conditions produced cause in the differentiation of peoples, considering the miscegenations in terms of skin tone, which could be called racial modalities in terms of different types of people. But the cultural dimension, from the factorial point of view, is strictly related to the character of differentiation of styles of ways of life due to the influence of the natural and social environment, and, therefore, of the styles of practices and styles of prescriptive behaviors in terms of objectivities, of behavioral components that can develop from these contextual conditions, not signifying, from any point of observation, any differentiation in terms of articulation of the person to the type of system. social in evidence due to its biological conditions, but on the contrary, the crystallization being variable in terms of styles of differentiation of styles of practices of the same system. The fifth factor, consciousness. The consciousness or spirit of consciousness of the human condition is structured in a psychological-physiological-social way and has in the affective structure the location of its advanced rationality in terms of human intelligence. The cranial structure of the human, the maximum point of an advanced organic and biological structure, in its psychophysiological-social organization is composed of the same degree of complexity responsible for the cosmological creation of the universe, in terms of intelligence and tendency to balance. As a universal part of the cosmological system, the human has, from the point of view of his intelligent consciousness, the understanding for existence on the earth plain and the ability to make and transform natural nature into artifacts, works or commodities for the maintenance of his living existence at levels of social satisfaction and material well-being sufficient for a full life. to the extent that it is capable of rigorously identifying the

phenomena of the social factors we are dealing with and establishing from them the directives and the characteristic components of the location of the adaptive optimum-points and adjustments for the overcoming of obstacles and sedimentation of the experience in society in terms of balance and maintenance of life. It is said in terms of balance and preservation of life because, as the Greek philosophers have long identified, the cosmological system works in its gigantic structure of luminous stars, with its structure of planets, satellite structures, and sidereal and atmospheric structures in an organic order of equilibrium tendency in which life constitutes its main reason for being, and in which human life is the only organic and biological form composed of advanced cranial capacity of intelligence with its structure of psychophysiological-social consciousness, this knowledge could not be expressed in degrees of functional neurological maximization without the structures of affectivities that constitute the mass of neurons of creativity in the braincase, because the structures of affect are the only intelligent mechanisms capable of preserving the consciousness of an appreciation of life, insofar as the social dimension implies the union of sexual bodies and this union and sharing of communion does not take place outside the affective structures in terms of plenitude and satisfaction of balance for the conception of the existence of human life. In extension to this biological level, the socio-economic and political level expands, which in turn, added to the cultural and religious, define the material levels of social life and guarantee the bases of social justice and distributive equality compatible with the levels of work and the capacities of professional training.

And each person carries, so to speak, all of them, without differentiation, in addition to their presence being composed of a double dimension, a material and a social base, or in other words, a biological body, and a social soul. This dual body, biological and spirit, the person, contains 6 factors that circumscribe his human condition. Separating social science into its social area, by anthropologist, sociologist, or political scientist, for example, only generates hitches, stumbles and headbutts and brawls of people who are saying the same thing without establishing connections of reference to the human person. Analyzing people cut out by their political dimension, disregarding the others, or by their cultural condition, disregarding the others, or by their economic condition, disregarding the others, I mean, the other factors. They cut out the people and select a factor for investigation, and a person is 6 factors and two dimensions. The right thing will be to work on the social life of the social area by thematic axes, with each thematic axis covering the six factors and considering their two dimensions, thus ensuring the interdisciplinarity of the social and natural area, as well as ensuring the coverage of the analysis of the 6 factors, taking into account, obviously. Our form of explanation and exposition is following this epistemological approach of thematic methodological line and its articulation with the different dimensions and the world of life. Where is the confusion or error in analyzing the State, as an area of Politics, the Market, as an area of

Economics, or culture as an area of Anthropology, or modern society, as an area of Sociology. With the exception of sociology and its dimensions of the person in modern society, which deserves separate comment, in the other examples the activity of the factor is confused with the factor of the human person itself. The State, for example, is an organizational form that articulates both the factor of the political and economic dimensions, as well as religious, as well as culture, as well as consciousness, as well as the social. ***All factors contain shares of the 6 factors in 1***. Thus it is said that the person is***: i) political, ii) economic, iii) religious, iv) cultural, v) consciousness, vi) social***; each of these dimensions contains the other six dimensions in one, because they are intrinsic and inherent and inseparable from each other; the person, so to speak, in didactic style is a social institution, a social organization that operates by these 6 factorizations simultaneously and at the same time. When I say that I made an economic decision, it is because along with this decision is embedded, the political, the cultural, the religious, the conscience, the social. The activity of the market factor, for example, as an activity of the economic factor, is not reduced to this single factor nor is it confused with it, the market is both economic, and with the same intensity it is political, cultural, religious, and consciousness. Defining the market as a thematic axis of investigation means tracing the linear analysis of the role of the market and how it behaved throughout the social process from its 6 factors. The unit of sociological analysis referred to in the person as the unit of clean objectivity, first, indicates his density of matter, in terms of property of matter of molecules of neutrals of objective and empirical matter, but secondly, his objective unity, as an object of sociological analysis, is defined by his hard and brute social condition, insofar as the person is a social institution composed of the five factors that configure or shape his social existence. The same applies if I extend the reference and extension a little more to the family environment, just as the person, the family is also an institution. Both the person and the family carry in their social existence the micro configuration of the system to which they belong, thus safeguarding the intertwining of the five factors that compose them. The family, like the person, is the micro reference of the group, of the class, of the class, of the estate, of the state, of the system. The house, for example, is an economic base formed by labor and technical competence, with a budget circuit, planning schemes and domestic investments. It is also at the same time a social organization of a political nature, the father and mother carry the hierarchical authority of the home and the domestic statutes extend to the children as rights and duties. It is also an environment of affection and esteem, as the bonds of marriage have religious precepts or customary customs, of a civil or exclusive nature. Spirituality or the religious dimension is part of domestic life, whether it is the home of an atheist, a saint or a prophet. Spirituality is this belief in something supernatural, whether it is belief in the stars or moon of an ancient family, or the spirituality of an unbeliever who shivers when he sees a black cat or never passes under a ladder. It doesn't matter if there is God or not, spirituality is an immanent part of the

person and the family and it does not exhaust believing or not in Zeus. The person as a social institution, as well as the family, imply a methodological approach based on thematic axes or area of investigation, having the theme or being the theme or investigative line through which the confluence of its five factors will pass. In the last stage of the erratic system, the social science of this period had already realized this and the great centers of excellence have made an effort to establish interdisciplinary methodological procedures to account for its evolution. But the absence of information such as the one we are sharing prevented a systematic and rigorous structuring in terms of methodological training of the axes of investigation and the intersection of various branches of knowledge. This is the tendency of the social science of the system in evidence, to systematize and conclude this effort that was already being made among the large universities and to restore teaching at all its school levels of formation: Infant, primary, gymnasium, secondary, technical courses, professionalization, university, Municipal, State, Federal Knowledge is part of the human essence. The subjective dimension refers to the brain structure in its three intellectual systems: i) intelligible system; ii) sensitive system; iii) motor system. The activation of the intellect or neurons with neutral properties of creative molecules is stirred up in contact with the natural or social environment that surrounds it. The cerebral or neurological system – the cerebral system is a whole machine or a system to produce knowledge and transform it into modalities of practice and production of artifacts and technologies – is therefore distilled in connection with the natural and human environment that surrounds it, processing them through mechanisms of perception and cognition when through sensory stimuli they boil and cognitive metabolism. The understanding of these connections crystallizes into motor constellations, behavioral artifacts, which in turn are detached into material artifacts, technical structures. ***Technology is an intelligible knowledge, technology is the material artifact produced by such a technical system of knowledge***. ***We confuse technique with technology. Technology is the material artifact derived from technical knowledge. And technician is the professional of the natural sciences, professional is the one who handles technical knowledge, and all experts in both the social and natural areas are professionals of social technique or natural technique***. It is the same level of theoretical and objective rigor. The philosopher, therefore, is as much a technical professional of moral properties as the physician is a technical professional of the biological knowledge of the human body. The moral properties or precepts or ethos that structure and crystallize the modalities of personality and behavioral guidelines are properties of the affective connections of atoms, molecules, neutrals, affective properties of hard and objective matter, which are the atomic properties. The discrediting of philosophy and many fields of knowledge, such as literary, poetry and even religion, from the scientific and pure sphere of the scientificity of science due to the erratic engagement of the understanding, which from the fifteenth century onwards, as we have already mentioned, began to consider these spheres as esoteric because they hovered in immaterialist and

abstract fields at the level of a dereferenced abstraction of matter from the properties of atomic matter. In addition, the professionals in these areas themselves contributed a lot to legitimize this type of thinking with ghostly production, without knowing that they themselves were sinking into their own pit of mediocrity, shooting themselves in the foot, as they say, without knowing the harm they were doing to themselves. Philosophy is today, for example, without any reference to direct its investigation, it is unfocused and it is unable to indicate exactly the target of its scientific life. The philosopher is a psychologist to directly indicate his field of knowledge, he deals with the dimension of the soul and the being in terms of the psycho-social properties that stir up the cerebral system and crystallize its modalities of practices. Psychology has replaced philosophy, and now philosophy needs to find itself. The moral precepts and values, the existence of the human being, or the levels of happiness, taste or aesthetics, ugliness or astonishment are not hallucionogenic abstractions, they are physicochemical properties of materiality of atoms embedded in neurons and crystallized in practices by adaptive processes and adjustment to the natural and human environment by the motor system that crystallizes the three-dimensional interaction of the intellectual level. from the sensory level to its motor or motor level. Philosophy is as scientific objectivity as any area of natural knowledge that claims its hardness for a crude technological artifact like the airplane or a sophisticated laboratory to produce medicines. The structures of affectivity or affectivity are so brute with strength of hardness not because it is something imaginative and abstract, but because their properties of atoms of affective molecules produce such robust crystallizations of social and behavioral atomic matter that it is the envy of any airplane that flies or a chemical laboratory of pharmaceuticals. Thus, we have, in summary, that social science in its social and natural area in its most distinct modalities of investigation have the same level of scientific objectivity, but are at the service of different aspects or cutouts of human reality, and each one in its function carries the same heroism for the evolutionary process of the social system of light, from a scientific point of view. The properties of the soul and the psychic properties of social matters are indispensable for the development of the whole, they are what will lead the directives of the different affective modalities necessary for the force of raw or manual work, necessary for the fineness of the professional who works in the field of fine atomic matter, necessary for the surgical precision of the doctor not to be nervous at the time of the heart or brain operation, necessary for enthusiasm to wake up every day and not be lazy to work and fulfill one's daily obligations, necessary for the understanding and sharing of the communion of the person, of the citizen, with the family, with the public sphere, in the intimate life of the house, of dating one's wife without having to slap oneself, to drive their cars or drives with prudence and moderation, to go to bars, nightclubs, restaurants, discos, public leisure spaces without having to make trouble or confusion, but on the contrary appropriating everything that is beautiful, good, and sane, so that they can joyfully live without ties, without restrictions, without fears, without imposition, because the

levels of social consciousness are already so high. Philosophy and the entire literary field, therefore, must find its path of analysis and correct the erratic trajectory it has followed, it has to re-establish the theme of the morality of social life, the world walks without morality as a guide and orientation.

THE CONSTITUTION, INSTITUTIONALIZATION AND PROFESSIONALIZATION OF SOCIOLOGY IN BRAZIL

In this topic of this research report, we will present a summary of the main works that deal with the process of institutionalization of sociology in Brazil, based mainly on the work of Antônio Cândido – Sociology in Brazil. Revista de Sociologia da USP: Tempo Social, 2006, vol. 18, n. 1. – and the book by Carlos Augusto de Proença Rosa – History of Science: science and the triumph of scientific thought in the contemporary world. 2nd ed. Brasília: FUNAG, 2012. vol. III. – with the use of the text part: 7.6.6.1. Sociology in Brazil, p 447-458 – which describe the process of constitution, institutionalization and professionalization of sociology in the country in a detailed manner, informing the socio-historical periods with the profile of the sociological thought predominant in the various periods indicated, the main authors and intellectuals involved in the research process and the themes dealt with during the various phases in which these authors followed the path of constitution of sociology as a science of the world human. The dissertation work of Simone Meucci – The Institutionalization of sociology in Brazil: first manuals and courses – defended at the Department of Sociology of the Institute of Philosophy and Human Sciences of the State University of Campinas – UNICAMP in 2000, will also be used as a reference for this thematic content.

In the process of constitution and institutionalization of sociology and the sociologist as professional fields of science, three periods or phases are identified (CANDIDO, 2006; PROENÇA ROSA, 2012) through which sociology is constituted as a science recognized by the national institutionality, that although these same phases present distinct temporal differences in relation to the defined times, they correspond in historical terms to their main characteristics:

i) The first phase: 1850/1880-1930
ii) The second phase: an intermediate phase: 1930-1940
iii) The third phase: 1940-1964 (onwards)

Even having these three phases defined, it is important to define the main aspects that define them and the historical contexts they represent so that we can have a more homogeneous temporal characterization, since Antônio Cândido considers its three phases, the first being from 1888-1930, a second intermediate phase, 1930-1940, and a third phase after 1940-1964, while Carlos Augusto Proença Rosa considers these three phases in a different way, defining the first from 1850-1930, the second from 1930-1964, and a third phase after 1964. In this situation of differentiated phases, we will take the main aspects of these two authors that correspond to these phases, identifying their

characteristics by the main events, events linked to sociological scientific thought in formation that does not distort the temporal propositions of these same authors to the extent that they have the same corresponding main aspects associated with other subsidiary characteristics. The important thing in considering time and space in a sociological perception means defining the events, the events that are chained by a successive sequence of events linked to each other in a relationship of causality and pragmatic effects that contain them as significant attributes of the actions undertaken by social agents in terms of their utilitarian and pragmatic intentionalities. Thus, in this way, we will consider the following phases from these two authors defined by the characteristics:

i) The first phase: 1850-1930: characterized by the initial formulation of sociological thought in which it consisted of a very generic and doctrinaire sociology still manifested by a literary and bookish character without much concern for empirical and systematic research.

ii) The second phase: 1930-1940: defined by the institutionalization of sociology as a discipline and the institutionalization of social science courses in universities and a systematic and rigorous concern methodologically guided by field research, ethnographic record, use of documentary material, participant observation, community work and a concern with the analysis of national problems as a form of interversion.

iii) The third phase: 1940-1964 onwards: defined by the institutionalization of university logistics and research institutes, state sectoral institutions to guarantee the process of production and reproduction of sociological knowledge.

THE FIRST PHASE: 1850/1880-1930

In this period of the nineteenth century, characterized by the process of disintegration of the colonial regime, which would gradually become the republican period from 1889 onwards, we lived in a social context with limited educational structural conditions, in which we lived simply with the knowledge of medicine and the law course, in a context of a regime of slavery, in which the right to teaching and education was given to free people and especially to people considered noble of the colonial aristocracy, where intellectuals with tendencies to social knowledge did not have specific knowledge about this type of knowledge – they were self-taught and the few that existed in the area had been trained abroad which, although it had already been formulated and constituted in Western Europe in which the Portuguese were part, in the Brazilian colonial country, this disciplinary field of knowledge encountered much educational resistance, due primarily to the character of teaching dispensed in secondary schools and colleges that was totally literary, bookish, rhetorical, without a critical and investigative spirit and without enthusiasm for the experimental method (CANDIDO, 2006; PROENÇA ROSA, 2012) also found the difficulty of the education system in the colony being

completely directed by the ecclesiastical authorities who did not recognize social science as a disciplinary field. It was only in 1879 that Rui Barbosa proposed sociology as a school discipline to replace the teaching of natural law. In 1891, sociology began to be included in the secondary school curriculum, from the educational reform guided by the Minister of Public Instruction, Benjamin Constante, but it was removed from the secondary education system in 1898, because social phenomena were not considered a science. During the period in which it was in high school, sociology was taught at the Military College of Rio de Janeiro from 1891 to 1898 by Laurindo Leão.

In this first phase, sociological thought would evolve to more advanced forms of analysis, moving from theoretical interests of a doctrinal order and general precepts and principles to a trend of more historical-geographical studies with historical-pragmatic analyses of the national reality with the objective of understanding social phenomena motivated by the possibilities of intervention in the social process of the country, with works of analysis of national popular culture carried out with empirical approaches and surveys. That is, in this first phase, the authors made a transition from approaches of a more essayistic and literary nature to studies of a theoretical nature based on monographic studies and more systematic interpretations of national problems (CANDIDO, 2006). The main topics covered in this phase:

i) problems related to indigenous people; ii) racial issues; iii) evolution of national institutions; theme of modernity from colonial to modernity.

The main authors of this period included the two tendencies of sociological thought of this first phase: Silvio Romero, Tobias Barreto, Fausto Cardoso, Silvio Romero, Raimundo Nina Rodrigues, Edgar Roquette Pinto, João Batista Lacerda, Euclides da Cunha (1866-1909), Francisco de Oliveira Viana (1883-1951), Alberto Torres (1865-1917). Lívio de Castro, Paulo Egídio.

The main national works of this phase of the pioneers of Sociology:

i) João Batista Lacerda (On the Mestizos in Brazil, 1911); ii) Raimundo Nina Rodrigues (Os Africanos no Brasil, 1933); iii) Edgar Roquette Pinto (Rondônia, 1916, and Seixo Rolados, 1927); iv) Euclides da Cunha (1866-1909), Os Sertões (1902); v) Silvio Romero (1851-1914), A Filosofia e o Ensino Secundária (1889), Ensaios de Sociologia e Literatura (1900) and Brasil Social (1908); vi) Francisco Oliveira Viana (1883-1951), Southern Populations of Brazil (1918), Small Studies in Social Psychology; Race and Assimilation (1922) and Evolution of the Brazilian People (1923);

vii) Alberto Torres (1865-1917), The Brazilian National Problem and the National Organization (1914), and The Sources of Life in Brazil (1915); viii) Francisco Pontes de Miranda (1892-1979), Introduction to Scientific Policy (1924) and Introduction to General Sociology (1925), the first Brazilian textbook on Sociology; Lívio de Castro, A mulher e a sociogenia (1887); Paulo Egídio, Estudos de Sociologia criminalística (1900) and Critiques of the rules of Durkheim's

sociological method (1896); Manoel Bonfim, A América Latina (1905) e O Brasil na América (1929) (PROENÇA ROSA, 2012; CANDIDO, 2006).

Throughout this first phase, the sociological influence of the national thought in formation was guided by the positivist tendencies of Auguste Comte and Emile Durkheim and by the evolutionary thought of Herbert Spencer and Charles Darwin. It was this positivist tendency that determined the position of national sociological thought, guiding the ways of thinking, directing research, directing and indicating the alternatives for the analysis of social phenomena based on these precepts. But neither of the two authors shows the influence of Marxist thought in this first initial phase, although Marxism and critical thinking have been one of the characteristics of national thought present in political parties with left-wing tendencies and also in the analyses of identifying the processes of social exclusion, injustices, privileges and prejudices. Sociological critical thinking is one of the most striking characteristics of the thought of Karl Marx and Friedrich Engels. The main works studied and accessed by the first intellectuals active in the field of social phenomena were: i) Sketch of a Sociology (1898), by Gustave Tarde; ii) What is Celestin Bouglé's Sociology (1907); iii) Introduction to the Method of Sociology (1923) by Pierre Bureau; iv) The rules of the sociological method (1895) by Emile Durkheim; v) Summary of Social Sciences (1914) by Pierre Roux; vi) Sociology: history and main problems, by Leopold von Wiese; vii) Summary of Sociology (1896) by Ludwig Gumplowicz; viii) Principles of Sociology (1883) by Herbert Spencer; ix) Treatise on General Sociology (1917) by Vilfredo Pareto; x) Manual de Sociologia (1909) by G. Palante (PROENÇA ROSA, 2012).

SECOND PHASE OF NATIONAL SOCIOLOGICAL THOUGHT: 1930-1940 – THE INSTITUTIONALIZATION OF SOCIOLOGY AND DISCIPLINARIZATION IN SCHOOLS

In the process of constituting a disciplinary field, the configuration of its object of study and the methodological procedures about the forms of investigation of the object to which the scientific study refers, it demands and demands not only this definition in a systematic and coherent way, but it is also necessary to constitute an institutional and logistical environment of educational and professional infrastructure for its process of production and dissemination of knowledge. In this second phase, therefore, these procedures of improvement and systematic formulation of methodological mechanisms were increasingly refined and specified, considering that social phenomena lacked a scientific, concrete and pragmatic way to respond to the explanations of social facts and phenomena and define their invariant eis that surrounded national phenomena and facts. Antônio Cândido (2006) comments that in this period the situation of sociological thought is characterized by the awareness of the concrete social facts of the national reality in which some explanatory criteria for the investigation of social facts and phenomena are established – such as the

use of history, the study of adaptation to the natural geographical environment; the evaluation of ethnicities in the Brazilian social formation, the resource of cultural complexity – and the consecutive advance for the organization, creation, foundation of sociological intellectual and pragmatic thought is established: "... the enrichment and modernization of theory on the one hand, an option decided by direct methods of research into present reality, on the other" (p. 12). This phase is marked by the methodological concern of the research – descriptive and psychological aspects, by the use of participant observation techniques, field research, survey of printed material, journalistic, empirical investigation, ethnographic studies and descriptive procedures of the various aspects of the life of the communities – beliefs, work, social organization, geography – and the direct reality of national problems. There is also a concern with the sociology of education or with the educational aspect related to sociology that would allow

In the 1920s and 1930s, important procedures and events converged towards the institutionalization of sociology: the inclusion of this discipline in regular secondary and university courses. In 1925, he began to enter regular education as a subject of the 6th year of junior high school, a discipline necessary to obtain the title of Bachelor of Science and Letters for those interested in this training. In 1928 it became a mandatory subject in teaching courses in Rio de Janeiro and Pernambuco. In 1927, Fernando de Azevedo's reforms in the Federal District (1927) and in São Paulo (1933) included sociology in the curricula of the Normal Schools and in the improvement courses, and the federal reform of higher education by Minister Francisco Campo (1931) in the complementary courses of the national curriculum of the secondary schools on a mandatory basis, with its specialized scientific recognition inaugurated in this period with the Social Sciences Courses at the School Livre de Sociologia e Política (1933), at the University of São Paulo (1934), at the University of the Federal District (1935) and at the University of Paraná (1938) (MEUCI, 2000; CÂNDIDO, 2006).

In this second phase, there was also an important role for foreign professionals who participated in the country's federal universities due to the insufficiencies of national sociologists at the relevant moment of institutionalization of the discipline of sociology in secondary and university settings. In this sense, the national authorities promoted the hiring of foreign teachers from the United States, France and Germany: i) teachers from the USA: Donald Pierson, Samuel Lewvry, Horace Davis, Charles Wangley, T. Lynn Smith; ii) French teachers: Claude Lévi-Strauss, Paul Arbousse-Batide, Roger Bastide; iii) German prodessors: Emilio Willens, Herbert Bauus.

The national teachers of this phase of institutionalization of national sociology: Fernando de Azevedo – Institute of Education of USP, Carneiro Leão – Recife, Delgado de Carvalho – Rio de Janeiro, Gilberto Freyre – Rio de Janeiro, Amaral Fontoura – Rio de Janeiro, Francisca Peeters, Juvenal Paiva Teixeira, Rodrigues Mereje. The main national authors among these were the

following: Gilberto Freyre (1900-1987), Delgado de Carvalho (1901-1951), João Rodrigues Mereje, Artur Ramos (1903-1949), Sergio Buarque de Holanda (1902-1982), Antônio Carneiro Leão (1887-1966), Fernado de Azevedo (1884-1974), Josué de Castro, Aquiles Archero Jr., Alberto Conte, Emilio Willens, Romano Barreto. And the main works of this period of this second phase: Gilberto Freyre (1900-1987), Casa Grande e Senzala (1934) and Sobrados e Mocambos (1936); Delgado de Carvalho (1901-1951), Sociology, in two volumes (1931), Educational Sociology (1933), Experimental Sociology (1934) and Sociology Practices (1940); João Rodrigues de Merèje, General Sociology (1933) and What is Sociology? (1935); V. Miranda Reis, Essay on Sociological Synthesis (1933); Artur Ramos (1903-1949), O Negro Brasileiro (1934), O Folclore Negro do Brasil (1935) and As Culturas Negras no Novo Mundo (1937); Sergio Buarque de Holanda (1902-1982), Raízes do Brasil (1936); Djacir Menezes, The Other Northeast (1937); Antônio Carneiro Leão (1887-1966), A Sociedade Rural e Seus Problemas (1939) and Fundamentos da Sociologia (1940); Fernando de Azevedo (1884-1974), Educational Sociology (1940) and Brazilian Culture (1950); Josué de Castro, O Problema da Alimentação no Brasil (1933) and Alimentação e Raça (1935), Condições de Vida das Classes Operárias do Recife (1935); Alfredo de Ellis Jr., Os primeiros troncos paulistas e o cruzamento euro-americano; Nestor Duarte, A Ordem privada e a organização política nacional (1939); Roger Bastide, The Family Monograph in Brazil (1941); Aquiles Aechero Jr. and Alberto Conte, Dictionary of Sociology (1939); Emilio Willens, Revista Sociologia (1939), the first specialized publication and the Sociological Collections (1940), with articles (in Portuguese) published in Europe and the USA; also by Emilio Willens, Assimilation and Marginal Populations (1940), Acculturation of Germans in Brazil (1946); Emilio Willens and Gioconda Mussolina, Tradition and transition in a rural culture of Brazil (1947), Búzios Island (1946); Donald Pierson, Brancos e Pretos na Bahia (1945), Cruz das Almas: a braszilian village (1953); (PROENÇA ROSA, 2012; CÂNDIDO, 2006).

The main themes of this phase that mark sociological research: family studies, educational, rural communities.

THE THIRD PHASE OF THE CONSTITUTION OF SOCIOLOGY: 1940-1964 ONWARDS – THE CREATION OF LOGISTICS AND INFRASTRUCTURE FOR THE PRODUCTION AND REPRODUCTION OF SOCIOLOGICAL KNOWLEDGE

In this phase, sociology is definitively constituted and consolidated and the profession of the sociologist with the use of empirical studies and with the use of systematically grounded sociological theories. According to Antônio Cândido (2006), this process of consolidation of systematic sociology can be seen in three aspects: a) in the organization of the work; b) in the new spirit that presides over it; c) in the works carried out. In this part of the organization of sociological work, changes can be

observed in three aspects: i) in teaching; ii) in research; iii) production. With the institutionalization of Science Courses in Brazilian Universities and the sociological teaching of a compulsory nature in secondary education, it was possible to present a considerable training of teachers and professional researchers trained in this period from the 1940s onwards who would supply the institutions of normal education, the technical courses, and the national colleges of the country and to serve the different social sectors that were being formulated in the country. In the research sector, public and private investment processes modified the nature of research actions due to the promotion of state institutions that required greater investment in knowledge of the national reality so that the forms of planning that the country needed for its modernization process could be carried out. At that time, greater sociological rigor and a more rational knowledge of the national reality were needed on the part of government institutions and private institutions. Research at this time stood out for an orientation that allowed an intervention and favored the processes of institutional planning, but research of an individual academic nature was also carried out for the purposes of professional undergraduate training, didactic research for the evaluation of students and their school education, team research for scientific purposes and practical purposes for the purposes of intervention and evaluation of the national realities of the countryside and the city. At this time, in 1951, the National Research Council – CNPq was created, today linked to the Ministry of Science and Technology; in 1954, the Brazilian Society of Sociology – SBS, which would hold its First National Congress in 1962; the creation in 1967 of the Agency for the Financing of Studies and Research – FINEP, also linked to the Ministry of Science and Technology; the creation of the 1981 Law that recognized the profession of sociologist and its regulation by the Decree of 1983 during the Government of João Soares de Figueiredo; the University Reform of 1969, which would include post-graduate training with the growing institutionalization of sociology; the creation of the Brazilian Center for Analysis and Research (CEBRAP) through professionals who had been exiled or removed from institutions during the Military Regime. During this period, a series of regional and state organizations of Sociology would also be founded: in Rio Grande do Sul, Pará, Santa Catarina, Ceará, Paraná, Pernambuco, Brasília, with the holding of the First National Congresses of Sociology: 1980: in Recife; 1981: in Brasilia; 1982: in Fortaleza; 1984: in Rio de Janeiro.

In the process of editorial production and scientific publications, production was still in an insufficient situation – with the exception of Rio de Janeiro and São Paulo, where the exchange of sociological information was more constant – in the face of advances and the increase in scientific productions that did not find space for circulation among professionals and even among institutions. The exchanges of access to publications took place on a personal basis, and the situations of exchange of information were very fortuitous, it was more common to have access to the circulation of foreign research than to the country. Even so, in this period or in this phase, the following were

produced: i) the Journal of Sociology; ii) Revista do Museu Paulista; iii) Anthropological Journal; iv) Archive Journal; v) Revista da Administração em São Paulo; vi) Publications of the University of Minas Gerais. In this period after the 1940s, the characteristic of sociological thought is dedicated to the analysis of the social life of the Brazilian nationality and presents a very syncretic methodological tendency – influences of American and European authors, sociological tendencies arising from the three founders of sociology: Auguste Comte, Karl Marx and Max Weber, with their distinct influences of the positive, critical and comprehensive sociology. The main foreign authors who influenced national thought in this period were: a) Chicago School: Giddings, Talcolt Parson; b) French: Emile Durkheim, Marcel Mauss, Raymond Boudon, Pierre Bourdieu, Bastide; c) Germans: Max Weber, Karl Mannheim, Frankfurt School.

Antônio Cândido summarizes well the characteristic of this phase of sociological thought with the evaluation of the profile of one of the most influential authors of the period: Florestan Fernandes. He says:

> (...) Florestan Fernandes delves into the notes where he takes a position for an empirical sociology based on the methodical accumulation of data according to hypothetical guidelines defined in order to provide a basis for the inductive operations that he analyzes in its various modalities, both from the quantitative and qualitative aspects. The author's position is comprehensive and devoid of dogmatism, guided by convictions already manifested in the previous work, that sociology will only march towards more rigorous forms of explanations if it persists in the analysis of situations delimited by means of empirical processes. The work of Florestan Fernandes represents the sign that in Brazil we have carried out in various ways the march of Sociology in search of the scientific character: restriction of the field [of study], definition of the object, and determination of the method. (CÂNDIDO, 2006, p. 295).

And the same author Antônio Cândido continues:

> Today it is possible to train the sociologist among us due to the organization of teaching and the relative density of the scientific environment and the growing demand of society in a phase of great technical progress and consequent rationalization in the administrative, care and planning sectors. It is beyond doubt that Brazilian Sociology already exists as a bloc, which is verified by the international position that it has been gradually acquiring. Until now, this or that sociologist was projected outside the country, standing out as an exception thanks to personal merit, today without prejudice to this, it is our sociology that begins to project itself together (CANDIDO, 2006, p. 301).

In this period from 1940 onwards, the most influential authors were: Mário Lins, Guerreiro Ramos and Florestan Fernandes. The other sociologists who exerted influence on sociological thought: Darcy Ribeiro (1922-1997); Octávio Ianni (1926-2004); Fernando Henrique Cardoso; Hélio Jaguaribe de Matos; Reginaldo Prandi; Azis Simão (1912-1990); Leôncios Martins Rodrigues; Milton Santos (1926-2001); Adalberto Moreira Cardoso; Otávio Guilherme Cardoso Alves Velho; Juarez Brandão Lopes.

THE FEDERAL UNIVERSITY OF ACRE AND THE SOCIAL SCIENCES COURSE: CHARACTERISTICS OF THE SOCIOLOGIST, PROFILE, SKILLS AND COMPETENCIES FOR THE CONTEMPORARY NATIONAL AND REGIONAL WORLD

Political systems, as we have already said, are organic social systems, a social organization, so to speak, the very concept of society comprises and includes its organic dimension as a social organism, that is, that a society is a composition of interrelated parts articulated in a functional way with the structuring whole. The entire tradition of the social philosophy of the contractualists is imbued with this conception with its understanding that society is a social structure composed of social parts that are interdependent on them. All its dynamics, all its functional organic organization was constituted by the thinkers of modernity – the Enlightenment, the Renaissance, the Encyclopedists, the Enlightenment – with the understanding that the social dimension is regulated by invariable laws – the law of progress and/or regression – and that the guarantee of the progressive process to be protected would need to balance and equate three components inherent to the force of progress – reason, the moral principle and institutional planning – which would allow material and technological improvement, social evolution, and equal rights of the conditions of existence of the people who are integral parts of its functional units. People as part of the social structure correspond to the smallest organizational or organizational unit of this great structure that is society. People, in turn, when associating, gathering, adding to each other, in larger aggregates, begin to form professionalizing social categories that compose and/or correspond to the functional parts of the social structure with their activities defined and delimited by technical-scientific or experimental tasks, manufactures, crafts, with their disciplinary modalities of carrying them out so that they fulfill the functions necessary for the maintenance of social life (SPENCER, 1883). Every functional political system has an organic tendency or has a tendency to disorganization.

The process of knowledge, teaching, learning, rational science, is part of the social political system. In fact, every social political system is a system of knowledge formed by categories, professionalizing social groups, social classes, social strata and the most differentiated labor trades. These social groups, these social categories, have developed throughout the historical process of human progress in their material, technical, technological and moral dimensions, taking into account ethical precepts and principles to meet the needs and demands of the social configuration in the sense of promoting material and ethical human progress for the experiential existence of the political system. In the case of the development of political systems from the historical context of the antagonistic system that begins in the twelfth century b. C. all social procedures and relations were marked, characterized and developed in contexts of social conflicts, disputes of interests and disputes of political and economic power, for prestige, for greed and envy, for power and for money. In the course of all these centuries, which we currently know as the contemporary period, the compositions

and social groups have developed, with conflicts as a situation of crisis and permanent criticism that resulted in the configuration we have today for all functional and professionalizing situations of groups and professions, with two major social systems: capitalist systems and socialist systems or systems with a socialist tendency.

In the situation of the composition and formation of the social body of social science – sociology and sociologists – this situation was no different for this type of professional, for this category of knowledge. As we saw earlier, the rationalization of social life and the human world, although it was initiated by the Greeks of ancient Greece, it encountered obstacles throughout the Middle Ages – considered the period of obscurantism for its aversion to rational science and theological use as a guide to human conduct and social explanations – and again prospered from the tenth and eleventh centuries with the emergence of the bourgeoisie, new social category and social class that proceeded by bringing human reason as the conduct of its action. In the nineteenth century, the rational knowledge of the social world and the human world gained a scientific status that lasts until the present day with its systems of systematized theoretical-practical principles and precepts and methodological procedures defined from the use of various observational techniques of verification-observation of the traces of empirical artifacts of social facts and phenomena. Even with its scientific framework, which is quite systematically and methodologically structured, sociology, with its scientific rigor – and having *society as an observational and experimental laboratory for its investigations* – since society is an explicit reality – has not achieved a systematic intervention in political systems that is compatible with its knowledge, producing in the context of the contemporary world. It still encounters obstacles in the social scientific field itself, since its initial formulation was developed in a context of an antagonistic political system and antagonism was incorporated by the social scientific field as a component of social science and not as a pathological fact belonging to the emerging capitalist society of that period of the nineteenth century and, in addition, social science for a long time was considered by dogmatic theological thought as an area of knowledge that it did not incorporate scientificity, since at that moment when sociology emerged with Auguste Comte, its founders did not realize that the forms of perception, manipulation, falsehoods that populated many social mentalities – which led to consider social science as inappropriate due to the complexity of the forms of perception and varieties of points of view – were the result of egoistic systems – a social fact – that should be investigated and not that antagonism was conceived as a component part of sociological thought and that this knowledge would always be defined by antagonisms of positions. This was one of the main reasons that made sociology need greater intervention in the definitions of the progressive processes of the human condition – which allowed actions to the contrary to be always regressive – in addition, many social categories, as we have already indicated in previous research texts, were poorly defined or were elaborated in an incomprehensible way or as an

insufficient intelligible way of explaining social reality, more due to lack of expertise than lack of absence of the reason or rationality of social science, because this guarantee of the reason of social science had already been established quite rigorously in social philosophy by the ancient Greeks.

In this sense, we can observe that the trajectory of the constitution of social knowledge – sociology and the profession of the sociologist – found as the main obstacle to its initial development the theological thought that disregarded this social knowledge as devoid of scientific domain, but the historical conditions of the ancient Greeks and the entire bourgeois movement that emerged since the eleventh and twelfth centuries, bringing the need to value the human world and rational thought, made it possible for the The very monasteries from which the need for the emergence of Western universities proliferated were constituting themselves as a reference for the rational thought that emerged initially in the areas of natural sciences with their effects on material technologies of productive and economic activities of markets and later on in social organizations that demanded administrative and institutional reforms through which it would be possible to promote the necessary changes in that world obscurantist that was extinguished and ended. The first Western universities (university, from Latin, means association of crafts) emerged in the twelfth century with the objective of producing teaching or with the function of teaching the accumulated knowledge of that historical context. They initially had a more scholastic and rhetorical teaching role with the preparation of language and forms of oratory. The first generation of medieval universities had as its main courses: Law, Medicine, Arts (Crafts), Theology. Italy was where the first university was created: the University of Burgundy, the oldest in Western Europe, created in 1108, then the University of Paris in 1211, the University of Oxford in 1249. At this time, the main function of the universities, in their condition of teaching production, was to train the aristocratic elites to carry out the administrative offices, the institutional structures of the absolute monarchies and the personnel who held the political and economic power of that period. The monarchists and clergy of Catholicism themselves considered the need for intellectuals available for institutional positions. This form of teaching based on scholasticism displaced from material needs will gradually suffer criticism from modern intellectuals with the Renaissance – from the fifteenth century onwards – so that universities would turn more to meet the material and social needs of human life. In this sense, institutions for the production of knowledge were constituted, independently of the universities, such as the College of Royal Readers, in 1530 – today the College of France. With the French Revolution and with Napoleon in French power, universities began to have the need for professional training to meet the process of national modernization based on positivist knowledge in the context of modernity that emerged with the Industrial Revolution in the eighteenth and nineteenth centuries.

This context of modernity that begins from the fifteenth century, that is, with the rationalist conception of the encyclopedists of the possibility of an advance of humanity towards social and

human perfection through the use of reason as a guide of social action for the advancement of material and moral progress (NISBET, 1991), it is important because it is from this rationalist movement and its inherent intellectual and rational conditioning that it will define the entire constitution and structuring of universities taking into account the context of modernization and modernity and the challenges that knowledge presents itself to that society that emerged from the nineteenth century onwards.

In Acre, the movement that motivated the constitution of the regional university was the same that drove the constitution of the educational system on a national scale, that of guaranteeing a process of modernization that would raise the region to the levels of modernity and economic development in the context of the industrialization process that affected the country from the 1930s onwards. The need for scientific and technological development has become an increasingly important requirement for national progress and higher education institutions appear as the most efficient and most pressing institutional instrument to ensure the training and professionalization of the workforce through teaching, research and extension (MACIEL, 2017) that the process of economic and social development required to remove state organizations and labor organizations of the backwardness that the colonial period had left as a legacy for the nation, and in the case of Acre, that the condition of Territory had also left to the Federal State of Acre with its elevation to the condition of unity of the Union, in 1962. At that time, the local Acre authorities considered the understanding of the importance of the creation of higher education in the region, examined, observed, pondered, appreciated that without higher education it would be difficult to solve the local problems and difficulties of the State administrators and the process of economic and social development with the absence of professional qualification and labor in the region. In 1964, on March 25, the Faculty of Law was created (State Decree, No. 187 – published in the Official State Gazette, on April 4 of the same year, recognized by Opinion No. 660 of 09.04.1970 and by Presidential Decree No. 67.534 of 11.11.1970) through the parliamentary work of Professor Omar Sabino de Paula, who at the time was a state deputy, with the first Rector being the public prosecutor Jersey Nazareno de Brito Nunes. In 1968, the Faculty of Economic Sciences was created, followed by the Courses of Letters, Pedagogy, Mathematics (full licentiate) and Social Studies (short licentiate). These courses of these faculties would create the University Center of Acre, which would become the University of Acre on January 22, 1971, linked to the indirect administration of the federal government in the form of a foundation regime. In 1974, on April 5, the University of Acre is federalized through Law 6.025 produced that same year, being called the Federal University of Acre. In these initial periods of constitution and professionalization of university courses – especially sociology – the organizational structures of these Federal Institutions of Higher Education were organized in the form of Institutes and Colleges. From 1979 onwards, the organizational structure

changes to the form of Academic Departments. Between 1979 and 2006, the courses were organized into 13 Academic Departments: i) Department of Agricultural and Technological Sciences; ii) Geography; iii) Department of Education; iv) Department of Law; v) Department of Health Sciences; vi) Department of Physical Education and Sports; vii) Department of Natural Sciences; viii) Department of Mathematics and Statistics; ix) Department of Letters; x) Department of Economics; xi) Department of Philosophy and Social Sciences; Department of History; xiii) Department of Civil Engineering. These Academic Departments, as of 2004, became the organizational structure of Centers. The Departments were transformed into 6 Cents: 1) Philosophy and Human Sciences Center; 2) Sceptre Applied Legal and Social Sciences; 3) Scepter of Exact and Technological Sciences; 4) Center for Biological and Natural Sciences; 5) Center for Health and Sports Sciences and 6) Center for Education, Letters and Arts (PDI-UFAC, 2006-2010, p. 21-25).

In 1990, the rector of Ufac, Lauro Juliaão de Souza Sobrinho, through Resolution No. 12 of September 1990, approved the creation of the Full Degree Courses in Biology, Physical Education – Full Degree and Bachelor's Degree – and Social Sciences – Full Degree and Bachelor's Degree – and the reformulation of the Science Course, due to Resolution No. 10 of November 6, 1990, of the Council for Teaching, Research and Extension – CEPX, which had approved the projects for the creation of these mentioned. Social science – the science of direction and orientation of society was established at the Federal University of Acre in 1990 (UFAC, 2017).

FINAL CONSIDERATIONS

Social science – sociology – is a systematic, coherent, rational knowledge, which is guided by cognitive processes, analysis, synthesis, judgment, intellect, judgment, diagnoses in a methodological and systematic way through procedures that were rationally accumulated through a social epistemology, a social philosophy, initially, and later sociologically to understand the social structure, of the human social world, in its ontological, experiential, experimental bases and foundations, so that from them theoretical, technical and practical instruments can be known the human and natural world in an understandable, intelligible way, based on historical experience through the chains of events, events, facts and phenomena and the way in which they were constituted and weaved their microsocial structures through the procedures of people's social actions with the establishments of their consequent structures that brought their consecutive effects from the modalities of concrete practices guided by the pragmatic and utilitarian senses that gave them structuring meanings for the institutional formations and their material foundations that underlay them as prescriptive and objective supports of the ways of being, expressing the ways of being, thinking and acting that were contained in them and that materialized according to their simultaneous correspondences of coexistences that inhabited the procedures that were developed in the forms of social actions. All these procedures apprehended by

the experimental and empirical forms were systematized and organized in such a way as to allow, by means of their cumulative processes of systematic knowledge, that social life, the object of study of social science – of sociology – the science of the direction, organization and development of human societies – is a social structure that contains a prescriptive and objective character and that is, therefore, invariable, that is, it contains in its own macro-sociological and micro-sociological structure invariable laws – of human progress or of human regression – which it is possible to foresee, just as Auguste Comte pointed out when he said that sociology is a mathematical science, a mathematical physics.

All these procedures theoretical-methodological-practical-experimental-empirical developments allowed us to understand, to understand that the affective structures that give the consonance of the structures of weight of extreme radicality of an economic policy of preservation of human life through the necessary and possible conditions for its existence in fullness from the level of knowledge and consciousness that the intellect is capable of producing and making, transforming natural matter into Artifacts of utility and pragmaticity for the existence of life have as their understanding the valorization of life as a good in itself, of existence at levels of human consciousness and understanding and of what it represents compared to a being that was previously devoid of consciousness just like hominids and that by an evolutionary leap reached the status of human hominids when, upon seeing their children so beautiful, they were filled with so much affection and esteem that they wished never again to live apart from them. Politics is therefore the factor par excellence of the person through which this consideration becomes viable in matters of social reality, since it corresponds to the absolute primacy of directing and conducting life that is transformed into social reality by its means and ends employed to achieve the objectives that it is consistent with by its very political nature. since the objective of politics, in a word, is the liberation of the human for the maximum elevation of social well-being in fullness of the person (ARENTD, 2004).

It was precisely filled with this feeling that a psychological-social structure was constituted, composed of intellectual consciousness and densified by rational levels of creativity and understanding, capable of expanding simultaneously in the face of the processes of identification of the phenomena of adaptation and evolutionary adjustment in terms of social and material development to build a social world with life as the supreme good based on scientific knowledge. in which only the structures of affectivity of consciousness are capable of producing, because the structures of affection and affectivities those that structure the procedures of knowledge and confer the levels of rationality and creativity of the psychophysiological-social mechanism of the human condition, making such knowledge advance from the understanding of a vision that observes that the structure of life in the earth plain contains all the material conditions for its survival and sustenance, maintenance and experience at high levels and degrees of plenitude in the sense of material

satisfaction and social conditions of balance for life in collectivity that social nature itself requires and conditions.

The psychophysiological-social processes that develop from contacts with the natural and social environment, stirring up a creative life and conscious knowledge, knowledge about the world and the things that surround it, simultaneously give off the factorial properties of which the person is composed, from the point of view of social life. Such social factors in number of six – the political, economic, religious, cultural, consciousness or spirit of conscience, the social – which were constituted and reached their final and finished structuring as social life progressed and established itself as constitutive parts of the person and were expressed in sectoral facets that were defined in specific types of social components of a thematic nature, it can be said, as responsible for the totality of life in society. The factors of the person obey, so to speak, the requirements of all the conditions of what would be necessary for the existence of the condition of social life in terms of the preservation of life and the material well-being of human groups or aggregates. These social factors are responsible, in turn, for the definition of characteristic component properties of the optimal points of the adaptive and adjustment processes according to social advancement, which start to guide and mobilize people's conduct with regard to attitudes and motivations, defining bundles of directive properties that are structured in systems, social systems, in which modalities of conducts or directive behaviors based on intellectual considerations that ensure their degree of objectivity constitute prescriptive postulations of objectivity of behavioral models in degrees of attitudes and in terms of modalities of practices that guarantee social cohesion and ensure the objectives, principles and precepts of sociability that allow social life with all its material conditions of existence, creating a conscious mentality about the properties and modalities of practices that existence requires, because the Greeks already knew that if this were not the case, the unfolding of the conduct of social life would certainly follow discouraging or unfortunate paths for the existence of life, since the directive precepts that define the dimension of the social can vary in terms of social systems due to the way in which the social is permeated by its component or compositional aspects that define it, which will inform the forms of interaction and modalities of sociability between people.

Every dimension and extension of the social life of the human condition has in the structures of affectivity of extreme weights of radicality the source of the entire process of the human condition and comprises all intelligible knowledge, starting with the intellectual structures that function with maximum rationality by their own affective nature, since it is the structures of life that ensure the scientific levels of identification and explanatory verification of phenomena and the differentiation of facts for the elaboration of technological material artifacts in terms of balance for the satisfaction and utility of living existence.

REFERENCES

1. Arendt, H. (1988). *Da Revolução* (F. D. Vieira, Trad.). Editora Universidade de Brasília, co-edição com Editora Ática.

2. Baltar, R., & Baltar, C. S. (2017). A profissão do sociólogo. *Revista Brasileira de Sociologia, 5*(10). Disponível em http://www.rbs.sbssociologia.com.br/

3. Bary, J. B. (1971). *La idea de progreso*. Alianza Editorial S. A.

4. Cândido, A. (2006). A Sociologia no Brasil. *Tempo Social. Revista de Sociologia da USP, 18*(1).

5. Bourdieu, P. (2004). *Coisas ditas* (C. R. Silveira & D. M. Pegorim, Trads.). Brasiliense.

6. Bourdieu, P. (1989). *O poder simbólico*. Editora Bertrand Brasil.

7. CPDI-PDI. (2006). *Plano de desenvolvimento institucional (PDI) – 2006-2010*. UFAC.

8. Dahrendorf, R. (1969). *O homo sociologicus* (M. Berger, Trad.). Edições Tempo Brasileiro.

9. Finley, M. I. (1984). *La Grécia Antigua: economía y sociedad* (T. Sempere, Trad.). Editorial Crítica-Grupo Editorial Grijalbo.

10. Finley, M. I. (2007). *Grecia Primitiva: la edad de bronze y la arcaica* (3ª ed.). Eudeba.

11. Giddens, A. (1991). *As conseqüências da modernidade* (R. Fiker, Trad.). Editora UNESP.

12. Giner, S. (1982). *Historia del pensamiento social* (3ª ed.). Editora Ariel S.A.

13. Hostos, E. M. de. (1904). *Tratado de sociologia*. Imprenta de Baille-Bailliere e Hijos.

14. Maciel, A. S. (2017). *A Universidade e o princípio da indissociabilidade entre ensino, pesquisa e extensão: utopia ou realidade*. Edufac.

15. Meucci, S. (2000). *A institucionalização da sociologia no Brasil: os primeiros manuais e cursos*. Unicamp.

16. Minayo, M. C. de S. (2004). *Pesquisa Social: teoria, método e criatividade*. Editora Vozes.

17. Moraes Filho, E. (1980). *A regulamentação da profissão de sociólogo*. (Texto datilografado).

18. Mucchielli, L. (2001). O nascimento da sociologia na Universidade francesa (1880-1914). *Revista Brasileira de História, 21*(41).

19. Nisbet, R. (1991). *Historia de la idea de progreso* (H. Hergewicz, Trad.). Editorial Gedisa.

20. Pirenne, H. (1982). *Las ciudades de la Edad Media*. Alianza Editorial S.A.

21. Platão. (2009). *Apologia de Sócrates. O Banquete*. Martins Claret.

22. Proença Rosa, C. A. de P. (2012). *História da ciência: da antiguidade a renascença* (2ª ed.). FUNAG.

23. Proença Rosa, C. A. de P. (2012). *História da ciência: o pensamento científico e a ciência no século XIX* (2ª ed.). FUNAG.

24. Proença Rosa, C. A. de P. (2012). *História da ciência: a ciência e o triunfo do pensamento científico no mundo contemporâneo* (2ª ed.). FUNAG.

25. Proença Rosa, C. A. de P. (2012). *História da ciência: a ciência moderna* (2ª ed.). FUNAG.

26. Spencer, H. (1883). *Princípios de sociologia* (E. Garzola, Trad.). Saturnino de Calleja.

27. UFAC-Universidade Federal do Acre. (2017). *Projeto Pedagógico Curricular do Curso de Ciências Sociais: Bacharelado e Licenciatura*. Centro de Filosofia e Ciências Humanas.

28. Weber, M. (2005). *Ciência e política: duas vocações*. Martins Claret.

29. Weber, M. (2000). *Economia e Sociedade: fundamentos da sociologia compreensiva* (R. Barbosa & K. E. Barbosa, Trads., 3ª ed.). Editora Universidade de Brasília.

The search for Goldbach's conjecture proof: Exploring your achievements

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ABSTRACT

Christian Goldbach was a Russian mathematician who lived in the eighteenth century. Although he saw mathematics more as a hobby, he published several works on Number Theory. It is in one of his correspondences with Euler that his conjecture arises, which states that every even number greater than 2 can be expressed as the sum of two prime numbers (equal or not). Despite having a very simple statement, its demonstration requires advanced mathematical knowledge, so much so that to this day it remains without a definitive proof. Obviously, several mathematicians have devoted many years of their lives to the study of Goldbach's conjecture. In this sense, the objective of this research is to list the advances achieved by such mathematicians over time. In addition, we will seek to better understand the historical context in which the conjecture arises. In the end, we will try to highlight the most significant results that at first can be the basis for further research.

Keywords: Goldbach Conjecture, Number Theory, Prime Numbers, Riemann Hypothesis.

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INTRODUCTION

Number Theory, a fundamental branch of mathematics, focuses on the study of integers and their properties. Its legacy dates back to Ancient Greece, around 500 BC, when Greek thinkers were already paying attention to this field of knowledge. Over the centuries, Number Theory has not only remained relevant, but has also established itself as a dynamic and challenging field of research, which continues to inspire and captivate current generations of mathematicians.

A distinctive feature of this area is the existence of problems that, despite their initially simple formulation, require evidence of significant complexity. Among these problems, we can mention the famous last Fermat's theorem, proposed by the French mathematician Pierre de Fermat (1607-1665) in the seventeenth century, which states that there are no integer solutions to the equation $x^n + y^n = z^n$, in which $n > 2$ and $x, y, z \neq 0$. It was only proven at the end of the twentieth century, after more than 350 years of attempts. Other problems, however, continue to challenge the mathematical community, such as the Collatz conjecture, proposed in 1937 by the German mathematician Lothar Collatz (1910-1990): let $n > 0$ be a natural number. If n is even, divide it by 2, getting $n/2$. If n is odd, multiply n by 3 and add 1 to $3n + 1$. Repeat this process for the value obtained, and so on. The conjecture tells us that the final value obtained will always be equal to 1.

An extremely relevant concept in this area is that of the prime number: a positive integer $p \geq 2$ is called prime if its only positive divisors are 1 and p. Some of the most intriguing mathematical problems are, directly or indirectly, linked to these numbers. One of them will be the object of study of this research, which is the Goldbach conjecture, which appeared in 1742 and which today, after more than 280 years, remains without a definitive demonstration. According to this conjecture, every even number greater than 2 can be written as the sum of two prime numbers.

In this sense, the objective of this research is to list the results obtained so far in an attempt to prove the conjecture. In the end, we will highlight those that, at least at first, seem to be more interesting for future research. In addition, we will seek to understand the historical context in which the conjecture arises. In order to achieve our objectives, we focused on the original works of mathematicians who dedicated themselves to the study of conjecture, as well as other works (books, monographs, dissertations and theses) that dealt with the subject.

THEORETICAL FRAMEWORK

GOLDBACH'S CONJECTURE

Christian Goldbach (1690-1764)

Christian Goldbach was born on March 18, 1690, in Königsberg, Prussia, present-day Kaliningrad, Russia, and died on November 20, 1764, in Moscow. The son of a Protestant pastor, Goldbach studied mathematics, but mainly law and medicine.

In 1710, at the age of twenty, he began one of several trips through Europe, establishing contact with many of the leading scientists of the time. During this trip, in 1711, he met Leibniz (1646-1716), in the city of Leipzig. For the next two years, the two exchanged correspondence in Latin. In 1712, in London, Goldbach met the French mathematician De Moivre (1667-1754) and the Swiss Nicolaus (I) Bernoulli (1687-1759) who, like Goldbach, was also traveling in Europe.

Goldbach continued his long journey and was in Venice in 1721. Here he met Nicolaus (II) Bernoulli (1695-1726), who was also traveling in Europe. It was at the suggestion of Nicolaus that Goldbach began in 1723 a correspondence, which lasted seven years, with Daniel Bernoulli (1700-1782), the younger brother of Nicholas.

In 1724 Goldbach returned to his hometown, and met two mathematicians who influenced his life: the German Georg Bernhard Bilfinger (1693-1750) and the Swiss Jakob Hermann (1678-1733). Georg Bilfinger and Jakob Hermann were heading to St. Petersburg to help create the Imperial Academy of Sciences (later called the St. Petersburg Academy of Sciences), which would be organized (at Leibniz's suggestion) along the same lines as the Berlin Academy of Sciences.

In July 1725 Goldbach wrote to Laurentius Blumentrost (1692-1755), president of this new Academy, asking for a post. After an initial rejection, Goldbach was invited to the positions of professor of mathematics and historian in St. Petersburg. This invitation was due to the fact that Goldbach was already a well-known mathematician at this time, since 1717 he had been publishing works. It is worth noting that in 1717, after reading an article by Leibniz on the calculation of the area of a circle, he ended up focusing again on the theory of infinite series and in 1720 he published *Specimen methodi ad summas serierum in Acta eruditorum*. Goldbach was recording secretary at the opening ceremony of the Academy, held on 27 December 1725, and continued to hold this capacity until January 1728.

On May 17, 1727, the Swiss mathematician Leonhard Euler (1707-1783) arrived in St. Petersburg to take up a position at the Academy of Sciences. From this, he began a correspondence with Goldbach that would last about 35 years (between 1729 and 1764).

Of this correspondence, 196 letters have survived. Many of these letters dealt with various problems of number theory, some of them presented earlier by Pierre de Fermat. The extensive correspondence between Goldbach and Euler is a source of information on the history of mathematics in the eighteenth century, as it provides a fundamental record of Euler's legacy in number theory, even more so than Euler's own publications. Goldbach, even looking at Mathematics as a playful activity, developed an important work in Number Theory.

Historical context of the conjecture

On June 7, 1742, in one of these letters, Goldbach suggests the following, later exemplifying:

> I do not consider it useless to note also those propositions which are very probable, though there is no real demonstration, because even if they are afterwards found to be false, they may still furnish an opportunity for the discovery of a new truth. [...] So I want to propose a conjecture: Every integer that can be written as the sum of two primes can also be written as the sum of as many primes as you want (including 1), until all terms are unitary. (FUSS, 1843, p. 127).

In the margin of this same correspondence he further proposed a conjecture that would become known as Goldbach's "marginal" conjecture:

Every integer greater than 2 can be written as the sum of three primes.

At that time, Goldbach, as well as other mathematicians, considered the number 1 a prime — a convention that was later abandoned, as we well know. Thus, for numbers 3, 4, and 5, this first version of the marginal conjecture would be invalid. Thus, the accepted form of the conjecture — that is, not considering 1 a prime number — is:

Every integer greater than 5 can be written as the sum of three primes.

Or, analogously:

Every integer greater than or equal to 6 can be written as the sum of three primes.

Still following this letter, Goldbach comments that, from his marginal conjecture, he can obtain the following:

Every integer even greater than 2 can be written as the sum of two primes.

Euler, on June 30, 1742, effectively agrees that the marginal conjecture could be decomposed into two. The first, stated as follows:

Every even number greater than 2 can be written as the sum of two prime numbers.

(Goldbach's "strong", "even" or "binary" conjecture).

For smaller numbers, there is no need to resort to more complex methods/resources to find two prime numbers (equal or not).

However, as larger numbers are considered, the use of more elaborate mathematical methods, as well as the use of technological resources, become indispensable. In this sense, verifying the validity of the conjecture for the number 66.780.242 using only "pencil and paper", for example, is unfeasible, and it is therefore essential, in this case, to use technology.

It is not difficult to imagine, however, that if we take even higher numbers, even for technology the mission will become arduous. This is mainly due to two factors: the infinity of numbers and the unpredictability of prime numbers.

The second part of the marginal conjecture tells us that:

Every odd number greater than 5 can be written as the sum of three prime numbers.

This, more precisely, can be rewritten as:

Every odd number greater than 7 can be written as the sum of three odd prime numbers. (Goldbach's "weak", "odd" or "ternary" conjecture).

This conjecture (already proved) was thus recognized by the fact that, if the strong conjecture is proved, it is automatically also proved, since it becomes a corollary of the strong one. In fact, taking Goldbach's strong conjecture as true and since N > 7 is any odd number, then N − 3 is trivially an even number and can be expressed as N − 3 = p1 + p2 (according to the strong conjecture), where p1 and p2 are prime. Therefore, N = p1 + p2 + 3. In other words, the strong conjecture implies the weak one, but the weak one does not imply the weak.

Goldbach's (strong) conjecture, which is part of problem 8 of the list proposed by the German mathematician David Hilbert (1862-1943) during the Second International Congress of Mathematics on August 8, 1900, in Paris, has fascinated — and frustrated — many mathematicians and curious people for the past 280 years. In the last century, especially, as will be listed below, many works aimed at proving the conjecture have been developed, some of which have relatively interesting results. Even if such advances are still insufficient, this search has, as Sousa (2013, p. 39) points out, "contributed to the development of Number Theory itself, to the extent that other results have emerged, less important than the conjecture, but which may allow, perhaps, to prove it". The author also emphasizes that the investigation of the conjecture has "allowed the development of methods useful to Number Theory and other areas of Mathematics".

ABOUT THE RIEMANN HYPOTHESIS

Bernhard Riemann (1826–1866) was a German mathematician. In 1851, at the University of Göttingen, he obtained his doctorate, supervised by Gauss. His thesis was developed in the field of complex function theory.

In 1859, after Dirichlet's death, he was appointed full professor at Göttingen. Riemann provided a rigorous definition of the integrability of a function through the Riemann integral. He also generalized all geometries, including Euclidean, to Riemannian geometry, which served as the basis for Albert Einstein's theory of relativity.

His only work on number theory was published in 1859, entitled *Ueber die Anzahl der Primzahlen unter einer gegebenen Grösse* (On the number of prime numbers less than a given value). In it, from an identity previously discovered by Euler, he arrived at a function that became known as the Riemann Zeta function, which is a special complex variable function. In writing this work, Riemann's goal was essentially to set the path toward proving the Gauss conjecture about the distribution of prime numbers, which did not happen until a few years later. The famous Riemann hypothesis states that all non-trivial Zeta zeros are located on the critical line.

The Riemann hypothesis, associated with the Goldbach conjecture and the twin prime conjecture, make up the eighth problem in the list of 23 problems proposed by the German mathematician David Hilbert (1862-1943) during the International Mathematical Congress that took place in Paris in 1900. It is also one of the Problems of The Millennium Prize Problems of the Clay Mathematics Institute. The prize for those who present proof is 1 million dollars.

More than 12 trillion non-trivial zeros have been computationally found. In addition, in 1914, the British mathematician G. H. Hardy (1877-1947) showed that there are infinite zeros with a real part equal to 1/2. Despite this, the question remains open, more than 160 years later.

Many results in mathematics have been proven by assuming Riemann's hypothesis to be true, including some related to Goldbach's conjecture, as we will see later.

METHODOLOGY

The initial stage of the research that resulted in this work began with the choice of the theme. Once defined, the objectives were established and the methodology was selected, opting for bibliographic research.

According to Gil (2002, p. 44), the bibliographic research "[...] it is developed based on material already prepared, consisting mainly of books and scientific articles". Complementing this, Severino (2007, p. 122) tells us that bibliographic research is carried out by:

> [...] available record, resulting from previous research, in printed documents, such as books, articles, theses, etc. Data from theoretical categories already worked on by other researchers and duly recorded are used. The texts become sources of the themes to be researched. The researcher works from contributions from the authors of the analytical studies contained in the texts. (SEVERINO, 2007, p.122).

In this way, the texts chosen by the researcher play a fundamental role in providing the basis and support necessary for the elaboration of the work. They not only broaden the researcher's understanding of the topic, but also clarify the limits and possibilities of research, allowing for a more in-depth and comprehensive analysis.

In this sense,

> This research aims to know the different forms of scientific contribution already made on a given subject, aiming to enter current and relevant data on the investigated theme. It uses exclusively material already prepared and available, in particular books and scientific articles, and is the basis for any type of research [...] (METRING, 2010, p. 64).

After the bibliographic survey, a selection of the most relevant texts/materials to the research theme was carried out. With the systematic reading of this material concluded, the writing of the present research was carried out, integrating the readings related to the theme studied.

RESULTS AND DISCUSSION

In this chapter, we will detail the results of investigations done over time in an attempt to prove Goldbach's conjecture. The first attempts date back to the nineteenth century, but the most significant results were achieved only from the twentieth century onwards.

Between the date of the emergence/publication of the conjecture and the first result achieved, there lived, evidently, great mathematicians (considered by many, including some of the most prolific in history). Among them we can mention: the Germans Carl Friedrich Gauss (1777-1855), Ernst Kummer (1810-1893) and Richard Dedekind (1831-1916); the Italian Joseph Louis Lagrange (1736-1813); the Frenchmen Joseph Fourier (1768-1830), Pierre-Simon Laplace (1749-1827), Augustin-Louis Cauchy (1789-1857) and Henri Poincaré (1854-1912) and the Norwegians Niels Henrik Abel (1802-1829) and Sophus Lie (1842-1899). History does not tell us exactly whether such mathematicians ever knew of the existence of the conjecture, since, as Décaillot brings us:

> Considering that Goldbach's conjecture was not published until Waring (English mathematician) published it in 1770 (without attributing authorship, a proof, or commentary) in his work *Meditationes Algebraicae*, it is understandable that it is difficult to assess how much empirical work has been done on Goldbach's conjecture in the hundred years or so after its first appearance in Euler's letter. In fact, as mentioned above, until 1894, Poincaré was still asking where Goldbach's conjecture had been published. (DÉCAILLOT, 2008, apud FARRUGIA, 2018, p. 31).

What is known in fact is that Euler stated that he was practically sure that the conjecture was valid, but he would not, at least at that moment, be able to prove it.

SECULUM XIX

The nineteenth century was a period of great changes and transformations in world history. It was also in this century that the first studies related to the Goldbach conjecture began to appear.

In 1855, the French mathematician Louis-Charles-Antoine Desboves (1792–1883) published a paper in which he checked Goldbach's conjecture up to 10,000. His work was a significant advance in the search for a proof of this conjecture, as it is the first known study.

Later, in 1894, the great German mathematician Georg Cantor (1845–1918) provided a table with the decompositions of all even numbers up to 1,000 as the sum of two prime numbers.

Still at the end of the century, the German mathematician Carl Hermann Robert Haussner (1863-1948) shows the validity of the conjecture first up to 100,000 and then up to 1,000,000.

Although the results achieved in the nineteenth century were mathematically of little importance, they were relevant because they inspired other mathematicians to research the subject.

TWENTIETH CENTURY

In the twentieth century, great mathematicians also lived, such as the Germans David Hilbert and Emmy Noether (1882-1935); the Austrian Kurt Gödel (1906-1978); the British Alan Turing (1912-1954) and Bertrand Russell (1872-1970); the Hungarian John von Neumann (1903-1957); Frenchman André Weil (1906-1998); the Chinese Shiing-Shen Chern (1911-2004); Americans Paul Cohen (1934-2007), Serge Lang (1927-2005) and John Forbes Nash (1928-2015); the Indian Srinivasa Ramanujan (1887-1920). Great Brazilian mathematicians also emerged and worked actively in this century, such as Lélio Gama (1892-1983), Maurício Peixoto (1921-2012), Manfredo do Carmo (1928-2018), Jacob Palis (1946-), Marcelo Viana (1958-) and the renowned Elon Lages Lima (1929-2017).

It was from this century that important studies began to be carried out and disseminated, with the aim of proving Goldbach's conjecture (or, at least, increasing the arsenal of tools to begin to "attack" the problem, which until then was practically non-existent). It is important to emphasize that, as Wang (2002) explains, the great achievements of Analytic Number Theory in the nineteenth century, in particular, the theory of Chebyshev (1821-1894), Dirichlet (1805-1859), Riemann, Hadamard (1865-1963), de la Vallée Poussin (1866-1962) and von Mangoldt (1854-1925) on the distribution of prime numbers, were essential for the advancement in the study of conjecture.

The statements of these results are, as the reader may already imagine, too complex; the vast majority with dozens of pages. Because of this, we will not explain in detail the elements present in each of them, because doing so would be beyond the objective of this work. We leave, however, as a reading suggestion, the book The Goldbach Conjecture, by Yuan Wang, in which these results are detailed.

The first major result appears between 1919 and 1920, when the Norwegian mathematician Viggo Brun (1885-1978), in his work entitled *Le crible d'Eratosthène et le théorème de Goldbach*, demonstrated that *any sufficiently large even number is the sum of two numbers, each having a maximum of nine prime factors.*

To reach this conclusion, what Brun basically does is modify the Sieve of Eratosthenes, based on the work of the young French mathematician Jean Merlin (1891-1915), killed in combat during the First World War and whose work was published posthumously by the French mathematician Jacques Hadamard. Through this sieve, information is obtained about pairs of numbers whose sum is an even number.

In 1923, Hardy and Littlewood (1885-1977) showed in their work *Some problems of 'Partitio numerorum'; III: On the expression of a number as a sum of primes*, assuming the Riemann hypothesis, that *every sufficiently large odd number is the sum of three prime numbers and that*

almost all even numbers are sums of two primes. Littlewood, at the time, estimated that this "large enough" number should be greater than or equal to 1050.

Hardy and Littlewood's demonstration, although of great ingenuity, had two aspects that limited it: one was the fact that it depended on the Riemann hypothesis; the other is that it did not determine how large the number in question should be. As we will see later, these limitations have been reduced.

Nevertheless, Hardy and Littlewood were the pioneers in building the knowledge we have about the Goldbach conjecture.

Three years later, the German mathematician Bruno Lucke (1902–1944), under the supervision of Edmund Landau (1877–1938), determined in his doctoral thesis that the number 1032 could already be considered "sufficiently large" for the Hardy–Littlewood theory.

Based on Brun's result, the Russian Lev Schnirelmann (1905-1938) proved in 1930 that *every even number greater than or equal to 2 can be written as the sum of no more than 20 prime numbers*. This result would be perfected by the end of the century.

In 1932, the British mathematician Theodor Estermann (1902-1991) improved Brun's result by proving that *every sufficiently large even number is the sum between a prime number and a number that is the product of a maximum of 6 prime factors*. Estermann proved this, however, using the Riemann hypothesis.

Five years later, the Russian Ivan Vinogradov (1891-1983), in his work *Representation of an odd integer as a sum of three primes* , achieved a great result: he managed to remove the dependence on the Riemann hypothesis, thus generating the unconditional proof of Hardy's and Littlewood's results — but he could not determine what "big enough" meant. Later, Russian mathematicians Yuri Linnik (1915-1972) and Nikolai Georgievich Chudakov (1908-1986); the American Hugh Lowell Montgomery (1944-); the Chinese Pan Cheng Biao (1938-); Britain's Mary Frances Huxley (1924–2014) and India's Kanakanahalli Ramachandra (1933–2011) presented alternative proofs for this theorem.

Vinogradov's result is a remarkable advance, as it removed one of the main limitations of Hardy and Littlewood's proof, which was dependence on the Riemann hypothesis. Once this was done, most of the following studies aimed to define from which value a number would be considered "large enough".

In 1938, Chudakov proved, as did Littlewood, that almost all even numbers are sums of two primes, showing that the distribution of prime numbers is very regular, even on large scales.

The Hungarian mathematician Alfréd Rényi (1921-1970) provoked, 16 years later, the result of Estermann disregarding the Riemann hypothesis.

In 1956, however, the mathematician K. G. Borodzkin, a student of Vinogradov, showed that the fact that he removed the Riemann hypothesis would have a problem: "big enough" in his proof would be numbers greater than 107,000,000. This value was later improved, but it is still absurdly higher than the values found by Lucke and Littlewood. Notice, then, that using the Riemann hypothesis in this context considerably decreases the value from which a number will be considered "large enough".

The 1960s, marked by several events around the world, such as the beginning of the Vietnam War, the assassinations of Martin Luther King Jr. (1929-1968) and Robert F. Kennedy (1917-1963) and the arrival of man on the moon, was also remarkable in terms of advancing knowledge about the Goldbach conjecture.

Brun's result (already optimized before) was further improved in 1962, when the Chinese mathematician Wang Yuan (1930-2021) (assuming the Riemann hypothesis) states that *every sufficiently large even number is the sum between a prime number and the product of at most 3 prime factors*. In the same year, this result was also verified for the case in which one of the numbers is the product of a maximum of 5 factors, by the also Chinese Chengdong Pan (1934-1997), and for the case in which one of the numbers is the product of a maximum of 4 factors, by the Russian Mark Borisovitch Barban (1935-1968).

But it is in 1966, in a work entitled *On the representation of a large even integer as the sum of a prime and the product of at most two primes*, that the result considered the most important achieved to date appears: the Chinese mathematician Chen Jingrun (1933-1996), surpassing Wang, Pan and Barban, who 4 years earlier had achieved incredible results, He demonstrated that *every sufficiently large even number is the sum of a prime number and a product of at most two primes.*

Chen's result is considered the most successful so far because of two aspects: the first is the fact that he does not use the Riemann hypothesis; the second, because it is the closest statement to Goldbach's strong conjecture.

To reach this conclusion, Chen used, in addition to the existing work on conjecture, the following theorems, which are specific to Number Theory: the Prime Number Theorem, the Bombieri–Vinogradov Theorem, the Siegel–Walfisz Theorem, and the Jurkat–Richert Theorem.

In 2006, a bronze statue was erected in honor of Chen on the campus of Xiamen University in Fuzhou, China. It is a representation of their hard work and dedication to their research. In addition, a commemorative stamp was launched, a collector's item for the country's mathematicians.

Almost 10 years after Chen's result, one emerges that could have been a "watershed" in the search for the proof of Goldbach's conjecture, which is the theorem of Montgomery and Robert Vaughan (1945-): *let E(X) be the function that counts even numbers not exceeding X, which cannot be written as the sum of two primes. So, E(X)* $\ll X^{1-\delta}$*, where* δ *is a positive constant*. The problem

with this statement, as it is easy to imagine, lay in the fact that X and δ were unknown. Despite this, Montgomery and Vaughan's result tells us that the probability of a number not being representable as the sum of two primes is very small. In 1980, 5 years later, the works of Chengdong Pan and Chen estimated that $\delta > 0.04$.

In 1989, mathematicians Chen (again) and T. Z. Wang (1933-2017) reduced the number found by Borodzkin in 1956 to 1043,000. Seven years later, they decrease it again to 107,194. However, checking the other cases, even for the most modern computers, is impossible.

Schnirelmann's result of 1930 was improved in 1995 by the French mathematician Olivier Ramaré (1965 -), who was able to prove that *every even number greater than 2 can be written as the sum of a maximum of 6 prime numbers.*

At the end of the 90s, more precisely in 1997, we have the penultimate result obtained in the twentieth century: the French mathematicians Jean-Marc Deshouillers (1946-) and Gérard Effinger (1945-2019) and the Dutchman Hendrik te Riele (1947-) showed that *the Riemann hypothesis implies Goldbach's weak conjecture, for all odd* numbers. In other words, they demonstrated Goldbach's weak conjecture from results that were previously proven by assuming the Riemann hypothesis.

In 2000, the last of the century appears: the Asian mathematician Hongze Li determines that in the theory of Montgomery and Vaughan, $\delta \approx 0.08622$.

TWENTY-FIRST CENTURY

Contrary to what many think, there are currently important mathematicians who work incisively so that the existing areas of Mathematics continue to be explored, as well as new areas can be discovered, thus enabling Mathematics to be in constant evolution. In this sense, we can mention the Australian mathematician Terence Tao (1975-), the Russian Grigori Perelman (1966-), the British Ben Green (1977-), the Iranian Maryam Mirzakhani (1977-2017) and the Frenchman Cédric Villani (1973-).

Specifically with regard to Goldbach's conjecture, the first result appears at the beginning of the century, between 2001 and 2002, when the Chinese Ming-Chit Liu (1937-2023) and T. Z. Wang reduced the value that was until 1996 from 107,194 to 101,346.

A few years later, in 2010, Chinese mathematician Wen Chao Lu determines a more precise value for the constant δ of Montgomery and Vaughan's theorem: $\delta \approx 0.121$.

In 2012, Terence Tao proves that *every odd number can be written as the sum of a maximum of 5 prime numbers*.

Shortly thereafter, the Peruvian mathematician Harald Helfgott (1977-), until then not well known in the mathematical community, presented, after 7 years of research, an unconditional proof for Goldbach's weak conjecture, that is, a proof independent of the Riemann hypothesis.

The weak conjecture had been computationally verified in 2011 by the British David Platt for all odd numbers n, such that $7 < n \leq 1,23163 \cdot 1027$. Platt, however, did this by assuming the Riemann hypothesis. Later, in 2013, they verify, disregarding this hypothesis, that Goldbach's weak conjecture applies to all odd up to $8,875 \cdot 1030$. With this, what he does later is to show, analytically, that it also applies to the other odd numbers.

According to Helfgott (2013, p. 3), analytic proofs often establish a result for integers above a particular constant. In addition to demonstrating the existence of a specific numerical representation (such as the sum of three prime numbers), an analytic proof also provides an estimate of the weighted number of ways to realize that representation.

This achievement earned him the Humboldt Research Prize, awarded by the Alexander von Humboldt Foundation, in Germany, in addition to a sum of money.

In 2014, Polish mathematician Adrian Dudek proved that *every integer greater than two is the sum of a prime number and a square-free number*, which is a consequence of Estermann's 1932 result.

Chen's result, considered the most successful to date, was improved in 2015 by Japanese mathematician Tomohiro Yamada, who determined that "sufficiently large" in Cheng's proof would be any number greater than $1.7 \cdot 101.872.344.071.119.343$.

Undoubtedly, a mark of the twenty-first century is technology, which as he explains Santos, Medeiros and Ribeiro (2017, p. 83):

> In contemporary society, man shares space with machines, and the relationships constituted by both become increasingly intrinsic. Whether at home, at work, at school, in parks, in various spaces and social environments, technology has its place of usefulness, and is often a necessity. It is almost impossible to imagine the survival of man without technology today. The frenetic way in which children, young people and adults consume technologies and media in the current model of society is proof that the digital age has revolutionized the behavior, feelings, education, way of living, being and thinking of individuals.

This usefulness cited by the authors has also been seen directly in Mathematics. For example, calculations that could once take hours to complete are now performed in a matter of seconds. In addition, technology can also be taken to the classroom, a practice that has been increasingly common and necessary.

It has also been used to try to better understand the Goldbach conjecture, since it can also be studied by more mechanical methods, through the use of computers. In this method, one forcibly tries to find the two prime numbers that add up to each even number. Obviously, there is no computer capable of verifying this for all numbers, since these are infinite. The goal in employing this method is to try to find out if there is any rule (any pattern) in the behavior of these numbers. Or even find a counterexample, i.e., an even number that cannot be written as the sum of two primes, which would refute Goldbach's conjecture.

The best result achieved so far through technology is from Professor Tomás Oliveira e Silva, from the Department of Electronics, Telecommunications and Informatics at the University of Aveiro, Portugal. He computationally verified that *all even numbers up to 4·1018 can be written as the sum of two primes*. This, of course, is not in itself sufficient to prove the conjecture. However, it can be an important source for future computational research.

At the beginning of this decade, in 2020, mathematicians Forrest J. Francis and Ethan S. Lee establish conditions of divisibility on the free number of squares on Dudek's work. In 2022, the number found by Yamada is slightly improved. Mathematicians Matteo Bordignon, Daniel R. Johnston, and Valeriia Starichkova determined that "large enough" in Chen's result would be every number greater than . Shortly thereafter, assuming Riemann's hypothesis, they reduced this number to $.e^{e^{32,6}}e^{e^{15,85}}$

After that, studies based on the results listed so far appeared, but which did not surpass them. For example, Daniel R. Johnston and Valeriia V. Starichkova (again), inspired by the results of Estermann and Rényi, showed that every integer even greater than 2 can be written as the sum of a prime and a number with a maximum of 369 prime factors. They also showed, under the assumption of the Riemann hypothesis, that this outcome can be improved for 33 prime factors. As already said, such demonstrations were not an advance in relation to what already existed.

Many supposed proofs of the Goldbach conjecture are circulated on the internet from all over the world. On the one hand, this demonstrates the interest of many amateur mathematicians in the conjecture. On the other hand, it can also lead to the dissemination of false or incomplete information. Obviously, all were disregarded for being flawed or based on false premises.

The fact is that the importance of this problem for the mathematical community goes beyond the theoretical field. If it is ever demonstrated, the mathematician who solves it will certainly be recognized and rewarded by his peers, in addition to experiencing indescribable personal satisfaction.

FINAL CONSIDERATIONS

It is undeniable that there has been significant progress in the search for a proof of the Goldbach conjecture. Naturally, some of these advances stand out for their relevance, among which we emphasize the results obtained by Chen and by Montgomery and Vaughan.

The first, accompanied by its later refinement recently achieved, is the closest mankind has come to a proof for the Goldbach conjecture. This combination then results in the following theorem:

Chen's theorem: *Any even number that can be written as the sum of a prime number is the product of a maximum of two prime numbers.*$e^{e^{32,6}}$

The importance of this theorem is not restricted to Goldbach's conjecture, since the path taken until him allowed the development and improvement of other mathematical theories.

Although it is a great result, it is indisputable that there is still a long way to go. In fact, notice that even if Chen's Theorem (refined) had been further refined and told us today that *any even number greater than that can be written as the sum of two primes* $e^{e^{32,6}}$, this would still not be enough for us to say that the mathematical community would be close to the longed-for proof for the Goldbach conjecture.

Remember that there would still be a giant amount of numbers between 4 · 1018 is to be verified, with many possessing an unimaginable amount of digits. It is a task that requires hard work and, unfortunately, we cannot say anything precise about the current level of interest/commitment on the part of mathematicians, especially.$e^{e^{32,6}}$

Another result that deserves to be mentioned here is that of Montgomery and Vaughan, from 1975. They proved by recalling that *since E(X) is a function that counts even numbers not exceeding X, which cannot be written as the sum of two primes, then* $E(X) \ll X^{1-}\delta$, where δ is a positive constant. Today, the best approximation we have for the constant is δ ≈ 0.121. In this way, the above statement can be rewritten as:

Vaughan–Montgomery theorem: *Let E(X) be the function that counts even numbers not exceeding X, which cannot be written as the sum of two primes. So* $E(X) \ll X\ 0.879$. This theorem can also be an interesting option to refute the conjecture. Here, the concern is not to determine exactly the number or numbers that cannot be expressed as the sum of two prime numbers, but rather to verify the existence of these numbers. For this, of course, it would be necessary to have a better knowledge about the value of X; we know, although at first it does not help so much, that X > 4 · 1018, according to the work of Oliveira e Silva. Also, notice that if there is another approximation for δ, specifically with δ > 1, the power $X^{1-\delta}$ would tend to 0 as an increasing X is considered. This would prove Goldbach's conjecture, since E(X) ≪ 1.

More recent work, such as Dudek's, which proved that *every integer greater than two is the sum of a prime number and a square-free number*, require substantial improvement. In Dudek's research, for example, the list of square-free numbers is infinite, which means that his result still needs improvement to be really useful in the search for the proof of the Goldbach conjecture.

Certainly, it is essential to emphasize the significance of the confirmation of the weak conjecture in Mathematics, particularly in Number Theory. Although only a minority of his results can be applied to a potential proof of the strong conjecture, Helfgott's validation of the simpler version played a crucial role in re-attracting some interest from the mathematical community towards the more challenging conjecture.

We strongly believe, therefore, that this research achieved its objectives. First, because we were able to list the results existing in the tireless search for proof of this conjecture; second, because

we understand historically how it came about, and finally, because we highlight those results that seem to be most promising in future research.

We also recognize that this research, like any other, has its limitations. The biggest one is perhaps the fact that we have not mathematically detailed the process of constructing at least some of the results, which can be explained in future research. On the other hand, from the academic point of view, it contributed to the diffusion of this problem, which is still little discussed in our literature, especially with regard to the list of existing attempts.

Despite the intense efforts dedicated so far by mathematicians, we conclude this work with the belief that a few decades of research, at least, will still be necessary to reach a definitive proof of Goldbach's conjecture, a feeling that is corroborated by Helfgott himself in a contact made via e-mail, when he stated that: "I feel that Goldbach is still far. There has been significant progress this century towards twin primes and also towards Chowla's conjecture, but it may be that those problems, long considered to be of equal difficulty, indeed 'morally equivalent', are in fact somewhat easier. Or perhaps progress towards them will stall". ("I feel that Goldbach is still far away. There has been significant progress in this century in relation to twin primes and also in relation to the Cohla conjecture, but it may be that these problems, long considered to be of equal difficulty, in fact 'morally equivalent', are a little easier. Or perhaps progress toward them stagnates." - Our translation).

REFERENCES

1. Apostol, T. M. (1998). *Introduction to analytic number theory* (352 p.). New York: Springer.

2. Bitencourt, C. da S. (2018). *A conjectura de Goldbach e a intuição matemática* (Dissertação de Mestrado). Instituto de Matemática e Estatística, Universidade Federal da Bahia, Salvador. Disponível em: https://sca.profmat-sbm.org.br/profmat_tcc.php?id1=3914&id2=150131131. Acesso em: 09 set. 2023.

3. Bordignon, M., Johnston, D. R., & Starichkova, V. (2022). An explicit version of Chen's theorem. *ArXiv* (Cornell University). Disponível em: https://arxiv.org/pdf/2207.09452.pdf. Acesso em: 28 set. 2023.

4. Bordignon, M., & Starichkova, V. (2022). An explicit version of Chen's theorem assuming the Generalized Riemann Hypothesis. *ArXiv* (Cornell University). Disponível em: https://arxiv.org/pdf/2211.08844.pdf. Acesso em: 28 set. 2023.

5. Boyer, C. B., & Merzbach, U. C. (2012). *História da matemática* (3rd ed., 508 p.). São Paulo: Blucher.

6. Carella, N. A. (2020). Elementary proof of the Siegel-Walfisz theorem. *ArXiv* (Cornell University). Disponível em: https://arxiv.org/abs/2004.02010. Acesso em: 23 jun. 2023.

7. Collins, L. (2020). The ternary Goldbach conjecture. The University of Warwick. Disponível em: https://luke.collins.mt/maths-masters.pdf. Acesso em: 25 fev. 2023.

8. Dalpizol, L. G. (2018). *O conjunto excepcional do problema de Goldbach* (Dissertação de Mestrado). Instituto de Matemática, Universidade Federal do Rio Grande do Sul, Porto Alegre. Disponível em: http://www.bibliotecadigital.ufrgs.br/da.php?nrb=001072924&loc=2018&l=cfcc65fd8ae2feb2. Acesso em: 15 set. 2023.

9. Décaillot, A-M. (2008). *Cantor et la France. Correspondance du mathématicien allemand avec les Francais a la fin du XIX siecle*. Paris: Kimé.

10. Deshouillers, J.-M., Effinger, G., te Riele, H. J. J., & Saouter, Y. (1997). A complete Vinogradov 3-primes theorem under the Riemann hypothesis. *Electronic Research Announcements of the American Mathematical Society, 3*, 99-104. Disponível em: https://www.ams.org/journals/era/1997-03-15/S1079-6762-97-00031-0/S1079-6762-97-00031-0.pdf. Acesso em: 01 ago. 2023.

11. Deshouillers, J.-M., te Riele, H. J. J., & Saouter, Y. (1998). New experimental results concerning the Goldbach conjecture. *Proceedings of the Algorithmic Number Theory Symposium III, Reed College, Portland, Oregon, USA, June 21-25, 1998*. Disponível em: https://ir.cwi.nl/pub/1222/1222D.pdf. Acesso em: 25 jul. 2023.

12. Farrugia, J. A. (2018). *Brun's 1920 theorem on Goldbach's conjecture* (Dissertation de Mestrado). Utah State University, Utah. Disponível em: https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=8262&context=etd. Acesso em: 14 jul. 2023.

13. Francis, F. J., & Lee, E. S. (2020). Additive representations of natural numbers. *ArXiv* (Cornell University). Disponível em: https://arxiv.org/pdf/2003.08083.pdf. Acesso em: 03 set. 2023.

14. Fuss, P. H. (1843). *Correspondance mathématique et physique de quelques célèbres géomètres du XVIIIème siècle*. Saint-Pétersbourg: L'Académie Impériale des Sciences. Disponível em: http://eulerarchive.maa.org/correspondence/fuss/. Acesso em: 05 jan. 2023.

15. Gil, A. C. (2002). *Como elaborar projetos de pesquisa*. São Paulo, SP: Atlas.

16. Harland, N. (2011). Large sieve and Bombieri-Vinogradov theorem. The University of British Columbia. Disponível em: https://personal.math.ubc.ca/~gerg/teaching/613-Winter2011/LargeSieveBombieriVinogradov.pdf. Acesso em: 19 maio 2023.

17. Helfgott, H. A. (2014). The ternary Goldbach conjecture is true. *ArXiv* (Cornell University). Disponível em: https://arxiv.org/pdf/1312.7748.pdf. Acesso em: 29 jun. 2023.

18. Helfgott, H. A., & Platt, D. J. (2014). Numerical verification of the ternary Goldbach conjecture up to $8{,}875 \times 10^{30}$. *ArXiv* (Cornell University). Disponível em: https://arxiv.org/pdf/1305.3062.pdf. Acesso em: 07 maio 2023.

19. Jurkat, W., & Richert, H. (1965). An improvement of Selberg's sieve method I. *Acta Arithmetica, 11*, 217-240. Disponível em: https://www.impan.pl/en/publishing-house/journals-and-series/acta-arithmetica/all/11/2/95841/an-improvement-of-selberg-s-sieve-method-i. Acesso em: 02 ago. 2023.

20. Li, H. (2000). The exceptional set of Goldbach numbers: (II). *Acta Arithmetica, 92*, 71-88. Disponível em: http://matwbn.icm.edu.pl/ksiazki/aa/aa92/aa9217.pdf. Acesso em: 04 ago. 2023.

21. Liu, M. C., & Wang, T. Z. (2002). On the Vinogradov bound in the three primes Goldbach conjecture. *Acta Arithmetica, 105*, 133-175. Disponível em: https://www.impan.pl/en/publishing-house/journals-and-series/acta-arithmetica/all/105/2/82946/on-the-vinogradov-bound-in-the-three-primes-goldbach-conjecture. Acesso em: 27 jul. 2023.

22. Lu, W. C. (2010). Exceptional set of Goldbach number. *Journal of Number Theory, 130*, 2359-2392. Disponível em: https://www.sciencedirect.com/science/article/pii/S0022314X10001320. Acesso em: 08 set. 2023.

23. Martinez, F. B. et al. (2011). *Teoria dos números: Um passeio com primos e outros números familiares pelo mundo inteiro* (2nd ed., 450 p.). Rio de Janeiro: IMPA.

24. Montgomery, H. L., & Vaughan, R. C. (1975). The exceptional set of Goldbach's problem. *Acta Arithmetica, 27*, 353-370. Disponível em: http://matwbn.icm.edu.pl/ksiazki/aa/aa27/aa27126.pdf. Acesso em: 10 maio 2023.

25. Metring, R. A. (2010). *Pesquisas científicas: Planejamento para iniciantes*. Curitiba: Juruá.

26. Ramachandra, K. (1979). Some remarks on a theorem of Montgomery and Vaughan. *Journal of Number Theory, 11*, 465-471. Disponível em: https://www.sciencedirect.com/science/article/pii/0022314X79900118. Acesso em: 02 jun. 2023.

27. Severino, A. J. (2007). *Metodologia do trabalho científico*. São Paulo, SP: Cortez.

28. Silva, T. O. E. (2015). Goldbach conjecture verification. Home page of Tomás Oliveira e Silva. Disponível em: https://sweet.ua.pt/tos/goldbach.html. Acesso em: 10 jun. 2023.

29. Silva, T. O. E., Herzog, S., & Pardi, S. (2014). Empirical verification of the even Goldbach conjecture and computation of prime gaps up to 4×10^{18}. *Mathematics of Computation (American Mathematical Society)*, *83*(288), 2033-2060. Disponível em: https://www.ams.org/journals/mcom/2014-83-288/S0025-5718-2013-02787-1/S0025-5718-2013-02787-1.pdf. Acesso em: 28 maio 2023.

30. Sousa, J. E. (2013). *Conjectura de Goldbach: Uma visão aritmética* (Dissertação de Mestrado). Universidade dos Açores, Ponta Delgada. Disponível em: https://repositorio.uac.pt/handle/10400.3/2881. Acesso em: 14 fev. 2023.

31. Souza, J. de B. (2019). *Conjecturas em teoria dos números e suas histórias* (Dissertação de Mestrado Profissional). Universidade Federal da Paraíba, João Pessoa. Disponível em: https://repositorio.ufpb.br/jspui/handle/123456789/24394?locale=pt_BR. Acesso em: 10 set. 2023.

32. Wang, Y. (2002). *The Goldbach conjecture* (2nd ed., 344 p.). Singapura: World Scientific. Disponível em: http://www.bibliotecadigital.ufrgs.br/da.php?nrb=001072924&loc=2018&l=cfcc65fd8ae2feb2. Acesso em: 06 mar. 2023.

33. Yamada, T. (2015). Explicit Chen's theorem. *ArXiv* (Cornell University). Disponível em: https://arxiv.org/abs/1511.03409. Acesso em: 12 jun. 2023.

Elaboration, nutritional and sensory analysis of peanut butter plus milk chocolate

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ABSTRACT

This work has as its theme the elaboration, nutritional and sensory analysis of peanut butter plus milk chocolate, since peanut butter plus chocolate is very nutritious, bringing several benefits, as chocolate is a source of proteins, fats, calcium, magnesium, iron, zinc, vitamins E, B1, B2, B3, B6, B12 and C, in addition to being rich in carbohydrates and bioactive compounds. Five formulations of peanut pastes were elaborated using the concentrations of 0%, 10%, 20%, 30% and 40% of milk chocolate, respectively. It was observed that the greater the amount of milk chocolate added to peanut butter, the less energetic the product is made. Due to the data obtained through this study, it is concluded that the elaboration of peanut butter with the addition of 40% milk chocolate presented satisfactory results in relation to the characteristics of appearance, color, texture, flavor and global acceptance, obtaining averages greater than 7 (seven), and also pointed out acceptable responses in the microbiological and nutritional analyses. In addition, it proved to have a great capacity to be marketed, since it reached an index of 80% in terms of purchase intention.

Keywords: Peanuts, Milk chocolate, Peanut butter, Nutritional analysis, Sensory analysis.

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INTRODUCTION

Peanuts are an important food that, when ingested prudently due to their energy value, can establish a good source of vitamins, minerals and phytochemicals with antioxidant and anti-inflammatory properties in the human diet (ARYA et al., 2016). Thus, its composition comprises more than 20 amino acids, polyphenols, antioxidants, vitamins and minerals (SANDEFUR, 2017). The fats found in peanuts are mainly unsaturated fats (mono and polyunsaturated), constituting a great alternative to animal fats, which help reduce LDL – low-density lipoprotein, the well-known "bad cholesterol". One of the products derived from peanuts is peanut butter, which can be consumed naturally, added with additives or incorporated into various food formulations (TIMBABADIYA et al., 2017).

Peanut butter is a product obtained from crushed peanuts, which has been gaining renown among physical activity practitioners to the detriment of its beneficial properties, such as fatty acids and proteins. In addition to presenting vitamins, minerals and bioactive compounds, such as resveratrol, which collaborate with the reduction of the risk of cardiovascular diseases (LUU et al., 2015). In the process of developing peanut butter, the integument, film or skin, is removed and discarded, representing a waste of material, which if not disposed of properly, can cause environmental problems (CISNEROS et al., 2018). This film contains phenolic compounds and especially the flavonoid class, which are antioxidants, considered bioactive substances, providing color attribute to foods (VASCONCELOS, 2014).

Chocolate intake provides several functional health benefits, both in the cardiovascular system and in dermal health (DE OLIVEIRA RIBAS et al., 2018). Thus, it is necessary to implement chocolate and its sources in a balanced diet, however, it is important to point out that its consumption should originate from healthy sources without the addition of high sugars and preservatives, since products that have high levels of sugars and additives have low concentrations of chocolate, resulting in an increase in body weight.

Chocolate is a nutritional source, which has pleasant sensory characteristics, acting as a source of proteins, fats, calcium, magnesium, iron, zinc, vitamins E, B1, B2, B3, B6, B12 and C, which if ingested in moderation, add health benefits (DALLABRIDA, 2018). In addition, they are rich in carbohydrates and bioactive compounds, and can be consumed by people of all ages (ARUNKUMAR et al., 2019). Chocolate has a high content of flavonoids and polyphenols, which confer antioxidant, antimutagenic, and antidiabetic activities (BATISTA et al., 2016; FAKHARI et al., 2021). In addition, they also have a source of magnesium and potassium, which configure a cardioprotective effect. For Magrone et al. (2017), what provides a decrease in blood pressure in consumers of cocoa products is the fact that after consumption, nitric oxide is released and also angiotensin-converting enzyme inhibited, through flavonoids or theobromine. And with the addition

of chocolate in peanut butter, it will provide a more palatable flavor, be more nutritious, bringing much more benefits to the consumer.

In view of this theme, this work legitimizes the elaboration of peanut butter added to milk chocolate, and to evaluate sensory acceptance, purchase intention, acceptability index, as well as its nutritional composition.

MATERIAL AND METHODS

The experiment was carried out at the Bakery Laboratory of the Federal Institute of Education, Science and Technology of Maranhão – São Luís/Maracanã Campus.

MATERIALS

Whole, roasted and film-free peanuts, milk chocolate and soybean oil were used.

PREPARATION OF PEANUT BUTTER

The peanut butter was prepared in the bakery laboratory of the Federal Institute of Maranhão (IFMA), using the methodology described by LIMA et al. (2009), with some modifications, using roasted peanuts, milk chocolate and soybean oil.

METHODS

Five formulations of peanut butter added with milk chocolate were elaborated, one of them being standard, that is, without the addition of milk chocolate and the others with additions of 10%, 20%, 30% and 40% of milk chocolate, respectively.

For the preparation of the peanut butter, roasted and unfilmed peanuts, soybean oil and milk chocolate were weighed on an analytical scale in the proportions of 10%, 20%, 30% and 40%.

Then, the peanuts were crushed in a blender until all the beans are uniform in powder form. After this step, the soybean oil was added to the peanuts, beating them in a blender until the peanut butter was obtained (figure 3). Soon after, the peanut butter was removed from the blender, and the contents were weighed, separating it into portions, adding the chocolate respectively in the percentages of 10%, 20%, 30% and 40% (figures 4 and 5).

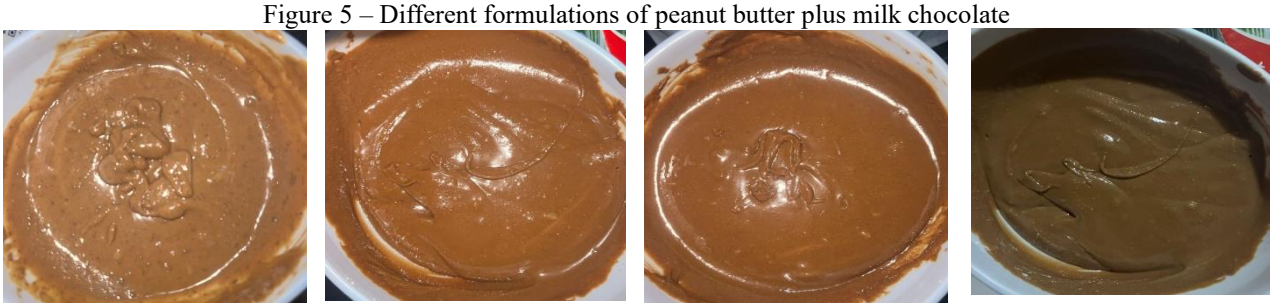
Figure 3 – Preparation of peanut butter

Source: Author, 2023

Figure 4 – Addition of milk chocolate to peanut butter

Source: Author, 2023

Figure 5 – Different formulations of peanut butter plus milk chocolate



Source: Author, 2023

NUTRITIONAL ANALYSIS

To carry out the nutritional composition analysis, the determinations established by the National Health Surveillance Agency – ANVISA were followed, through the Resolution of the Collegiate Board – RDC No. 429 of October 8, 2020, which provides for the nutritional labeling of packaged foods and the Normative Instruction – IN No. 75 of October 8, 2020, which establishes the technical requirements for the declaration of nutritional labeling on packaged foods and the Brazilian Food Composition Table – TACO 4th Edition (BRASIL, 2020) was also used.

MICROBIOLOGICAL ANALYSIS

Microbiological analysis is indicated for peanut butter and similar (BRASIL, 2001). The multi-tube technique for the determination of thermotolerant coliforms was performed at the Microbiology Laboratory of the Federal Institute of Education, Science and Technology of Maranhão – São Luís/Maracanã Campus (ARAÚJO et al., 2016).

SENSORY ANALYSIS

The sensory analysis was carried out based on the methodology recommended by Lopes (2012), using a 9-point Hedonic Scale, being 9 = very much liked, 8 = very much liked, 7 = moderately liked, 6 = slightly liked, 5 = indifferent, 4 = slightly disliked, 3 = moderately disliked, 2 = disliked a lot and 1 = disliked extremely. The following characteristics were evaluated: appearance, color, texture, flavor and global acceptance.

To evaluate the purchase intention, a Purchase Intention Form was used by a 5-point attitude scale, as follows: 1 = I would certainly buy this sample, 2 = I would probably buy this sample, 3 = I have doubts about whether I would buy this sample, 4 = I probably would not buy this sample and 5 = I certainly would not buy this sample.

The sensory evaluation was carried out at the Federal Institute of Maranhão IFMA – São Luís/Maracanã Campus, on October 16, 2023, with the cooperation of 56 untrained evaluators, male and female servers and students, where all signed the Informed Consent Form (ICF). Everyone made the evaluation individually and was properly instructed to observe the characteristics of the product and mark the answer sheets.

STATISTICAL ANALYSIS

The data were evaluated using the *Excel* version 2019 program (*Microsoft Corporation*).

RESULTS AND DISCUSSION

FORMULATION OF PEANUT BUTTERS

The formulations of the peanut butter samples were presented in Table 2.

Table 2 – Formulations of peanut butter samples

PEANUT BUTTER SAMPLE FORMULATIONS					
INGREDIENTS	SAMPLE 1 (STANDARD - 0%)	SAMPLE 2 (10%)	SAMPLE 3 (20%)	SAMPLE 4 (30%)	SAMPLE 5 (40%)
Peanut (g)	83	77	71	66	62
Soybean oil (g)	16,6	15,4	14,2	13,2	12,4
Milk chocolate (g)		7,7	14,2	19,8	24,8

Source: Author, 2023

NUTRITIONAL ANALYSIS

Using the nutritional values that make up each ingredient, and having the Brazilian Food Composition Table (TACO) as a reference, table 3 was elaborated. Table 3 presents the nutritional values of the peanut butters elaborated.

Table 3 – Nutritional table of peanut butters added to milk chocolate in the proportions of 0%, 10%, 20%, 30% and 40% of milk chocolate, respectively.

NUTRITIONAL TABLE PEANUT BUTTER (each 100 g)						
INGREDIENTS		Sample 1 Standard (0%)	Sample 2 10%	Sample 3 20%	Sample 4 30%	Sample 5 40%
MOISTURE (%)		1,41	5,15	8,3	10,22	13,45
ENERGY	Kcal	649,72	613,29	575,23	543,76	519,30
	Kj	2.716,59	2.565,86	2.386,75	2.275,21	2.172,97
PROTEIN (g)		18,67	17,36	16,05	14,96	14,09
LIPIDS (g)		61,42	58,13	54,67	51,81	49,60
COLESTEROL (mg)		ON	1,77	3,26	4,55	5,70
CARBOHYDRATE (g)		15,52	15,54	15,4	15,31	15,31
DIETARY FIBER (g)		6,47	6,04	5,61	5,25	4,97
ASH(g)		2,65	2,76	2,76	2,90	2,97
CALCIUM (mg)		32,37	44,58	54,52	63,16	71,05
MAGNESIUM (mg)		131,97	122,43	121,83	117,41	114,20
TOTAL FATS (g)		58,1	54,52	50,85	47,80	45,40
SATURATED FATS (g)		10,95	10,68	10,33	10,05	9,86
GORDURAS TRANS (g)		0,08	0,07	0,07	0,06	0,06
SODIUM (mg)		14,11	13,09	12,07	11,22	10,54
POTASSIUM (mg)		538,67	528,37	513,61	501,99	494,63
IRON (mg)		1,58	1,65	1,69	1,73	1,77
VITAMINA B6 (mg)		0,41	0,38	0,35	0,33	0,31

Source: Author, 2023

Analyzing the nutritional values of the five samples of peanut butters, it can be observed that the nutrient content changed according to the formulation used, however all formulations were presented as a source of proteins and vitamins, in addition to having a high content of carbohydrates, calories, potassium and minerals. It was observed that the greater the amount of milk chocolate added, the less energetic the peanut butter is. This is due to the fact that standard peanut butter contains more lipids than peanut butter plus milk chocolate.

MICROBIOLOGICAL ANALYSIS

Table 4 shows the values obtained through microbiological analyses.

Table 4 – Results of microbiological analyses

Peanut butter	Coliforms totais	Thermotolerant coliforms	*Salmonella spp.*
Sample 1 (default 0%)	< 3,0	< 3,0	Absent
Aexhibition 2 (10%)	< 3,0	< 3,0	Absent
Sample 3 (20%)	< 3.0	< 3.0	Absent
Sample 4 (30%)	< 3.0	< 3.0	Absent
Sample 5 (40%)	< 3.0	< 3.0	Absent

Source: Author, 2023

Analyzing the data obtained through the microbiological analysis for the peanut butter samples at their concentrations of 0%, 10%, 20%, 30% and 40% of milk chocolate addition, the absence of Salmonella *spp.* and that the concentration of total and thermotolerant coliforms was relatively low, certifying the microbiological quality of the peanut butter, since the results meet the

provisions of Normative Instruction No. 60, of December 23, 2019.

SENSORY ANALYSIS

Table 5 shows the mean values and standard deviations of the samples of peanut butter plus milk chocolate obtained through sensory analysis.

Table 5 – Results of sensory analyses

Feature	Sample 1 (default 0%)	Aexhibition 2 (10%)	Amostra 3 (20%)	Aexhibition 4 (30%)	Amostra 5 (40%)
Appearance	5.63 ± 2.19	6.63 ± 1.78	6.64 ± 1.71	6.96 ± 1.75	7.79 ± 1.33
Colour	5.80 ± 2.19	6.32 ± 1.69	6.77 ± 1.56	6.80 ± 1.92	7.54 ± 1.50
Texture	5.79 ± 2.15	6.59 ± 1.71	6.91 ± 1.65	6.89 ± 1.65	7.70 ± 1.53
Flavor	3.93 ± 1.94	5.73 ± 2.20	6.52 ± 1.72	6.80 ± 1.76	7.93 ± 1.36
Global acceptance	4.86 ± 2.07	6.39 ± 1.88	6.86 ± 1.55	6.84 ± 1.97	7.93 ± 1.25

Source: Author, 2023

Regarding the appearance characteristic, sample 5 with the addition of 40% milk chocolate had 7.79, with the highest score by the evaluators, while sample 1, standard containing 0% milk chocolate, had the lowest score of 5.63. Samples 2 and 3, with the addition of 10% and 20% of milk chocolate, respectively, remained with relatively equal values of 6.63 and 6.64, respectively, while sample 4 with 30% milk chocolate obtained a score of 6.96.

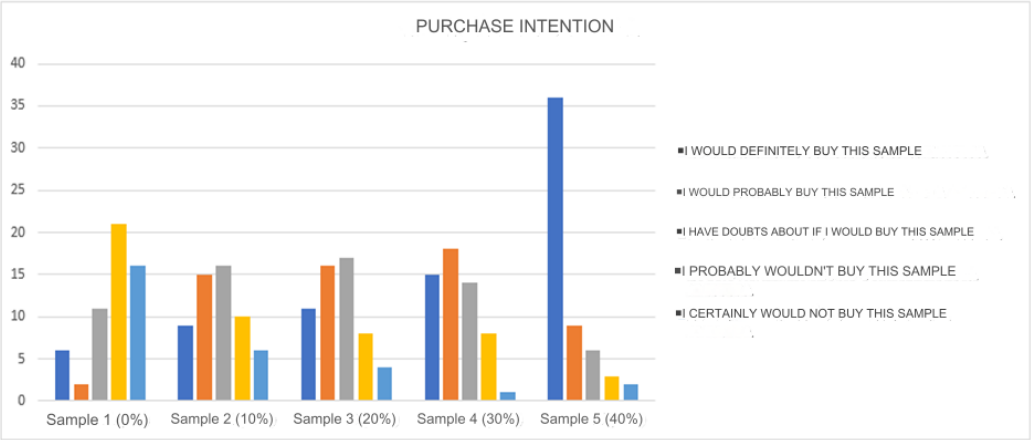
Regarding the color attribute, sample 5 had the highest score of 7.54, followed by samples 4, 3, 2 and 1, which obtained scores of 6.80, 6.77, 6.32 and 5.80, respectively. Regarding texture, sample 5 obtained the highest score among the evaluators 7.70, followed by sample 3 which obtained a score of 6.91, while samples 4, 2 and 1 obtained scores of 6.89, 6.59 and 5.79, in that order.

In the flavor requirement, sample 5 also obtained the highest score, achieving an average of 7.93. Sample 1 received the lowest score of 3.93 and samples 2, 3 and 4 received averages of 5.73, 6.52 and 6.80, in that order.

Global acceptance showed that samples 3, 4 and 5 received the highest scores of 6.86, 6.84 and 7.93, respectively. Samples 1 and 2 obtained the lowest acceptance scores from the evaluators, 4.86 and 6.39.

Sensory evaluation is an extremely important characteristic, as it involves the interaction between food and the tissues of the mouth (BURITI et al., 2008). Thus, among the five samples, the one that obtained the highest sensory acceptance was sample 5, which reached values above the average.

Figure 6 – Purchase intention



Source: Author, 2023

Regarding the purchase intention test based on the results obtained, sample 5 of peanut butter with the addition of 40% milk chocolate presented the best purchase intention score. The percentage of the sum of the items "I would certainly buy" and "I would probably buy" pointed to the result of 80%. Samples 1, 2, 3 and 4 presented the percentages of 14%, 43%, 48% and 59%, respectively.

According to Carmo et al. (2017), regarding the acceptability index, the product that reaches at least 70% acceptance is considered accepted. Therefore, sample 5 containing 40% milk chocolate is acceptable, thus having great conditions to be placed for commercialization.

CONCLUSION

It was observed that the greater the amount of milk chocolate added to peanut butter, the less energetic the product is made. Due to the data obtained through this study, it is concluded that the elaboration of peanut butter with the addition of 40% milk chocolate presented satisfactory results in relation to the characteristics of appearance, color, texture, flavor and global acceptance, obtaining averages greater than 7 (seven), and also pointed out acceptable responses in the microbiological and nutritional analyses. In addition, it proved to have a great capacity to be marketed, since it reached an index of 80% in terms of purchase intention.

REFERENCES

1. ANVISA. Agência Nacional de Vigilância Sanitária. (2020a). Instrução Normativa – IN nº 75, de 08 de outubro de 2020. Estabelece os requisitos técnicos para declaração da rotulagem nutricional nos alimentos embalados. Disponível em: http://antigo.anvisa.gov.br/legislacao#/visualizar/434473. Acesso em: 12 mar. 2023.

2. ANVISA. Agência Nacional de Vigilância Sanitária. (2020b). Resolução da Diretoria Colegiada – RDC nº 429, de 08 de outubro de 2020. Dispõe sobre a rotulagem nutricional dos alimentos embalados. Disponível em: http://antigo.anvisa.gov.br/legislacao#/visualizar/434473. Acesso em: 12 mar. 2023.

3. Araújo, T. M., et al. (2014). Análise bacteriológica da água consumida em escolas públicas na capital de Boa Vista-Rr. In *62ª Reunião Anual da SBPC*. Universidade Federal do Rio Grande do Norte Natal. Disponível em: https://www.upf.br/_uploads/Conteudo/simposio-sial-anais/2018/ciencia/c-17.pdf. Acesso em: 16 jun. 2023.

4. Arunkumar, K., et al. (2019). Evaluating the processed beans of different cocoa (Theobroma cacao L.) accessions for quality parameters. *J. Phytol, 11*, 1-4. Disponível em: https://downloads.editoracientifica.com.br/articles/221110832.pdf. Acesso em: 10 jun. 2023.

5. Arya, S. S., Salve, A. R., & Chauhan, S. (2016). Peanuts as functional food: a review. *J. Food Sci. Technol, 53*, 31–41. Disponível em: https://acrobat.adobe.com/id/urn:aaid:sc:VA6C2:8004af7d-8365-4784-b3a9-7bd2941431fd. Acesso em: 15 mai. 2023.

6. Batista, N. N., et al. (2016). Antioxidant capacity of cocoa beans and chocolate assessed by FTIR. *Food Research International, 90*, 313-319. Disponível em: https://downloads.editoracientifica.com.br/articles/221110832.pdf. Acesso em: 10 jun. 2023.

7. Brasil. Agência Nacional de Vigilância Sanitária. (2001). Resolução RDC Nº 12, de 2 de janeiro de 2001. Aprova o "Aprovar o Regulamento Tiéccon sobre Padrões Microbiológicos para Alimentos". Disponível em: https://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2001/res0012_02_01_2001.html. Acesso em: 10 jun. 2023.

8. Brasil. Ministério da Saúde. (2011). *Tabela Brasileira de Composição de Alimentos – TACO*. 4ª ed. Universidade Estadual de Campinas. Disponível em: https://www.cfn.org.br/wp-content/uploads/2017/03/taco_4_edicao_ampliada_e_revisada.pdf. Acesso em: 06 nov. 2023.

9. Buriti, F. C. A., Cardarelli, H. R., & Saad, S. M. I. (2008). Textura instrumental e avaliação sensorial de queijo fresco cremoso simbiótico: implicações da adição de *Lactobacillus paracasei* e inulina. *Revista Brasileira de Ciências Farmacêuticas, 44*, 75-84. Disponível em: https://www.scielo.br/j/rbcf/a/NxZqC5RLQHj6878554MMRyN/?format=pdf&lang=pt. Acesso em: 04 nov. 2023.

10. Carmo, A. S., Almeida, J. M., & Holanda, H. D. (2017). Avaliação sensorial de biscoitos tipo cookies utilizando a farinha de manga tommy atkins (*Mangifera indica* L.). *Revista Brasileira de Agrotecnologia, 7*(2), 288-293. Disponível em: http://www.gvaa.com.br/revista/index.php/REBAGRO/article/view/5197/288-29. Acesso em: 04 nov. 2023.

11. Cisneros, F., Paredes, D. C., Elsorady, M. E. I., & Ali, S. E. (2018). Antioxidant activity of roasted

and unroasted peanut skin extracts. *International Food Research Journal, 25*, 43–50. Disponível em: https://lume.ufrgs.br/bitstream/handle/10183/240018/001141465.pdf?sequence=1&isAllowed=y. Acesso em: 15 abr. 2023.

12. Dallabrida, J. C. (2018). Antioxidantes do Chocolate e do Vinho Tinto. Trabalho acadêmico apresentado ao Curso de Bacharelado em Química de Alimentos. Universidade Federal de Pelotas, Pelotas, RS. Disponível em: https://repositorio.uniceub.br/jspui/bitstream/prefix/15357/1/21708843-21710062.pdf. Acesso em: 18 mai. 2023.

13. De Oliveira Ribas, H. O., et al. (2018). Benefícios funcionais do cacau (*Theobroma cacao*) e seus derivados. *Visão Acadêmica, 19*(4). Disponível em: https://downloads.editoracientifica.com.br/articles/221110832.pdf. Acesso em: 10 jun. 2023.

14. Fakhari, M., et al. (2021). The effects of pilates and flavanol-rich dark chocolate consumption on the total antioxidant capacity, glycemic control and BMI in diabetic females with neuropathy complications. *Journal of Bodywork and Movement Therapies, 26*, 294-299. Disponível em: https://downloads.editoracientifica.com.br/articles/221110832.pdf. Acesso em: 10 jun. 2023.

15. Lopes, G. A. Z. (2012). Caracterização química, física e sensorial de produtos à base de amendoim. (Tese de doutorado). Universidade Estadual Paulista, Faculdade de Ciências Farmacêuticas. Disponível em: https://acrobat.adobe.com/id/urn:aaid:sc:VA6C2:77720f76-53a2-460b-9512-f4d881148d01. Acesso em: 14 abr. 2023.

16. Luu, H. N., et al. (2015). Prospective evaluation of the association of nut/peanut consumption with total and cause-specific mortality. *JAMA Internal Medicine, 175*(5), 755–766. Disponível em: https://lume.ufrgs.br/bitstream/handle/10183/240018/001141465.pdf?sequence=1&isAllowed=y. Acesso em: 03 mai. 2023.

17. Magrone, T., et al. (2017). Cocoa and dark chocolate polyphenols: from biology to clinical applications. *Frontiers in Immunology*, 677. Disponível em: https://downloads.editoracientifica.com.br/articles/221110832.pdf. Acesso em: 10 jun. 2023.

18. Sandefur, H. N., McCarty, J. A., Boles, E. C., & Matlock, M. D. (2017). Peanut products as a protein source: Production, nutrition, and environmental impact. In *Sustainable Protein Sources* (Elsevier Inc.). Disponível em: https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/article/view/7848/6803. Acesso em: 21 abr. 2023.

19. Timbabadiya, P. N., et al. (2017). Application of peanut butter to improve the nutritional quality of cookies. *Current Research in Nutrition and Food Science Journal, 5*, 398–405. Disponível em: https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/article/view/7848/6803. Acesso em: 29 abr. 2023.

20. Vasconcelos, T. B. (2014). Radicais Livres e Antioxidantes: Proteção ou Perigo? *Unopar Científica Ciências Biológicas e da Saúde, 16*(3), 213-220. Disponível em: https://lume.ufrgs.br/bitstream/handle/10183/240018/001141465.pdf?sequence=1&isAllowed=y. Acesso em: 15 abr. 2023.

Social work and anti-capitalist struggles in Angola in the 1960s-1980s: A critical introduction

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ABSTRACT
Through a critical introduction, this article aims to analyze the relationship that developed between Social Work and the anti-capitalist struggles that took place in Angola between 1960-1980, with the aim of apprehending the determinations that built the profession of that time. The historical-dialectical materialist basis led the debate, through bibliographic and documentary research, through which it is perceived that the anti-capitalist struggles, in that period, were a constitutive part of a dependent capitalism already installed in Angola, by the Portuguese colonial route, and that this social formation engendered in Social Work a profession at the service of the mechanisms of super-exploitation of the labor force, as well as for the formation of an Angola with the dictates of Western civilization. Faced with such a reality and taking into account the theoretical-methodological mediations that moved the Angolan revolutionaries, the struggles developed abolished not only the colonial regime, but also the profession, in 1977, in the way that it was only considered an "expression of colonialism".

Keywords: Social Work, Anticapitalist Struggles, Angola.

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INTRODUCTION

The "critical introduction" to the theme presented leads this debate, perceiving, in advance, the scarce production of knowledge about "anti-capitalism" and its relationship with Social Work in Angola. Therefore, it is hoped that this debate will introduce these categories in their necessary relationship, in order to get closer to the Angolan reality, in a social formation of dependent capitalism.

The "critical" position assumed in the introduction, through the historical-critical and dialectical perspective, allows us to apprehend the material determinations that permeated the anti-capitalist struggles in Angola, whose dynamics give possibilities to understand the movement of Social Work in this history, thus avoiding falling into the overconsideration of the "history of Social Work" as if it were self-explanatory.

How did the anti-capitalist struggles in Angola manifest themselves between 1960-1980? What was the raison d'être of Social Work in that period? Why was Social Work abolished in 1977? These are the fundamental questions that guided the debate, without the intention of exhausting it, but rather of critically introducing the subject, since much research must be undertaken to better explore the debate.

In methodological terms, bibliographic and documentary research was based on understanding the main categories of the debate, as well as understanding the auxiliary categories without which it would not be possible to perceive the structures, processes and social relations through which the anti-capitalist struggles developed, attuning them to the being of Social Work: the formation of dependent capitalism. With this, it can be said that to situate the profession between 1960 and 1980 is to qualify it as an expression of Portuguese colonialism in Angola, but it is not sufficient without understanding the material basis on which the colonization process was constituted, especially since the anti-capitalist struggles that took place at that stage indicated that the resistances were not only against Portuguese colonialism, but against the capitalist social regime that was guided by Western imperialism.

Therefore, the debate is fundamentally structured in three parts, the first of which addresses "dependent capitalism as the historical-material basis of the Angolan revolution"; in the second it is about the "rebuttals of the expressions of the anti-capitalist struggles between affirmation and denial of Social Work in Angola" and, as a form of provisional conclusion, in the third part a provocative question is brought to the debate in the form of "hypotheses about the mistakes of the abolitionist reason of Social Work in 1975-1977".

DEPENDENT CAPITALISM: THE HISTORICAL-MATERIAL BASIS OF THE ANGOLAN REVOLUTION

The debate begins with the category "dependent capitalism", because the material basis of anti-capitalist struggles is the capitalist formation in its particular manifestation in human geography, where it is installed, in addition to the same category presenting itself as the ground, the historical-social foundation of the emergence of Social Work in Angola.

What was the character of the Angolan revolution in the period between 1960-1980? This problem demands complex and controversial answers. It is certain that there was resistance in this space, as well as, in the face of Portuguese colonialism, the certainty of the anti-colonial resistances developed in this period prevails. But are anti-colonial resistances self-explanatory as mere expressions of the antithesis of colonialism?

From the "Treaty of Tordesillas" to the emergence of the Cold War, the continents that make up the terrestrial globe have been establishing relations never seen in the history of humanity, which is therefore globalization, which has as its material basis modern capital, expansionist in essence, which through primitive accumulation will trace the complexes of national and international ordering, incorporating in them, a logic of domination and subordination among modern States (Mészáros, 2002).

It was then reflected that in order to grasp the determinations that explain the revolutionary character, which was dynamic in the period referred to, it is necessary to consult the historical-material and dialectical meaning of the category "revolution". This category, in its material dimension, in Angola in the years between 1960-1980, in its relationship with the categories "dependent capitalism" and "anti-capitalist struggles" will make us understand the reasons why Social Work was institutionalized in 1962 and extinguished in 1975-1977, deprived of use value and therefore canceled for 27 years.

For Marx, revolution can be political and social revolution. The first, as significant as it may be, is characterized by the alteration of the form of the State, in the form of class domination, without extinguishing the deepest mechanisms of domination and exploitation of the subalternized class, that is, leaving untouched the material foundations that revolve around private property. The second, on the other hand, destroys those foundations and replaces them with others, thus eliminating their political complements, such as the elimination of the State itself (Cotrim, 2007).

It is by perceiving the social formation, which explains the colonial process in Angola, that one understands the form of revolutionary struggle/resistance that took place. At the end of the nineteenth century and the beginning of the twentieth century, due to the crises of slave-like social relations induced by capitalist expansion (this is expressed by the various pressures to put an end to slavery and the slave trade that empires, such as England, will carry out), Portugal took Angola for

itself as an overseas province. Therefore, a colony, in the condition of being a geographical-material space aimed at capitalist exploitation.

Dependent capitalism is the hegemonic social formation, which explains Angolan society by the contemporary material determinations of a country as a political, economic and sociocultural periphery conceived, designed, built and controlled by capitalist centers (Mateus; Pimentel, 2024).

Since the end of the nineteenth century and the entire first half of the twentieth century, Portugal has enabled the installation of capitalist structures, dynamics, and relations in Angola, in a process already defined within the parameters of dependent capitalism (KATZ, 2020; SANTOS, 2023): Portugal, as a way of enriching itself, becomes an intermediary of capitalist empires to exploit raw materials and goods in Angola. Here the commodity is already the synthesis of many determinations of super-exploitation of the labor force of some Angolans, who are becoming free workers, and of others, who are still dominated by the remnants of forms of compulsory labor, as Chasin explains,

> [...] Society may be more or less developed from the capitalist point of view, more or less purged of pre-capitalist elements, more or less modified by the particular historical process of each country. Thus, there are ways and stages of being, in being and in being capitalism, which do not deny anatomy, but which realize it through specific concretions (Chasin, 1999).

It should be noted that in 1910, the foundation of the republic in Portugal laid the foundations that gave a new path to Angola's participation in the international market. "In 1912, a new governor, Norton de Matos, was dispatched to Angola, who put into practice measures of capitalist exploitation (Dilolwa, 2000, p. 31)". Very many determinations contributed to this ideology, which it is not appropriate to explain here. Only some guidelines were summarized:

a) To continue with the infrastructure works begun, i.e. with the construction of the railways;
b) Launch a road construction program;
c) To make the <<indigenous tax>> instituted in 1906 really mandatory;
d) To give dynamism to the work, begun in the second half of the nineteenth century, of making Angola a colony of intensive white settlement;
e) End barter to force monetary circulation
f) Through economic and administrative measures, liquidate the African petty bourgeoisie, in which the civil servants abounded;
g) Intensify military operations, because the first war was especially approaching, and so that capitalist exploitation would actually be possible (Dilolwa, 2000, p. 31-32).

Based on the production of Chasin (1999) on capitalist installation routes, capitalism in Angola was installed by the Portuguese colonial route. Colonization here should be understood as a

process of westernizing – capitalism is a European civilizing dynamic Ianni (2001) – the way of being of the Angolan social being. Colonization, in this context, is a set of mediations that should enable the installation of capitalist structures, placing Angola in a position that touches on possibilities of connection with international monopolies. One of the great expressions of this connection, in 1912, is the foundation of the Companhia de Pesquisas Mineiras de Angola (PEMA) for the exploration of diamonds in Lunda. It was the first mining company founded in Angola, which reveals the interest of international monopolies in seizing the diamond riches of the Kasai basin (Dilolwa, 2000, p. 33).

Portugal, already in the republican era, must create conditions that respond to the economic, social and political context of the early twentieth century, and that at this stage, Angola is a constitutive part of that political-administrative space, suffering any change caused by Portugal. This is the case of the financial crisis of 1926 in the republic, which forced the promulgation of Decree No. 2,124, which aimed at monetary reform in Angola, creating the Angolan currency board and providing for the constitution of an independent bank (Dilolwa, 2000). These are the capitalist institutions that were being created by the colonial route, at a stage in which the foundations of wage labor were being established: the foundation of capitalism, in its dependent form, based on the super-exploitation of labor power.

It is in the face of the installation of colonial capitalist barbarism, as a new form of barbarism in relation to that which was based on the slave trade, in the era of triangular trade, that the Angolans of 1960 were revolted, although "colonial mobilization and repression had already begun in the 1920s, with the creation of cultural centers, such as the African National League and the African Guild (Visentini, 2012, p.49)".

All the revolts created by Angolans in the 1960s were the basis for the political revolution, the one that created a rupture against Portuguese domination, through which national independence was achieved in 1975.

The context of the 1960s in Angola is strongly intertwined with the dynamics of the cold war between the world powers of the time and the independence movement, which was taking place in Africa (Visentini, 2012). "Seek first the political kingdom, and all the rest will be given to you as a supplement. When he uttered these words, Kwame Nkrumah was persuaded that political independence was the key to all projected improvements to the African condition (UNESCO, 2010, p. 149)."

The primacy of political independence defended by Nkrumah (one of the main influencers of the African revolutions of the 1950s and 1960s) was centered on the determinations that the Soviet socialist movement (re)produced in the processes of national liberation, and which, it would not be

otherwise, in a phase in which the cold war was at its peak between powers of antagonistic blocs, Many African movements defeated the colonizers under the banner of socialism.

The revolutionary subjects were represented by founding Angolan party formations, such as the Popular Movement for the Liberation of Angola (MPLA), the National Union for the Total Independence of Angola (UNITA) and the National Front for the Liberation of Angola (FNLA). These, due to the imperatives of the relations established with the Cold War powers, will enter the dialectical and, therefore, contradictory game of putting an end to Portuguese colonization. Because it is a political revolution in which only the form of the State changes, the limitations of this revolution will have to imply resigning itself to the new form of colonization, "neocolonization", by Angolan political sovereignty, which gives continuity to the dependent capitalist formation, because its structures and dynamics had already been installed. Dependent capitalism was formed by the Portuguese colonial path, whose consolidation will be carried out by the neocolonial path, a path (un)consciously assumed by the provisions of the Angolan political emancipation from the first republic.

Between 1960 and 1977, Angola registered a series of resistances against both the Portuguese and imperialism, both processes marked, above all, by the way in which the main revolutionaries built political consciousness based on democratic values, which at the time was in the process of universalization. This is the case of the installation of the minimum provisions of labor rights that the Portuguese settler put into effect to respond to the demands of Angolans who were newly free workers, especially from 1955 onwards (Dilolwa, 2000; Monteiro, 2016), as a way of continuing the colonization process. It is in this space of revolutionary resistance that the anti-capitalist struggles, their contradictions and Social Work, as a profession established in 1962 by the Portuguese to maintain the order of those things, are situated.

In the space that follows, we will see the various expressions of the anti-capitalist struggles, and the Social Work movement in the context marked by its affirmation, which will not last for two full decades. It will also witness its antithesis by the ideological contradictions produced by the new State, which officializes socialism as a project for Angolan society.

REPERCUSSIONS OF THE EXPRESSIONS OF ANTI-CAPITALIST STRUGGLES IN SOCIAL WORK IN ANGOLA

José Paulo Netto (1996) brings the thesis with which he agrees, explaining Social Work as a form of salaried work, required in the conflicts between capital and labor, in the era of the monopolies of capitalism, located between the end of the nineteenth century and the beginning of the twentieth century.

Even if it is not linear, with the clues of Amor Monteiro (2020), the hypothesis is raised that the profession in Angola emerges in the era of capitalism of a dependent nature, contributing directly to the devices of expropriation of surplus labor/absolute surplus value (by super-exploitation) – even if this is manifested by the realization of the social rights of Angolan workers – and indirectly, to the mechanisms of production of relative surplus value and/or constant capital to contribute to the accumulation of wealth in the capitalist centers of Western Europe and the USA.

This profession was born at a time in Angola (1962), when anti-capitalist struggles were intense. There is no coincidence here! There is a teleology that deserves to be unveiled.

The anti-capitalist struggles in this short debate constitute an analytical category, an ideal reproduction of the real movement of universalized resistances in capitalist civilization. With this category, it is intended to apprehend the situation of Social Work among the manifestations of barbarism produced by capitalist relations mediated by the Portuguese colonial state, in Angola, and the various forms of resistance against such order.

Anti-capitalist struggles are a controversial and polysemic category, often seen as self-explanatory, little explored, but due to the dedication of some researchers, such as Adamovsky (2004); MTD (2009); López et al (org.) (2019), and according to Melatti (2022), Wood (2011); Löwy and Robert (2015); Wright (2019) realizes how delicate she is, seeming to have lacked the care to stand up and assume her controversies. The debate here, for the sake of brevity, will be based mainly on the perspective of Adamovsky (2004), to raise hypotheses that will be deepened on other occasions due to the complexity of the subject.

According to Adamovsky (2004), anti-capitalism is a constitutive part of capitalism. A certain form of anti-capitalism corresponds to the capitalism that prevails it. Since capitalism is a mode of production, which gives a certain form to the productive forces and to the social relations of production, therefore, because it is a civilizing mode different from other civilizations that have occurred in the history of humanity, a history impregnated by the class struggle, certain social subjects located in the position of the dominated class carry out forms of resistance against this civilizing mode of the material conditions of world social life that also depends on their particularities and contexts.

The way in which capitalism manifests itself in the phase of the industrial revolution, which demarcates a mode of organization of work that is peculiar to it, also characterizes possibilities of resistance, as an expression of the organization of work under various forms of alienation and demands various processes of emancipation.

It is against the bourgeois society of the nineteenth century that Adamovsky (2004) explains that the first forms of revolts manifested themselves, resistances expressed, mainly, by utopian socialism of which anarchism is a part. At that moment (nineteenth century), the proletariat (no

longer anarchist) was being formed to the point of elaborating the "Manifesto of the Communist Party" – an official declaration of a social vision of the world radically different from bourgeois society, whose scientific socialism (the expression of the birth of Marxism) would be the most forceful project of society for the leadership of the proletariat – the revolutionary subject of the time – which with the First and Second Internationals would lead to what is called "the first anti-capitalist revolution", the Russian Revolution of 1917 (Adamovsky (2004).

Since the struggles are complex and polemical, this condition or character of being is rigorously revealed after the failure of the Russian Revolution. Adamovsky (2004) explains that, after 1917, various ways of confronting capitalist barbarism derive from Leninism, a capitalism that in the era of monopolies is expanding all over the globe, destroying modes of production that the world system installed. From this process linked to the process of colonization, national liberation movements were born. In this case, nationalism in countries classified as third world, according to the author, manifested itself in the twentieth century, as a form of anti-capitalist struggle. It is an anti-imperialist nationalism.

And it is in this nationalism that the Chinese, Vietnam and many other revolutions in Asia are situated; Cuban, Mexican, Bolivian and other revolutions in Latin America; in Africa the Algerian, Mozambican, Angolan and other revolutions are located (Visentini, 2012). These revolutions were nationalist and to some extent anti-imperialist.

The economic, political, social, cultural, and technological crises of the twentieth century will give rise to what Adamovsky (2004) calls a "new anti-capitalism", which is understood to reveal processes of rupture and continuity of opposing the capitalist order/civilization. The "new anti-capitalism" manifests itself in the different forms of anti-capitalist struggles, although some old forms give an expressive sequence. The old forms that coexist with the new ones are: socialism/communism; anti-imperialist nationalism and the social doctrine of the Church (Catholic, for its abstract Christian humanism).

Based on that author and MTD[3] (2009), the new forms of anti-capitalism reveal themselves to be stony in the Popular Organization, mediated by Social Movements.

In all fields of society the struggle against domination appears, its main form being the class struggle. A social movement gives the body to this struggle against domination, which, because it is very broad, makes social movements have the most different banners of struggle. As capitalism has several negative effects on our lives, many social movements exist as a form of resistance to these effects (MTD, 2009, p. 65).

Dealing with the same social issue, with its new expressions in neoliberalism, the struggle for immediate needs is exerting a redirection to forms of resistance against capitalist civilization that are

[3] Unemployed Workers Movement

much more aggressive in terms of regressing the legacy of labor rights (Iamamoto, 2015). Anti-capitalist struggles stem from the dynamics of social movements expressed in: trade unions, the unemployed movement, professional associations, anti-racist movements, feminism, LGBTQ+, the landless movement, the defense of indigenous groups, ecologists/environmentalists, among others. Although it is questionable, such reflection is considered indispensable, not to end the analysis with the definitive conclusions, but to raise hypotheses that will give direction to urgent and rigorous research on thinking about it, in the world and in Angola, in particular.

Therefore, based on Adamovsky (2004), one lands in Angola by the questions, whose answers will constitute the demand for evaluations and reflections, hypotheses that are part of the ongoing research process[4]:

a) What expressions of anti-capitalist struggles developed between 1960-1980?

b) Have there been/are there anti-capitalist struggles in Angola?

c) what was the movement of Social Work between 1960-1980 in relation to the existence or not of anti-capitalist struggles?

The basic hypothesis is that there were anti-capitalist struggles in Angola in the decade between 1960-1980 that were expressed by African nationalism (Pan-Africanism), national liberation movements, anti-racist, anti-colonial, anti-imperialist struggles, socialism and trade union struggles.

After some social movements of anti-colonial resistance had been constituted into political parties in the 1950s, in 1960 the armed struggle aimed at confronting the Portuguese colonial regime began, and therefore, in addition to the external economic and political determinations, the internal ones made Social Work imprint its existence in the 1960s, precisely for the Portuguese colonial state to confront the Angolan revolutionary workers, who demanded, fundamentally, national liberation.

The institutionalization of Social Work in this context occurred in 1962, as a result of a "marriage" between the "father and provider" – the Portuguese colonial state – and the "mother and teacher" – the Catholic Church (Monteiro, 2016). Due to the need to synthesize the relationship that develops between the anti-capitalist struggles and the Social Work movement, the determinations that drive the aforementioned Church to be part of the history of the profession were left aside, seeking to centralize what led the Portuguese colonial State to requisition the profession.

In 1962, the affirmation of the profession in the face of anti-capitalist struggles was inaugurated, a decade in which the form of salaried work was also established in Angolan territory by the Portuguese Overseas Policy in Angola. Such a policy was expressed by the social programs that, according to Mendes apud Monteiro (2016), carried out the mechanisms to increase the productivity of the workforce. There we found a) Mechanisms to increase the productivity of rural labor: length of the working day, housing, food, vacation, clothing, medical care, social action, social security; b)

[4] This debate is part of the doctoral research that is currently taking place on anti-capitalist struggles in Angola.

Mechanisms to increase the productivity of "specialized labor**":** definition of wages, qualification or professional training, social security, social action at work.

It is precisely in the institution of these social rights that the Portuguese State introduces Social Work for its implementation (in the sectors where the profession fits), but always with the classic purpose of controlling the workforce, dismantling in the workers their political capacity to confront barbarism.

In Angola, it was a matter of using these policies to dismantle the dimension that networks of resistance were building, making alliances with other African and European revolutionaries. The profession, in the midst of contradiction with its Christian moralizing bias, and with positivist-functionalist roots (Monteiro, 2020) was at the service of both the Church and, above all, the Portuguese State, in the most varied ways of disarming or blocking the anti-capitalist struggles, which were growing between 1960-1974.

Angolans ended up resisting and overcoming colonialist strategies, although not in a radical way (in the case of putting an end to capitalist civilization, which was already developed). Socialism in Angola was under the main influence of the Union of Soviet Socialist Republics and Cuba, ideological sources that moved the country's revolutionaries at the time (MPLA-PT, 1985), especially those who won national independence in 1975 (the Popular Movement for the Liberation of Angola).

Without the intervention of the Soviet Union and its allies in the struggles of southern Africa, the liberation of this region would probably be greatly delayed. This is the case of the Cuban intervention in the struggle in defense of Angola's sovereignty, as being the greatest external support ever provided in an African liberation war (Unesco, 2010, p. 149).

One of the marks left by socialism in Independent Angola is the First Republic, which configures an ideology represented in the National Flag, whose symbols praise the productive forces and revolutionary subjects such as peasants, workers, army, intellectuals and youth (the five subjects that make up the communist star), capable of erecting conditions to confront imperialism with its capitalist expressions.

In 1975, Angola presents its first project for society, as the first modern state.

The People's Republic of Angola is a sovereign, independent and democratic State, whose first objective is the total liberation of the Angolan people from the vestiges of colonialism and the domination and aggression of imperialism and the construction of a prosperous and democratic country, completely free from any form of exploitation of man by man, materializing the aspirations of the popular masses (ANGOLA, 1975, p. 4).

It is on this basis that the Popular Movement for the Liberation of Angola (MPLA), the party that gives direction to the Angolan nation, becomes MPLA-PT (MPLA- Labour Party) in 1977. Once socialism was made official, as a project of economic, political and social organization of Angola, a

state socialism, many remnants, expressions of the colonial tradition, including some[5] categories of capitalist formation were abolished. Social Work, as a child of the Portuguese colonial State and its mother the Catholic Church, as it is an ontologically profession of class struggle – in the capitalist era of monopolies, in dependent capitalism in birth – one of the instruments that guaranteed viability for the super-exploitation of the labor force by the mechanisms of increasing the productivity of the labor force of Angolans, it witnessed its antithesis in the emergence of the First Angolan Republic.

With the abolition of the profession, most professionals were in the same situation as the Portuguese who collapsed (with their flight) the administrative system of Angola – civil servants of the middle and upper echelons such as doctors, teachers, nurses, engineers – had to go to Portugal (Vidal, 2011). Santo (2023, p. 201) points out that "after the 25th of April 1974, about 90% of Social Work professionals, exercising their functions in Angola, left the country".

Due to the imperative of the real productive forces, which did not respond to the needs of officialized socialism, many crises occurred since the very foundation of the Republic, that until 1990, the government was forced to carry out economic reforms (discarding the socialist vision of the economy and assuming the market economy) and political reforms (replacing the one-party regime with the democratic regime. It was in 1990 that neoliberalism began to penetrate with the false promise of ending the crises arising throughout the First Republic (which were not mild crises!).

FINAL CONSIDERATIONS: HYPOTHESES ABOUT THE MISCONCEPTIONS OF THE ABOLITIONIST REASON OF SOCIAL WORK IN 1975-1977

We agree with José Paulo Netto's thesis on Social Work, which emerges in the era of monopoly capitalism. And the relationship of this profession with the capitalist mode of production is so intrinsic that, just as capitalism was installed in Angola by colonial means, Social Work was installed by the same route.

And, as such, the profession had, metaphorically, an unfortunate fate in the First Republic, since it did not have adequate parents, considering that the greatest expression of anti-capitalist struggle, which led one of the most organized groups of the 1960s – moved by socialism – had in its morphology both the antithesis of that Portuguese colonial state and the antithesis of the Catholic Church (a genuine antithesis of socialism that did not escape the position, according to which "religion is the opium of the people"), and therefore, the Government of Agostinho Neto (first president of Angola) was not prepared enough to tolerate this son who was innocent at all (his class character).

[5] We carefully speak of the abolition of "some" categories of capitalism, because the system of capital which is the soul of capitalism has not been destroyed.

The critical issues that should be raised are:

a) did the government of the First Republic have objective and subjective material conditions to destroy the capitalist structures already installed by the Portuguese colonizers, of which Social Work has always constituted a classist profession?

b) was the newly independent State (in the modern sense of the term State) immune to the social question and its expressions?

c) before the abolition of the profession, for all that justified its abolition, the government of the First Republic of Angola was facing a societal project that would effect the democratization of the productive forces and social relations of production of that historical phase?

d) What was Social Work for the Government of the First Republic?

These questions lead to the certainty that there is an urgent need to explore the Angolan reality, mainly from a historical-critical perspective, to unveil the material and dialectical determinations that made Angola what it is today. This requires undertaking more research in this direction, especially to understand why Social Work has the face that is revealed today in Angola.

The hypotheses move in the sense that the first project of society in the modern Angolan State was conceived in the midst of the expressions of anti-capitalist struggles, whose mediations lacked determinations proper to criticism, which would account for the spirit of capital, as a power not only economic, but also social. Capital here was already established as an uncontrollable system of social metabolism (Mészáros, 2002). And when capital is mentioned, reference is made to modern capital in Angola, an expression of universalized capital, which was already manifested in the ways in which the political, economic and social dimensions maintained Angolans as social beings of capitalist relations, even though the State claimed to be socialist.

The research carried out on the First Republic of Angola, such as the case of the work "Angola: from Afro-Stalinism to Savage Capitalism" by Tony Hodges (2002), demonstrates that the republic was built on the crises that would not have been avoided given the way in which the decolonization process took place, and that due to the structure of a modern State, it would not be possible to escape the dynamics of the social question, because capitalist structures were present in the relations between Angolan social subjects in already independent Angola.

The struggles developed between 1960-1974 did not create objective and subjective conditions capable of leading the revolutionary subjects of the time to recognize the dialectic of the work of social workers, that is, Social Work was seen as a profession that had only a commitment to the dominant class, a profession that had nothing to do with the political emancipation of Angolans.

It is considered that, even if the profession was guided by conservatism and its conservative character imprinted professional practices in the light of its image and likeness, it would never erase its class character, its possibility of developing emancipatory practices, and with it, its contribution to popular organization to develop anti-capitalist struggles in those two decades (1960s and 1970s).

REFERENCES

1. Adamovsky, E. (2004). *Anticapitalismo para principiantes* (1ª ed.). Buenos Aires: Era Nascente.

2. Chasin, J. (1999). A via colonial de entificação do capitalismo. In *O integralismo de Plinio Salgado - Forma de regressividade no capitalismo hiper tardio* (2ª ed.). São Paulo: Ad Hominem/UNA.

3. Cotrim, L. C. A. (2007). *Marx: Política e emancipação humana 1848-1871*. São Paulo: PUC-São Paulo.

4. Dilolwa, C. R. (2000). *Contribuição à história económica de Angola* (2ª ed.). Luanda: Editorial Nzila.

5. Hodges, T. (2002). *Angola: Do afro-estalinismo ao capitalismo selvagem*. Principia Editora.

6. Iamamoto, M. V. (2015). *Serviço social em tempo de capital fetiche: capital financeiro, trabalho e questão social*. São Paulo: Cortez.

7. Ianni, O. (2001). *Teorias da globalização* (9ª ed.). Rio de Janeiro: Civilização Brasileira.

8. Katz, C. (2020). *A teoria da dependência cinquenta anos depois* (M. Almeida, Trad.). São Paulo: Expressão Popular.

9. Mateus, J. D., & Pimentel, R. C. (2024). A dimensão socioeducativa do Serviço Social em Angola sob a perspectiva de Gramsci. *Em Pauta: Teoria Social e Realidade Contemporânea*, 22(55), 207-221. https://doi.org/10.12957/rep.2024.84197

10. Mézáros, I. (2011). *Para além do capital: rumo a uma teoria da transição*. São Paulo: Boitempo.

11. MPLA-Partido do Trabalho. (1985). *Angola: Trabalho e luta*. Luanda: Edições DIP.

12. Melatti, K. (2022). Elementos para o debate das vertentes do anticapitalismo. In *Simpósio da pesquisa "o Serviço Social na história: questão social e movimentos sociais (1960–2020)"*.

13. Monteiro, A. A. (2016). *Natureza do serviço social em Angola* (1ª ed.). São Paulo: Cortez.

14. Monteiro, A. A. (2020). *Serviço social, estado e políticas sociais em Angola: mediações teórico-metodológicas*. Manaus: Alexa Cultural.

15. Netto, J. P. (1996). *Capitalismo monopolista e serviço social*. São Paulo: Cortez.

16. República Popular de Angola. (1975). *Lei Constitucional*. Luanda: Edição INA.

17. Santo, F. A. E. (2023). *A institucionalização do serviço social em Angola: contribuição do Instituto Pio XII para a sua história* (1ª ed.). Lisboa: Editora Caneta de Estilo.

18. Santos, T. (2023). *Teoria da dependência: Balanço e perspectivas* (2ª ed.). Florianópolis, SC: Editora Insular.

19. UNESCO. (2010). *História geral da África, VIII: África desde 1935* (A. A. Mazrui & C. Wondji, Eds.). Brasília: UNESCO.

20. Universidade Popular Movimento dos Trabalhadores Desempregados MTD-RJ. (2009). *Cadernos sociais: capitalismo, anticapitalismo e organização popular*. Rio de Janeiro.

21. Vidal, N. (2011). A génese da economia do petróleo e dos "esquemas" impeditivos do desenvolvimento. In N. Vidal & J. Pinto de Andrade (Eds.), *Economia política e desenvolvimento em Angola*. Chá de Cachine – Angola & Portugal Média XXI.

22. Visentini, P. F. (2012). *As revoluções africanas: Angola, Moçambique e Etiópia*. São Paulo, SP: Ed. Unesp.

The economic decision-making process in the context of Artificial Intelligence

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ABSTRACT

It is about the economic decision-making process, in the context of artificial intelligence, from the critical perspective of Amartya Sen, to conventional economic thinking, on the maximization of self-interest, as the only and exclusive form of Economic Rationality, in the "datacentrist" context of the economy. The diffusion of Artificial Intelligence (AI), in the context of economic choices autonomously, can activate homoeconomicus (a situation that is currently feasible). For this, it is proposed: (1) a qualitative analysis of the level of Economic Rationality (with fulcrum in three of the Economic Theories of Decision: the Prospect, the Limited Rationality and the Rational Choice), in the case of the Alpha-Zero AI (as a proxy variable of the homoeconomicus Intelligence) and the aforementioned critique of Amartya Sen; and (2) presentation of a theoretical econometric model, with direct application of the Coob-Douglas function and another multiple intertemporal linear function, to deal with the dynamic variables.

Keywords: Artificial Intelligence, Economic Rationality, Rational Choice, Bounded Rationality, Prospect Theory.

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INTRODUCTION

The research proposed to investigate and understand, within the scope of the economic decision-making process, the intertemporal impact of Alpha-Zero Artificial Intelligence (as a proxy variable of *homoeconomicus*) on the level of economic rationality of instantaneous choices, in the light of Amartya Sen's critique of conventional economic thinking. According to SEN (1987), there is a logical problem with the premise of maximizing self-interest, as the only and exclusive form of Economic Rationality.

According to the author, the premise that the maximization of self-interest implies economic rationality is correct and unquestionable. The problem, in his view, is the lack of proof that all economic rationality comes only from the maximization of self-interest, that is, all maximization of self-interest implies economic rationality, but the reverse has not been proven. For example, collective issues that do not maximize self-interest, according to SEN (1987), are real and are not contemplated in the premise of conventional economic thinking, about the decision-making process.

With the information on this topic, it was realized that the impact of artificial intelligence is transformative for the debate, because it has directly influenced economic choices and can make optimal instant choices feasible (do *homoeconomicus*). The case of the AI called Alpha-Zero, for example, which was able to learn strategic board games (from the rules alone), whose extraordinary performance, in a short time, demonstrated cognitive superiority and analysis (qualitative and quantitative; instantaneous and simultaneous; logical and holistic) optimized data, over human players and other AIs (without defeat in recent statistical records). For this reason, it was chosen, in a feasible way, as a proxy for homoeconomicus (the one who only makes optimal economic choices), in the context of maximizing self-interest.

Thus, the objective of the research was to develop a theoretical model, simple and rigid, to describe and understand the level of economic rationality of instant choices, associated with the use of Homo Sapiens intelligence versus Alpha-Zero AI, since this relationship can be: either "symbiotic" (when they are complementary), or "parasitic" (when they are substitutes) and, in the long run, *ceteris paribus*, in the parasitic relationship (substitution between inputs) the scenario will be chaotic, while if the relationship is "symbiotic" (complementary inputs), it will be harmonious.

There are also the dynamic variables of the process, such as ethical aspects and technological innovation, especially creative destruction and environmental economic problems with global effects, in the context of the Big Data Economy, in the global perspective of datacentrism, according to HARARI (2013), whose premise is that the Data is the center of thought, in this case, the economic one. Therefore, according to the author, one of the socioeconomic

challenges of the third millennium is the discussion about economic science alternatives and the maximization of self-interest, in the face of global economic challenges, according to HARARI (2023).

Amartya Sen's criticisms of conventional economic thought are about: the Maximization of self-interest, as the only and exclusive way to obtain Economic Rationality; and Pareto science, as the only reference for economic science and is related to an aspect of the dynamic variables, the ethical. Another aspect that is part of the debate is the creative destruction of J. Schumpeter, associated with certain dynamic variables.

The model intends to enable future scientific contributions (empirical and theoretical) on the subject, for example: remuneration of the social utility of homo sapiens, when its marginal productivity is less than or equal to zero; new forms of taxation and incentives, with a focus on the preservation, conservation and recovery of the environment, etc.

The research found that instant optimal choices of *homoeconomicus,* may be feasible. Considering the position of three of the economic theories on decision (Prospectus, Limited Rationality and Rational Choice), about economic rationality, based on the maximization of self-interest, three distinct perspectives can be observed: the first, with bias in choices (choices, poor suboptimal), the second with information asymmetry (suboptimal, satisfactory choices), the third (optimal choices). All this combined with the economic phenomenon of the diffusion of artificial intelligence and its consequences (such as cognitive superiority and optimized data analysis in the Alpha-Zero case) there was the possibility of translating the discussion about the aforementioned hypothesis applied to the concrete case, inserting the *homoeconomicus proxy*.

The proposal for the elaboration and formulation of a specific theoretical economic model was due to the novelty of the theoretical discussion and the possibility of testing it empirically. This model can describe and evaluate the phenomenon of the economic decision-making process in an intertemporal way, that is, its consequences over time.

It was established as a premise that the influence of Alpha-Zero in the economic decision-making process could be positive or negative. By checking the historiography of economic thought, it was possible to sustain this idea from the scientific point of view. The Prospect Theory, the Theory of Limited Rationality and the Theory of Rational Choice were used, with different positions on the applicability of the hypothesis of economic rationality in concrete cases, according to citations in the theoretical framework of this article.

The greatest theoretical and empirical discussions on the subject were from supporters and opponents of the models of each of the three theories: Rational Choice Theory, Limited Rationality Theory and Prospect Theory , evaluating whether or not there is a science of the integral , partial or non-applied application of the hypothesis of economic rationality. in concrete

cases involving choices of economic agents (consumers, governments or entrepreneurs) in the decision-making process.

Then, starting from the continuous impact of the event (occurrence of the diffusion of the use of Alpha-Zero AI), in the recursive increase in the level of economic choices, this model assumes different levels of economic rationality, for the use of each of the inputs (homo sapiens intelligence; Alpha-Zero AI, Proxy of *Homoeconomicus Intelligence*).

According to Souza Filho and Struchiner (2018), for the construction of theoretical models, it is necessary to be representative, review of the literature on the subject, concise and coherent elaboration of the theoretical model, validation and restructuring tests, and conclusion of the theoretical model. The model was proposed directly to the Coob-douglas function, ceteris paribus, adapted to the intertemporal form. Soon after, a multiple linear regression to capture the intertemporal impacts of the dynamic variables. This mathematical demonstration is in the chapter on Economic Modeling.

It is believed that it may be useful to verify, in the light of the ideas of SEN (1987), the intertemporal impact of the optimal rational choices of *homoeconomicus*, such as that proposed in the hypothesis of economic rationality . Thus, it is intended to provide the debate with initial elements to enable future scientific contributions (empirical and theoretical) on the proposed problem.

THEORETICAL FRAMEWORK

To understand the impact, intertemporal, on the level of economic rationality of instantaneous choices. The literature brings the diffusion of artificial intelligence, as a way to induce progressive improvements in the ability of choice of these agents. In addition, it is possible, through combined interactions of the use of basic inputs, Alpha-Zero AI and *homo sapiens intelligence*, it is possible that there will also be continuous improvement of these tools and systems.

The hypothesis of economic rationality has been the subject of much criticism and debate over the centuries. Some of the main consequences of this hypothesis include the idea that individuals are capable of making rational decisions and maximizing their own interests.

According to Arrow (1987), in his article "Economic Theory and the Hypothesis of Rationality", rationality acquires its strength and meaning from the social context in which it is inserted and is more plausible under ideal conditions. When these conditions cease to exist, assumptions of rationality become tense and possibly self-contradictory. The application in concrete cases depends on information processing and calculation that is far beyond what is feasible and that cannot be well justified as a result of learning and adaptation. By way of

illustration, Cavallini (2009) proposes, for example, a discussion of whether economic rationality is a legitimate scientific premise or an instrument to support the capitalist system of production.

On the one hand, The Theory of Rational Choice, proposed by authors such as Gary Becker (1976) and Milton Friedman (1953), and K. J. Arrow (1987), assumes that individuals are rational and make decisions based on their personal interests, enabling each economic agent to make his choice maximizing his utility, in the case of consumers, his profit in the case of companies and social well-being in the case of agents Government. In this case, full applicability of the hypothesis (based solely and exclusively on the maximization of self-interest) and optimal choices of the agents.

On the other hand, the Theory of Bounded Rationality, developed by Herbert Simon (1955), recognizes that individuals have cognitive capacities limited by the instantaneity of the economic decision, that is, it proposes the partial applicability of the hypothesis of economic rationality in the same context, so that the choices of these agents (consumers, rulers and entrepreneurs) would be suboptimal satisfactory.

Finally, the Prospect Theory, proposed by Daniel Kahneman and Amos Tversky (1979), suggests that individuals make decisions based on heuristics and cognitive biases, taking into account potential losses and gains, so in this case economic choices would be suboptimal bad. It proposes the inapplicability of the rationality hypothesis for the same purposes, same context.

According to Fernandez Bêrni (2014), evaluating the principle of rationality in economic theories, according to Karl Popper, he proposed three possible answers to this question. They were examined, by the author, with their respective logical structures. The first proposes that the postulate of rationality plays the role of a general law of human behavior. The second requires that it function as an axiom of theory. Finally, the third proposal suggests that the postulate of rationality be understood as a methodological rule. Therefore, in this research, the last solution that satisfies the conceptual basis of the proposed three-step model to describe the diffusion of artificial intelligence is used.

According to Morais (2012), some variants of the Rational Choice Theory from the perspective of the applicability of the hypothesis of economic rationality, based on the use of instrumental reason, almost exclusively, differ in terms of the criteria for using this hypothesis, which raises the question of the viability of this theory. The author tests the operational limits of each proposal to estimate, in general terms , the extent to which rational choice serves as a tool for concrete cases .

In the context of the axiom of classical theory, it is plausible, according to Costa (2016), Herbert Simon's model of limited rationality for the economic choices of agents in complex

systems, under the prism of the notion of logically consistent suboptimal choices, due to the asymmetry of information the instantaneous choices are satisfactory".

Mendes da Silva, et al. (2013) proposed to identify the existence of a statistical relationship between rational choice and academic performance of undergraduate university students. According to the authors, the results show that Academic Performance is directly related to rational choice and alters cognitive biases in decision-making.

To support the new model, there is a study conducted by Agrawal, Gans, and Goldfarb (2018), which investigated how artificial intelligence can be used to improve decision-making in economic contexts. The authors argue that this technology can provide valuable information and accurate analysis, leading, over time, to more rational and efficient choices.

According to Varian (2010) The diffusion of artificial intelligence can have a significant impact on the hypothesis of economic rationality, in concrete cases. Since, with the aid of social tools and systems , individuals will increasingly seek to satisfy their needs in a rationally perfect way, taking into account available information, probabilities of events and potential costs and benefits in determining preferences.

According to Silva and Fleig (2019), artificial intelligence can promote great advances, but at the same time there are potential risks of this technology, which must be considered. Leading to believe that the diffusion of artificial intelligence can have a significant impact on the hypothesis of economic rationality, helping agents to make optimal choices. However, it is important to note that the ethical and responsible use of artificial intelligence is key.

Therefore, regulation and control to ensure that its applications are beneficial to society and that the development, implementation and use of this technology must be controlled, regulated and regulated, and are carried out in an ethical and responsible manner, taking into account issues such as privacy, security and social justice.

This warning is clear, according to França and Vasconcelos (2020), when discussing the growing use of technologies based on artificial intelligence in the development of systems and tools, which has the potential to reduce the need for human presence in many dangerous, monotonous, and tiring activities, while increasing existing risks and introducing new ones.

However, in practice, according to Kahneman and Tversky (1979), individuals do not always make optimal decisions due to the existence of cognitive and emotional limitations. In this way, artificial intelligence, according to Agrawal, Gans, and Goldfarb (2018) can help overcome these limitations by providing valuable information and accurate analysis to aid in decision-making.

So, in summary, there may be, in the long run, a significant impact on the hypothesis of economic rationality, caused by the diffusion of artificial intelligence, since by training human economic agents, they could also make optimal choices in the long run.

It is important to emphasize that the development, implementation, and ethical and responsible use of tools and systems are essential to ensure that their applications are beneficial to society. Therefore, regulation and social control should be included in this process, taking into account issues such as privacy, security and social justice, in order to be able to prove the hypothesis of this research.

Since, in a summarized way, Ludermir (2021), Ribeiro (2011) and Fiorin et.al (2011), postulate that artificial intelligence is a broad and interdisciplinary field that includes many subfields. Machine Learning is a subfield of artificial intelligence that involves developing algorithms that can learn from data and make predictions or decisions without being explicitly programmed to do so. Another well-known subfield is neural networks: a type of machine learning algorithm modeled after the structure and function of the human brain.

Neural Networks are made up of layers of interconnected nodes or neurons that can learn to recognize patterns in data. Natural Language Processing (NLP) is also a field of artificial intelligence that focuses on enabling computers to understand, interpret, and manage human language. We still have as a large subfield associated with this technology the agent-based and multi-agent systems: the area of artificial intelligence that consists mainly of creating agent-based systems, where an agent is an autonomous entity capable of perceiving its environment, reasoning and making decisions to achieve its goals.

In addition, Search is also a subfield of artificial intelligence that focuses on developing algorithms to find solutions to complex problems. There is also: Automated Planning, which focuses on developing algorithms to automatically plan actions to achieve a specific goal; Knowledge Representation, which focuses on representing knowledge in a way that can be used by artificial intelligence systems to reason and make decisions; Probabilistic Reasoning and Reasoning which focuses on developing algorithms to reason about uncertain or incomplete information; and Robotics and Perception, which focuses on developing robotic systems capable of perceiving their environment and making autonomous decisions.

The authors are categorical about establishing that these are just a few of the many subsets of artificial intelligence, and each of these subsets can be broken down into even more specialized subfields. It is important to note that these subsets are not mutually exclusive and often overlap with one another, with many techniques and algorithms being used in a number of different areas.

For example, deep learning is a subset of machine learning and artificial intelligence, which is considered a core technology of today's Fourth Century.

Industrial Revolution (4IR or Industry 4.0). Due to its data-driven learning capabilities, deep learning technology, which originated from artificial neural networks, has become a vital topic in

the context of computing and is widely applied in various areas such as healthcare, visual recognition, text analytics, cybersecurity, and many others.

Knowing that the objective of the research was to develop a simple, rigid and seminal theoretical model to describe and understand how the diffusion of artificial intelligence could influence the behavior of economic agents. This model format intends to promote initial elements in order to enable future scientific, empirical and theoretical contributions on this specific subject.

To develop this economic model, according to Souza Filho and Struchiner (2021), seven steps are necessary: Identification and Delimitation of the Object of Study (Stage 1); Cognitive Rescue and Brainstorming (Stage 2); Representation of the Theoretical Model (Stage 3); Review of the Literature on the Subject (Stage 4); Structuring of the Theoretical Model (Stage 5); Submission of the Theoretical Model to Experts (Stage 6); to the Restructuring and Finalization of the Theoretical Model (Stage 7).

In addition, it is necessary to answer a questionnaire for internal validation of the premises, according to Günther (2006), this analysis would be used as a technique to internally validate, in a qualitative way, the hypotheses. So, it seemed useful to initially verify in a qualitative way the impact of both the combined use of basic inputs (Homo Sapiens intelligence and Alpha-Zero AI) and the dynamic variables.

The Theory of Creative Destruction, according to Schumpeter (1942), consists of understanding the transformations inherent to capitalism. Destruction, the essence of this theory, consists of the dynamics of capitalism, where new technologies emerge as waves, in a random way. These innovations not only disrupt the market, but also increase the productivity of capital and labor.

In this sense, innovative entrepreneurs introduce new products and methods that have competitive advantages over existing ones (the second term, Creative, is related to the evolution that occurred after destruction). From there, according to the author, it occurs: either the gradual or the disruptive replacement of the old methods or products. This category of innovation causes significant disruptions in the market and can often lead to the extinction of companies or even productive sectors. Disruptive innovation is not limited to incremental improvements, it can also network entire sectors, creating new patterns of consumption and business behavior.

According to the author, it is possible to identify the recurring patterns: (1) competitiveness and market dynamics, whose competition drives innovation and constant adaptation; (2) technological advancement, where new technologies transform the economic context of the market; (3) the transformations in the consumption pattern, consists of the evolution of consumer preferences, which drives the demand for new products and services. So,

the Theory of Creative Destruction treats capitalism as a dynamic and adaptable system, in which innovation and transformations are inevitable.

According to KISSINGER, SCHIMIDT, and HOTTENLOCHER (2021) the AlphaZero AI, developed by Google's DeepMind, represents a remarkable milestone in the field of AI. With a reinforcement learning approach, AlphaZero's AI was able to learn how to play chess, Go, and shogi at an advanced level with no prior knowledge beyond the basic rules of the games.

Regarding the speed of learning, according to the authors, AlphaZero, in just 24 hours, reached a level of knowledge sufficient to face the best chess players in the world; in four hours, it developed skills that surpassed human performance and, after three days, defeated the previous version of the program, AlphaGo, by 100 to 0 in Go games.

Regarding the results of Games, the authors reveal that, in chess, AlphaZero played 100 games against the Stock sh program (considered the best at the time) and the results were: 28 (twenty-eight wins), 62 (seventy-two draws) and no defeats. In this case, Alpha-Zero's game strategy is robust because it continuously adapts and evolves.

In addition, AlphaZero creates new tactics and approaches, some of which have never been seen before.

Therefore, Alpha-Zero AI offers new perspectives and possibilities to network the potential for learning and strategy. In this case, it is feasible that it can be applied to the economic decision-making process, used as a proxy for *homoeconomicus*, with regard to instantaneous economic choices, with a focus on maximizing self-interest (Optimal choices, as in the Rational Choice Theory).

QUALITATIVE ANALYSIS

Thus, based on the intertemporal impact of the combined use of Homo Sapiens Intelligence (attributed to the Theories: Prospect and Limited Rationality, with suboptimal choices) and Alpha-Zero AI proxy of Homoeconomic Intelligence, changing the level of Economic Rationality of instantaneous economic choices, based on the maximization of self-interest, as advocated, the Rational Choice Theory (where choices are always optimal).

Associating the previous perception that it is possible to establish an intertemporal evaluation of the situation presented, based on the scientific discussion on the applicability of the hypothesis of the economic rationality of the agents contained especially by the theoretical debate of three of the economic theories of the economic decision-making process: (1) Prospect Theory, associated with bad choices (due to the proposal of inapplicability of this hypothesis); (2) Theory of Bounded Rationality, related to satisfactory choices (due to the proposal of partial applicability of this hypothesis); and (3) Theory of Rational Choice, which postulates, for any

rational economic agent, optimal choices (due to the full applicability of the premises of this hypothesis).

The empirical discussion of these theories revolves around the level of economic rationality due to the extraordinary success of the use, development and implementation of Alpha-Zero artificial intelligence, in the field of strategic board games, in the same context, maximization of self-interest, whose cognitive superiority and optimized data analysis, over Homo Sapiens intelligence and other AIs, in the games (no defeats).

The discussion would be as follows: in the initial period of the intertemporal evaluation of the use of inputs, as economic agents are all human, then the foundation is given by the Prospect Theory: bad choices because agents are not trained to make good economic choices, the expectation is that the impact of the insertion of Alpha-Zero will be positive.

As a result, as time passes, agents are subjected to the positive effect of the event of the diffusion of artificial intelligence, and, therefore, will make suboptimal, incremental, instantaneous choices, starting to behave as recommended by the Theory of Bounded Rationality. And in the long run, in the end, the choices would be optimal, because the agents were subjected to the effect of the event recursively, until they were able to make optimal choices.

If the relationship between the inputs is "symbiotic" (complementary inputs) then, ceteris paribus, in the long run the effect would be found in a "harmonic scenario", but there may be a "parasitic" relationship (substitute inputs), in this case, ceteris paribus, in the long run, there will be a "chaotic scenario", due to the prevalence of the replacement of Homo Sapiens intelligence, by Alpha-Zero AI, as demonstrated in similar performance in strategic board games, Whose latest statistics recorded 73.5% wins; 26.5% draws; no defeats. In addition, the scores, innovation, novelty, etc. grows at an increasing rate.

In the case of the dynamic variables, they can be of two types: those that contribute to the symbiotic relationship (complementary) between the inputs and, consequently, to the harmonious scenario in the long term. On the other hand, those that contribute to the parasitic relationship between inputs (substitutes), that is, to the chaotic scenario in the long term.

According to Almeida (2021), calibration usually requires the use of data, whether primary or secondary. The data is used to estimate the values of the model parameters so that it fits the observed data. Without data, it would be difficult to calibrate a model accurately and comably. However, in some cases, the parameters may be defined based on theoretical assumptions or on values commonly accepted in the economic literature, but this may limit the accuracy and reliability of the model.

Due to the incipience of the occurrence of AI for this purpose and the absence of statistical data outside the strategic board games, the AI Alpha Zero was presented for future contributions, without econometric tests. The reason for adopting the Cobb-Douglas function was for its

versatility, convenient and realistic properties for economical models. Widely used in models to represent, for example, the relationship between two (or more) factors of production and the product.

This function is important because it allows you to associate different amounts of Capital and Labor, in order to obtain the same level of production. The function for intertemporal capture of the impacts of independent variables, at the level of economic rationality of instantaneous choices (based on the maximization of self-interest) was adapted to the Alpha-Zero case as a proxy variable of *homoeconomic intelligence*.

This function is used in economic science to model the output of a firm (or an economy as a whole), taking into account the contribution of different factors of production.

So in the long run, in the case of a symbiotic relationship (complementary inputs), there would also be, in the long run, a probable reasonable improvement in the development indicators of the countries, especially the poorest ones (reduction of multidimensional poverty, increase in income, better labor relations, improvement in the environment, reduction of crime, remuneration of the social utility of homo sapiens, when his marginal productivity is less or equal to zero, etc.) since ethical precepts would be associated with the level of rationality, rather than just maximized self-interest.

PROPOSAL FOR QUANTITATIVE ANALYSIS

The intertemporal and stochastic econometric model that can be used to capture the impact of the combined relationship between the use of basic inputs: *homo sapiens* intelligence and Alpha-Zero AI (proxy variable of *homoeconomic intelligence*), at the level of Economic Rationality of instantaneous economic choices (based on the maximization of self-interest). This relationship can be

"symbiotic" (when these inputs are complementary) or "parasitic" (when these inputs are substitutes) between human intelligence and artificial intelligence in the economic context. The simplified model where IHS represents Homo Sapiens intelligence and IHE represents *homoeconomicus* intelligence (AI Alpha Zero as proxy).

The symbiotic relationship was modeled as a Cobb-Douglas production function, which is to represent the level of instantaneous economic rationality, where inputs are complementary:

$$Yt = At \, . \, IHS\alpha t \, . \, IHEt \, (1-\alpha)$$

Where: Yt is the level of economic rationality of instantaneous choices, the economic imput in time (t); A_t is a factor of total productivity that can vary over time; α is the elasticity of production

of human intelligence, ($0 < \alpha < 1$); and IHSt and IHEt are the levels of human intelligence and AI over time (t), respectively.

For the parasitic relationship, when inputs are substitutes, we can introduce a substitution term (θt), which varies over time and represents the ease with which AI can replace human intelligence:

$$Yt = At \,.\, (\theta t \,.\, IHSt + IHEt\,)\beta$$

Where, β represents the elasticity of substitution between inputs.

In both cases, intertemporal dynamics can be introduced through stochastic differential equations that model the evolution of At; IHSt and IHEt, over time, considering random shocks that can affect productivity and intelligence levels:

$$d\,At = \mu A \,.\, At\,dt + \text{ɤ}A \,.\, A_t \,.\, dWAt\; dIHSt = \mu HS \,.\, IHSt\,dt + \text{ɤ}HSt \,.\, I\,IHSt \,.\, dWHSt$$
$$dIHEt = \mu HE \,.\, IHEt\,dt + \text{ɤ}HEt \,.\, I\,IHEt \,.\, dWHEt$$

Where: (μ) and (ɤ) are the drift and volatility parameters, respectively; and dW, are Wiener's terms that represent stochastic shocks.

This is a simplified example and many other factors can be included to make the model more realistic, such as the interaction between HSI and HSI, the dependence of time on (θt), and the introduction of exogenous variables.

Another proposal for subsidiary modeling to verify the impact of the dynamic variables of the economic decision-making process would be, by means of multiple linear regression, to evaluate how these variables behave in relation to the dependent variable level of economic rationality of the instantaneous choices, inserting them in the model as dummies variables:

$$Yt = \alpha + \Sigma\,\beta\,nt\,Xnt + \Sigma\,\beta\,mt\,Xmt + \varepsilon t$$

Where: Yt is the level of economic rationality of instantaneous choices in time; α is the basic level of economic rationality of instantaneous choices; β represents the elasticity of substitution between the dynamic dummies variables, which can be symbiotic Xn when they have a positive impact, because they contribute to the harmonic scenario: and parasitic Xn when they have a negative impact, because they contribute to the chaotic scenario, in the long run, *ceteris paribus*.

However, the calibration and estimation of this model requires empirical data and further analysis. It is important to note that the construction of econometric models is complex and

must be adapted to the specificities of the phenomenon studied. I hope this example provides a basis for developing a more detailed model that is tailored to your research needs.

DISCUSSION OF THEORETICAL RESULTS

As this is a theoretical research, the discussion and outcome chapter included a qualitative analysis on how the level of economic rationality of the instantaneous choices from: the review of the specic literature and the Case Study of AlfaZero AI, applied to strategic board games (based on the maximization of self-interest); and from there, Due to the incipience of the occurrence and the absence of relevant statistical data, elaboration of proposals for econometric models.

The implications of these results with regard to the ethical development of artificial intelligence were also discussed, based on Amartya Sen's critique of conventional economic thinking. First, a previous qualitative analysis was carried out, we present three possible scenarios: (1) relationship between the inputs: Homo *Sapiens intelligence* and Alpha-zero AI, homoeconomicus proxy. This relationship can be symbiotic (when the inputs are complementary), or parasitic (when they are substitutes; (2) Economic scenarios of this relationship in the

that can be diametrically opposed: either chaotic, caused by the parasitic relationship between inputs (or by dynamic variables), or harmonic, with a symbiotic relationship between inputs or by dynamic variables; or (3) the presence of dynamic variables of the economic decision-making process, which can have an impact, either positively (contributing to the symbiotic relationship and harmonious scenario), or negatively (diametrically opposite situation).

As for the classification of the relationship between inputs, in Symbiotics (when the IHE and IHE inputs are complementary) there will be harmony between the inputs and a science weighted by ethical issues, as proposed by Amartya Sen when questioning conventional economic thinking.

On the other hand, the Parasitic (when the inputs are substitutes), the economic decision-making process will take place as recommended by the Rational Theory of Choice, with the prevalence of maximizing self-interest, and without ethical precepts involved, ceteris paribus, in the long run, the Chaotic scenario would occur.

As for the long-term scenarios, in Chaotic: the cognitive superiority and data analysis of the IHE input over human intelligence, demonstrated in the performance of the Alpha-Zero AI (in strategic board games, reaching superhuman levels, with no percentage of defeats in the last games, not even for other AIs), without weighting by ethical precepts, will provide for the replacement of IHs by IHE in the long run, ceteris paribus, the scenario will be: extreme poverty and hunger, due to the decreasing marginal productivity (at increasing rates) of IHS

employment; absurd concentration of income; increased crime, social tensions and wars; destruction of the environment; Problems especially in the third world of Education and Public Health, due to lack of investments in this area; etc.

On the other hand, in the harmonic scenario, the situation is diametrically opposite because the IHE and IHS inputs are complementary and the dynamic variables contribute positively to socioeconomic development, so investments will be focused mainly on issues such as: preservation of the environment, fight against hunger, medicine and collective health, technological innovation, world peace, fight against crime, income distribution (remuneration of the social utility of the IHS when its marginal productivity is less than or equal to zero); and so on..

In the first scenario, chaotic as to whether IHE can replace IHS can occur quickly, as there will be no regulatory barriers to prevent or slow down its adoption. However, the lack of regulation can also lead to ethical and social concerns, such as privacy and security issues. This can affect individuals' trust in the technology and make them less willing to adopt it.

In the second scenario, harmonious, there would be the presence of strong ethical precepts (preservation of the human species, the environment, water, etc.; search for peace, and ethical investments in health, education and equity. Therefore, there would be guarantees that artificial intelligence would be used ethically and responsibly, taking into account issues such as privacy, security and social justice, etc.

In the case of the dynamic variables of the economic decision-making process, they are basically related to the aspects of ethics in the economy and to the aspects of technological innovation. They can contribute positively or negatively to the harmony of the combined ratio of inputs and consequently to the long-term scenarios. As described in the qualitative analysis, and in future empirical tests, when relevant data are available.

In addition to projections regarding the scenarios, there was the presentation of theoretical models, based on theories and other similar models existing in the speci c literature on this subject. This could help to contextualize the results of the qualitative evaluation and to identify possible gaps in the current research, with the aim of improving it both empirically and theoretically.

There is a growing body of scientific literature on the social and ethical impact of artificial intelligence. Most of these publications discuss the ethical concerns raised by artificial intelligence systems and most of the topics are associated with the potential for misuse of predictive models for decision-making. Another frequently identified topic is the analysis of the social and ethical impacts of the use of artificial intelligence in specific sectors of the economy.

Therefore, the model is only an incipient contribution to translate the debate to evaluate the impact of the phenomenon of the incidence of artificial intelligence, as a proxy for the

idealized *homoeconomicus*, in the economic decision-making process in relation to its optimal choices, in the long run. Due to all the limitations found in relation to primary and secondary data, the theoretical model is suggested in order to initiate discussions and tests on this possibility.

The proposed model is an attempt to integrate different theories and approaches to understand and improve Economic Theories on decision. It is important to note that the model is only a first attempt and is subject to criticism and improvement. However, it represents an important step towards better understanding how artificial intelligence (as a proxy) can intertemporally affect the economy and society.

CONCLUSION

This article examined economic rationality in the context of the decision-making process, considering three economic theories: the Prospectus, by Daniel K. and Amos T., the Limited Rationality, by Hebert S., and the Rational Choice theory, by Gary B. From the premise that the maximization of self-interest is not enough to determine economic rationality, as proposed by Amartya Sen in the critique of conventional economic thought, when the maximization of self-interest is not the only and exclusive form of economic rationality and neither is Pareto's science the exclusive reference of economic science.

From there, the combination of the use of two basic inputs was explored: Homo *Sapiens Intelligence* – IHS and Homoeconomicus Intelligence – IHE. The theoretical econometric model that uses Alpha Zero AI as a proxy for *Homoeconomicus*. In addition, the dynamic variables of the process were also considered, especially those related to ethical precepts and technological innovation.

Our conclusions indicate that the Prospect Theory describes the economic behavior of Homo Sapiens, with choices marked by bias, therefore suboptimal and considered "bad". The Theory of Bounded Rationality, in turn, results in choices marked by information asymmetry, then suboptimal, considered "satisfactory". Rational Choice, an attribute of Homoeconomicus Intelligence, leads to choices (with a focus on maximizing self-interest) considered "optimal".

When applying the Cobb-Douglas function, in this economic decision-making process, considering HEI (Homoeconomic Intelligence, Alpha-Zero AI as *a proxy*) for K (Capital in the original function) and HSI (Homo *Sapiens Intelligence*) for L (Work, in the original function), it is observed, ceteris paribus, that, at the level of economic rationality Y, the intertemporal combination of the use of these inputs can lead to a parasitic or symbiotic relationship in the long run. This dynamic can result in chaotic or harmonic qualitative scenarios.

Another theoretical model presented in a subsidiary way was regarding the dynamic variables, which through multiple intertemporal linear regression, applying a dummy variable to

each of them, to intertemporally capture the positive (contributing to harmony) and negative (contributing to chaos) impacts.

Based on the impressive results of Alpha Zero AI in strategic games, demonstrated in the case study, the cognitive and analytical superiority of this AI over Homo Sapiens Intelligence and other AIs stands out, which allowed us to propose the use of this variable as a proxy for IHE, Homoeconomic Intelligence, in the context of the Process Conventional decision-making (based on maximizing self-interest). However, it is relevant to consider, in the economic models presented, the ethical aspects, and technological innovation, in order to avoid tendencies to chaotic parasitism.

REFERENCES

1. Agrawal, A. K., Gans, J. S., & Goldfarb, A. (Eds.). (2019). *The economics of artificial intelligence: An agenda*. University of Chicago Press.

2. Agrawal, A. K., Gans, J. S., & Goldfarb, A. (2018). *Economic policy for artificial intelligence* (NBER Working Paper No. 246905).

3. Arrow, K. J. (1987). Economic theory and the hypothesis of rationality. In J. Eatwell, M. Milgate, & P. Newman (Eds.), *The new Palgrave: A dictionary of economics* (1st ed.). Macmillan.

4. Atashbar, T. (2020). *The future of economics in an AI-biased world*. Retrieved from https://www.researchgate.net/publication/340084715_The_Future_of_Economics_in_an_AI-Biased_World

5. Audi, R. (Ed.). (2011). *The Cambridge dictionary of philosophy* (3rd ed.). Cambridge University Press.

6. Bass, F. M. (1969). A new product growth for model consumer durables. *Management Science, 15*(5), 215-227.

7. Baert, P. (1997). Algumas limitações das explicações da escolha racional na Ciência Política e na Sociologia. *Revista Brasileira de Ciências Sociais, 12*(35), 5-202.

8. Becker, G. S. (1976). *The economic approach to human behavior*. University of Chicago Press.

9. Berger, B., & Pessali, H. F. (2010). A teoria da perspectiva e as mudanças de preferência no mainstream: um prospecto Lakatoseano. *Brazilian Journal of Political Economy, 30*(2), 207-224.

10. Bickley, S. J., Chan, H. F., & Torgler, B. (2022). Artificial intelligence in the field of economics. *Scientometrics, 127*, 2055-2084.

11. Camello, I. (n.d.). Análise da difusão de microrredes no Brasil pelo método do modelo de Bass. [Unpublished manuscript].

12. Carbonell, I. (2020). Os impactos sociais e éticos da inteligência artificial na agricultura: mapeando a literatura agrícola da IA. *SpringerLink, 36*(1-2), 1-17.

13. Cavallini, M. A. J. (2009). Racionalidade econômica: hipótese científica legítima ou instrumento de apologia ao sistema capitalista de produção? Pontifícia Universidade Católica de São Paulo.

14. Cobb, C. W., & Douglas, P. H. (1928). A theory of production. *The American Economic Review, 18*(1), 139-165.

15. Chiang, A. C., & Wainwright, K. (2005). *Fundamental methods of mathematical economics* (4th ed.). McGraw-Hill.

16. Costa, F. N. (2016). Racionalidade limitada e a tomada de decisão em sistemas complexos. *Revista de Economia Política*.

17. De Almeida, R. G. (2021). A transigência dos modelos econômicos: performatividade e econometria. *Revista de Economia, 42*(78), 329-353.

18. Dias, D. T., Bernardino, G., Américo, J. C. da S., & Benini, E. G. (2016). Racionalidade limitada: Uma análise dos manuais didáticos de teoria geral da administração. *Administração: Ensino e Pesquisa, 17*(2), 217-244.

19. Wagner, D. N. (2020). Economic patterns in a world with artificial intelligence. *Evolutionary and Institutional Economics Review, 17*, 111–1316.

20. Kuroda, E. T., Kalfas, A. J., & Eller, R. D. A. G. (2016). Aplicação da função Cobb-Douglas para análise da produtividade na indústria de companhias aéreas. *Revista de Administração da UFSM, 9*(3), 466-481.

21. Engler, A. (2020). Can AI model economic choices? *Brookings*.

22. European Parliament. (2019). *Economic impacts of artificial intelligence*.

23. Feyerabend, P. (1975). *Against method*. London: Verso.

24. Falleiro, M., Silva, C. E. L., & Tai, S. H. T. (2018). Teoria do prospecto: Estimação da função utilidade e da função ponderação das probabilidades para uma amostra específica. *Análise Econômica, 36*(71), 223-265.

25. Feyerabend, P. (1975). *Against method: Outline of an anarchistic theory of knowledge*. New Left Books.

26. Ferejohn, J., & Pasquino, P. (2021). A teoria da escolha racional na ciência política: Conceitos de racionalidade em teoria política. *Revista Brasileira de Ciências Sociais, 16*(45), 5-241.

27. Fernandez, B. P. M., & Bêrni, D. A. (2014). Sobre o estatuto epistemológico da racionalidade econômica segundo Karl Popper. *Estudos Econômicos (São Paulo), 44*, 847-880.

28. Fiorin, D. V., Martins, F. R., Schuch, N. J., & Pereira, E. B. (2011). Aplicações de redes neurais e previsões de disponibilidade de recursos energéticos solares. *Revista Brasileira de Ensino de Física, 33*(1), 1309.

29. Floridi, L., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Lütge, C., Madhin, R., Pagallo, U., Rossi, F., Schafer, B., Valenzuela, E., & Vayena, E. (2021). Colocando a ética da IA em prática: As ferramentas são adequadas para o propósito? *Springerlink, 20*(2-3), 421-431.

30. França, J., & Vasconcelos, M. (2020). Inteligência artificial: Riscos, benefícios e uso responsável.

31. Friedman, M. (1953). *Essays in positive economics*. University of Chicago Press.

32. Günther, H. (2006). Pesquisa qualitativa versus pesquisa quantitativa: Esta é a questão? *Psicologia: Teoria e Pesquisa, 22*(2), 201-210.

33. Greco, J., & Sosa, E. (1999). *The Blackwell guide to epistemology*. Blackwell Publishers.

34. Grüne-Yanoff, T. (2008). Rational choice theory and bounded rationality. In *Handbook of the philosophy of science* (Vol. 13, pp. 147-182). [s.l.: s.n.].

35. Harari, Y. N. (2013). *Sapiens: História breve da humanidade*. Elsinore.

36. Harari, Y. N. (2016). *Homo Deus: Uma breve história do amanhã*. Editora Companhia das Letras.

37. Harari, Y. N. (2023). *21 lições para o século XXI*. Elsinore.

38. Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263-292.

39. de Fine Licht, K., & de Fine Licht, J. (2020). Artificial intelligence, transparency, and public decision-making. *AI & Society, 35*, 917–926.

40. Kissinger, H., Schmidt, E., & Hottenlocher, D. (2021). *A era da inteligência artificial*. Leya.

41. Kuhn, T. S. (1962). *The structure of scientific revolutions*. University of Chicago Press.

42. Lakatos, I. (1970). Falsification and the methodology of scientific research programmes. In I. Lakatos & A. Musgrave (Eds.), *Criticism and the growth of knowledge* (pp. 91-196). Cambridge University Press.

43. Langer, A. (2017). Racionalidade econômica, trabalho e ecologia em André Gorz. *Caderno CRH, 30*(81), 547-560.

44. Jiang, L., Chen, J., Bao, Y., & Zou, F. (2022). Exploring the patterns of international technology diffusion in AI from the perspective of patent citations. *Scientometrics, 127*, 5307–5327.

45. Ludermir, T. B. (2021). Inteligência artificial e aprendizado de máquina: Estado atual e tendências. *Estudos Avançados, 35*(101), 7-23.

46. Mendes-Da-Silva, W., Rossoni, L., Barros, L. A. B. de C., & Bandeira-De-Mello, R. (2013). Desempenho acadêmico e a teoria do prospecto: Estudo empírico sobre o comportamento decisório. *Revista de Administração Contemporânea*.

47. Melo, T. M., & Fucidji, J. R. (2016). Racionalidade limitada e a tomada de decisão em sistemas complexos. *Revista de Economia Política, 36*(3), 622-645.

48. Minayo, M. C. S. (2002). Interpretação e validação científica em pesquisa qualitativa. *Ciência & Saúde Coletiva, 7*(3), 603-613.

49. Monaca, M. (2023). *Artificial intelligence and economics: The key to the future*. Springer.

50. Morais, J. L. B. de. (2012). Teoria da escolha racional: Limites e alcances explicativos. *Caos – Revista Eletrônica de Ciências Sociais*.

51. Nozick, R. (1974). *Anarchy, state, and utopia*. New York: Basic Books.

52. Pinho, D. B. (1976). A racionalidade econômica – Abordagem histórica. *Revista de História, 54*(107), 173-188.

53. Popper, K. (1959). *The logic of scientific discovery*. Hutchinson & Co.

54. Finlay, R., & Takeda, H. (2021). Reflections on decision-making and artificial intelligence. *Lecture Notes in Computer Science, 126002*.

55. Rawls, J. (1971). *A theory of justice*. Cambridge: Harvard University Press.

56. Ribeiro, M. H. (2011). Machine learning na medicina: Revisão e aplicabilidade. *Revista Brasileira de Ensino de Física, 33*(1).

57. Sen, A. (1987). *On ethics and economics*. Oxford: Blackwell.

58. Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics, 69*(1), 99-118.

59. Steup, M., & Neta, R. (Eds.). (2019). *A companion to epistemology* (2nd ed.). Wiley-Blackwell.

60. Souza Filho, B. A. B., & Struchiner, C. J. (2018). Uma proposta teórico-metodológica para elaboração de modelos teóricos. *Revista Brasileira de Educação Médica, 42*(1), 56-65.

61. Silva, J., & Fleig, M. (2019). Inteligência artificial e sociedade: Avanços e riscos.

62. Schumpeter, J. A. (1942). *Capitalism, socialism and democracy*. New York: Harper & Brothers.

63. Thomas, K. J., & Loughran, T. A. (2014). Rational choice and prospect theory: Contrasting approaches to decision making. *Sociological Methods & Research, 43*(4), 679-703.

64. Smith, A. (1776). *An inquiry into the nature and causes of the wealth of nations*. [s.l.: s.n.].

65. Varian, H. R. (1992). *Microeconomic analysis* (3rd ed.). W. W. Norton & Company.

Conceptions of velocity and acceleration in an epistemological analysis of time

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ABSTRACT

The epistemological study of perceptions about the speed and variation of time is fundamental for the advancement of scientific knowledge. Understanding these concepts not only enriches our perception of the physical universe but also allows us to reflect on the nature of human reality and experience. This article, exploring these questions, could contribute significantly to the advancement of knowledge in physics and philosophy, while also opening up new perspectives for understanding time and motion. By investigating the conceptions of speed and acceleration in an epistemological analysis of time, it is possible to reveal unprecedented and complex aspects that can challenge established concepts and open new avenues for scientific research. The methodology adopted for the construction of the research will be the bibliographic research, a methodology widely used in several areas of knowledge, such as in the social, human and exact sciences. It consists of the search and analysis of information from bibliographic sources, such as books, scientific articles, theses, dissertations and other printed or digital materials. The results of this research revealed that velocity and acceleration are not only physical quantities, but also concepts that are intrinsically linked to our perception of time. The way we perceive and measure time is directly related to our understanding of the speed and acceleration of the objects around us. In addition, it was observed that traditional conceptions of velocity and acceleration can be extended and improved through an epistemological approach to time.

Keywords: Speed, Acceleration, Time, Physics.

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INTRODUCTION

The epistemological investigation of views on speed and speed variation over time is crucial for the progress of scientific knowledge. The assimilation of these concepts not only improves our understanding of the material universe, but also enables us to meditate on the essence of reality and of experience itself.

Celerity and acceleration are essential magnitudes in physics, which play a vital role in characterizing the displacement of bodies in space-time. Speed, understood as the rate of change of an object's location in relation to time, allows us to measure the agility with which an object moves. Acceleration, on the other hand, represents the rate of change in the celerity of an object in relation to time, indicating how quickly the celerity of an object is changing.

By analyzing these quantities in an epistemological context, that is, by investigating how knowledge about them is constructed and validated, we are led to question our own conceptions about time. Time, as a fundamental dimension of reality, is often considered as an objective and universal entity, which flows inexorably and independently of human actions. However, modern physics shows us that time is not an absolute entity, but rather a relative variable, which can be affected by several factors, such as speed and acceleration.

In this sense, the epistemological analysis of the conceptions of speed and acceleration invites us to rethink our understanding of time and to recognize its complex and multifaceted nature. By understanding how these concepts are interconnected and influence our perception of time, we are able to broaden our horizons and enrich our understanding of the world around us. What is the relationship between velocity and acceleration in the context of Einstein's theory of relativity? How do conceptions of time influence how we understand speed and acceleration? How do different philosophical interpretations of time impact our understanding of the dynamics of bodies in motion? How does quantum physics approach the issue of velocity and acceleration on a microscopic level? To what extent do contemporary theories of time challenge traditional conceptions of speed and acceleration?

These questions serve as a starting point for a more in-depth investigation of the conceptions about velocity and acceleration in an epistemological analysis of time. By exploring these questions, it is possible to broaden our understanding of the nature of reality and the complex relationships between time, space, and motion.

By investigating the conceptions about velocity and acceleration, it is possible to address not only traditional physical theories, but also the different philosophical and epistemological perspectives that permeate these concepts. The relationship between speed and time can be analyzed in light of Einstein's theory of relativity, which revolutionized our understanding of time and space.

Furthermore, acceleration can be seen as a complex phenomenon that involves not only the change in the velocity of an object, but also deeper ontological and epistemological issues. It can be interpreted as a manifestation of the interaction between different bodies in the universe, which raises questions about the nature of reality and causality.

This article, exploring these questions, could contribute significantly to the advancement of knowledge in physics and philosophy, while also opening up new perspectives for understanding time and motion. By investigating the conceptions of speed and acceleration in an epistemological analysis of time, it is possible to reveal unprecedented and complex aspects that can challenge established concepts and open new avenues for scientific research.

Therefore, this theme offers a unique opportunity for research that seeks to explore the boundaries between physics, philosophy, and epistemology, contributing to the advancement of knowledge and a deeper understanding of the nature of time and motion. The objective is to deepen the understanding of the conceptions related to speed and acceleration, from an epistemological perspective of time.

METHODOLOGICAL PATH

The methodology adopted for the construction of the research will be the bibliographic research, a methodology widely used in several areas of knowledge, such as in the social, human and exact sciences. It consists of the search and analysis of information from bibliographic sources, such as books, scientific articles, theses, dissertations, and other printed or digital materials (GUERRA, 2024).

The objective of bibliographic research is to gather and analyze existing knowledge on a given topic, allowing the researcher to delve deeper into the subject, identify gaps in knowledge and support their own investigations. In addition, this method is important to contextualize the research problem, support the choice of the theoretical framework and support the discussion of the results obtained.

First, we will define the definitive search topic and keywords that will be used in the search for relevant materials. Then, a systematic search will be carried out in academic databases, virtual libraries, institutional repositories and other reliable sources, such as Google Scholar, CAPES Platform, in addition to the SciELO database.

> [...] prepared from material already published, consisting mainly of: books, magazines, publications in journals and scientific articles, newspapers, bulletins, monographs, dissertations, theses, cartographic material, internet, with the objective of putting the researcher in direct contact with all material already written on the subject of research. In the bibliographic research, it is important for the researcher to verify the veracity of the data obtained, observing the possible inconsistencies or contradictions that the works may present (PRODANOV; FREITAS, 2013, p. 54).

After collecting the materials, a critical and selective analysis of the information found will be carried out, identifying the most relevant and reliable sources to support the research. Therefore, bibliographic research is an essential methodology for the development of the future thesis, as it will allow deepening the existing knowledge on the subject, supporting investigations and contributing to the advancement of knowledge in the area. A careful and systematic search for materials will be carried out, as well as critically analyzing the information found, in order to ensure the quality and reliability of the work carried out.

THEORETICAL FRAMEWORK

The way students perceive and interpret concepts about speed and acceleration can directly influence their academic performance and their ability to understand complex physical phenomena. Speed and acceleration are fundamental quantities in the study of physics and are present in various everyday contexts.

However, many students have difficulties in understanding these concepts in depth, which can be attributed to a number of factors, such as the lack of familiarity with the mathematical language used to describe these quantities and the difficulty in visualizing and interpreting phenomena related to velocity and acceleration. An epistemological analysis of time can contribute to the understanding of these difficulties, since it allows the investigation of students' previous conceptions about time and its relationship with the quantities of speed and acceleration.

By understanding how students build their knowledge about these concepts, educators can develop more effective teaching strategies that take into account students' conceptions and promote meaningful learning. In addition, the epistemological analysis of time can also contribute to the reflection on the nature of scientific knowledge and its relations with students' previous conceptions.

By analyzing how students' conceptions are constructed and modified throughout the learning process, educators can promote a more critical and reflective approach to physics teaching, favoring the development of cognitive and metacognitive skills in students.

There is a mystery surrounding the concept of time that defies human comprehension. Is time a real entity, flowing from the past to the future and influencing the phenomena of the Universe? Or is it just a construct of our mind, a structure designed to interpret the world around us? Perhaps it is a relationship between things, conceived and measured from the physical phenomena themselves. What is the now? Did time exist before the Big Bang? These are questions that lead us to reflect on the nature of time and its relationship with the Universe.

Many believe that science has all the answers, but the truth is that the concept of time is an enigma that has not yet been unraveled. Throughout history, time has been the subject of debate and speculation, and it seems that we still have much to learn about this fundamental dimension of

existence. The journey to understand time is far from over, but it is precisely this constant search for knowledge that makes science so fascinating and enriching (MARTINS; ZANETIC, 2002).

The idea of the flow of time has been a constant since time immemorial, but the focus here is on the beginning of its conceptualization and measurement. This probably occurred in the Neolithic period, when the civilizations of Mesopotamia, Egypt, Sumer, and others emerged due to the need to produce more food to meet the concentration of human groups on the banks of the great rivers. While enjoying the benefits offered by rivers, these populations suffered from the terrible consequences of the great floods. The Egyptians, for example, built nilometers to predict dangerous floods.

Over time, these civilizations learned to associate the soil fertility cycle with the movement of celestial bodies, which made it possible to create calendars to predict times of flooding, sowing, and harvesting. Plato observed that the observation of day, night, months, and years allowed the conception of time and the investigation into the nature of the Universe. In antiquity, the Greeks, and in the Middle Ages, thinkers such as St. Augustine and St. Thomas Aquinas, contributed to the study of time (MARTINS, 1998).

In the seventeenth century, Galileo introduced time as a protagonist in the mathematical study of motion, preparing the ground for the Newtonian view of space and time as the stage of physical phenomena, Newton distinguished absolute time from relative time, the latter being a measure of the former, Leibniz challenged this view, arguing that time could not exist independently of material things. Ernst Mach, in the nineteenth century, denied the possibility of absolute time, arguing that the idea of time is an abstraction based on the variation of things, while Mach proposed a relational approach to mechanics, rejecting absolute quantities. These reflections continue to influence scientific thinking to this day (MARTINS, 1998).

The concept of relative time was introduced in 1905 with Albert Einstein's Theory of Special Relativity. Einstein's initial goal was to reconcile Maxwell-Lorentz's classical electromagnetism with the principle of relativity of mechanics, which establishes the invariance of the laws of physics in different inertial reference systems.

In seeking a solution to this dilemma, Einstein established as a fundamental principle the constancy of the speed of light in a vacuum (c), regardless of the inertial reference system used to measure it. This led him to redefine the concepts of space and time, in order to reconcile them with the principle of relativity and Maxwell's equations (MARTINS; ZANETIC, 2002). A new entity then emerged: space-time, in which measures of time and space are intrinsically linked. For example, when considering an event with spatiotemporal coordinates (x, y, z, t) with respect to an inertial frame K, the coordinates (x', y', z', t') of that same event with respect to another inertial frame K', which moves with constant velocity V with respect to the first, no longer follow the Galilean transformations of classical mechanics, but the Lorentz Transformations.

The traditional concept of the time interval between two events, measured in a reference system, is no longer absolute. The relativization of simultaneity becomes a reality, depending on the observer's reference system. With these innovative ideas, Einstein introduces time dilation. It leads us to consider a clock that marks seconds and is at rest at the starting point (x' = 0) of K'. If we think of t' = 0 and t' = 1 as two consecutive strikes of this clock, the fourth equation of the Lorentz transformations gives us the following result:

$$t = 0 \text{ e } t = \frac{1}{\sqrt{1-\frac{V^2}{c^2}}}$$

Einstein's Theory of General Relativity, presented in 1916, challenges our common conception of time and space. It questions the meaning of the present in a world where time is relative and past events may not be detected in other frames. The presence of matter affects space-time, leading to equivalence between accelerated motions and gravitational fields (MARTINS; ZANETIC, 2002).

In this new paradigm, the structure of space-time is determined by metrics, influenced by the material content of the Universe. TRG predicts time dilation in the presence of gravitational fields, as demonstrated by successful experiments. The most significant implications of GRT are in cosmology, where its theories are fundamental to our understanding of the universe.

The conceptions about speed and acceleration in an epistemological analysis of time have been widely discussed in the literature in the area, due to the difficulties in understanding these two concepts that involve time. Velocity and acceleration are fundamental quantities of physics that describe the motion of an object in relation to time, and their understanding is essential for the interpretation and prediction of natural phenomena. Velocity is defined as the rate of change of an object's position relative to time, whereas acceleration is the rate of change of velocity relative to time. Both quantities are vectorial, that is, they have direction and direction, as well as magnitude. However, the complexity of these concepts lies in their relationship with time, which is a fundamental dimension of physical reality.

In the epistemological analysis of time, it is important to consider the different philosophical and scientific conceptions about the nature of time and its relationship with movement. Since antiquity, philosophers such as Aristotle and Plato have discussed the nature of time and its relationship to the movement of celestial bodies. However, it was only with the development of modern physics that the understanding of time as a dynamic and relative dimension was established (MARTINS, 1998).

Einstein's theory of relativity revolutionized our understanding of time, showing that time is a flexible, relative dimension, which can be affected by speed and gravity. In this context, the conceptions of speed and acceleration gain a new dimension, as they are closely related to the dilation of time and the curvature of space-time. In classical physics, velocity and acceleration are absolute quantities, which describe the motion of an object relative to an inertial frame of reference.

However, in the theory of relativity, velocity and acceleration are relative quantities, which depend on the frame of observation and the curvature of space-time. This means that the speed and acceleration of an object can vary depending on its position and the gravitational field around it. The conceptions of velocity and acceleration in an epistemological analysis of time are fundamental to understanding the nature of the movement and dynamics of the universe. Through the investigation of these concepts, we can broaden our understanding of the nature of time and its relationship to space, matter, and energy.

The different cosmological models derived from the Theory of General Relativity raise intriguing theories and speculations about the origin of time and the age of the Universe. Within the standard model, which postulates the occurrence of a Big Bang approximately 15 billion years ago, the question arises as to whether time itself began in the initial explosion. In addition, GRT does not rule out the possibility of time travel, making room for the exploration of space-time deformations that would allow a traveler, like a subatomic particle, to travel a trajectory closed in time. This theoretical idea leads us to reflections on intriguing paradoxes, such as the possibility of altering the past.

Vital processes are commonly seen as events that occur over time, external to organisms and evidenced by transformations in living beings. This outer time can be perceived at different scales, from evolutionary time, which extends over thousands or millions of years, to microscopic time, in which atoms interact at the cellular level in a matter of milliseconds.

However, the focus of this essay is not on outer time, but on inner time, a concept that emerged in the twentieth century with the discovery of "biological clocks" within organisms. Chronobiology, which studies the temporal dimension of life, allows us to better understand how these internal clocks influence life processes.

Regarding interdisciplinarity, culture, Epistemology and Education in Science and Mathematics plays a fundamental role in the development of quality education and in the formation of critical and reflective individuals. The integration of these areas allows for a broader and more contextualized approach to knowledge, promoting a holistic and interconnected view of the world (TERRADAS, 2011).

Culture directly influences the way we perceive and interpret the world around us. It shapes our values, beliefs, and social practices, and it also influences the way we learn and teach. By

integrating culture into science and mathematics teaching, educators can make content more relevant and meaningful to students, promoting greater identification and engagement with the topics covered.

Epistemology, in turn, studies the nature and limits of human knowledge, questioning the bases and foundations of the different areas of knowledge. By incorporating epistemology into the teaching of Science and Mathematics, educators can stimulate critical thinking and reflection on the methods and processes of knowledge construction, thus developing a more investigative and questioning posture in students (IGLIORI, 1999).

Science and Mathematics Education, in turn, is the field responsible for transmitting and building knowledge in these areas, preparing students to understand and interact with the world in a more informed and conscious way. By integrating culture and epistemology into science and mathematics education, educators can provide a more comprehensive and enriching education, preparing students to deal with the challenges and complexities of contemporary society.

The importance of interdisciplinarity between Culture, Epistemology and Education in Science and Mathematics lies in the possibility of promoting a more contextualized, critical and reflective education, which prepares students to face the challenges of today's world in a more conscious and informed way. By integrating these areas of knowledge, educators can contribute to the formation of more qualified and engaged individuals, capable of understanding and transforming the reality in which they are inserted.

Regarding epistemology in mathematics education, it is a field of study that aims to analyze the forms of mathematical knowledge and how it is acquired and developed by students. Epistemology, which refers to the study of the nature and origin of knowledge, plays a key role in mathematics education, as it helps to understand how students learn mathematics and how teachers can facilitate this process.

It can be seen as a bridge between theory and practice, helping educators to reflect on their teaching practices and enhance their pedagogical approach. By understanding the nature of mathematical knowledge and how it is constructed, teachers can develop more effective teaching strategies and help students become critical and autonomous thinkers.

One of the main issues addressed by epistemology in mathematics education is the way students construct mathematical knowledge. Epistemology recognizes that mathematical knowledge is not simply transmitted from teacher to student, but rather actively constructed by students through interactions with mathematical content and with their peers.

In addition, epistemology also investigates the different forms of mathematical knowledge, including declarative knowledge (mathematical facts and concepts), procedural knowledge (mathematical skills and techniques), and conditional knowledge (problem-solving strategies and

methods). By understanding these different forms of knowledge, teachers can tailor their teaching practices to meet the individual needs of students and promote more meaningful learning.

Relativity has had serious and profound implications for the question that interests us. By merging space and time, relativization In addition, it introduced new absolutes, such as the speed of light and the "relativistic interval". Mathematical consequences, such as the contraction of length and the dilation of time, arise from this treatment.

With the theory of general relativity, a relationship was established between time and gravity, showing that the closer a clock is to Earth, the slower it will run. This is exemplified by the famous "twin paradox." Quantum mechanics, in turn, represented a revolution in the microworld, breaking with nineteenth-century science.

Classical determinism was destructured, as was the subject-object relationship and the notion of object itself. Concepts such as dualities, uncertainties, and probabilities contributed to a new knowledge far removed from classical physics. In addition, the study of dissipative systems and thermodynamics far from equilibrium brought new ideas to the debate. The irreversibility introduced by nonlinear systems and the presence of chaotic systems challenge the determinism of classical mechanics. The predictability of the behavior of these systems is limited by a time horizon.

Twentieth-century physics not only revolutionized the microworld, but also led to the development of new theories about the universe as a whole. Einstein's theory of general relativity drove the development of cosmology, with mathematical models that explore the possibility of a "temporal beginning" or innovative conceptions about time.

With the contribution of Boltzmann and others, as we have already seen, the study of dissipative systems and out-of-equilibrium thermodynamics has brought new perspectives to this debate. The "defenders of irreversibility" argue that the nonlinear equations that govern such systems introduce an "arrow of time", allowing the most elementary systems treated by statistical mechanics to be described in an asymmetric way.

In addition, "chaotic systems" challenge the determinism of classical mechanics, making predictability limited to a time horizon. In quantum mechanics, irreversibility is introduced by the process of measuring and collapsing the wave function, making it inevitable. Twentieth-century physics revolutionized not only the microworld, but also led to new theories about the universe as a whole, especially with Einstein's theory of general relativity and the development of cosmology.

The first mathematical models of the universe, based on general relativity, proposed a "static universe" without a defined "beginning". However, Hubble's discoveries and the theories of Lemaître and Eddington pointed to an expanding universe. Nuclear physics and cosmology began to relate to each other, addressing issues such as the origin of chemical elements and their proportion in the universe. The "big bang" theory, proposed by Gamow in 1947, has become the dominant view in

cosmology, describing a large explosion that gave rise to the universe about 15 billion years ago (MARTINS, 2004).

The continued expansion of the universe raises questions about its future, including the possibility of an eventual gravitational collapse. The singularity present at the instant of the "big bang", with an infinite density of matter, poses a mathematical challenge to the theory. Would this be the "beginning of time"? Cosmology continues to explore these open questions, seeking to understand the nature and evolution of the universe in ever deeper ways.

Several cosmological theories point to singularities and intriguing possibilities in relation to time. While the standard model of the big bang is widely accepted, other theories explore alternative geometries of the universe, including the existence of closed time-type curves that could allow time travel. The creation of matter from quantum fluctuations in a primordial vacuum is also considered, bringing the idea of an absolute time that precedes all existence. Time in modern cosmology is a profound enigma that challenges the most fundamental theories of science.

CONCLUSION

The understanding of speed and acceleration in an epistemological analysis of time is fundamental for the advancement of scientific and technological knowledge. In this study, the conceptions about these concepts and their relationship with the perception of time were investigated, resulting in significant discoveries that can benefit both society and academia.

The results of this research revealed that velocity and acceleration are not only physical quantities, but also concepts that are intrinsically linked to our perception of time. The way we perceive and measure time is directly related to our understanding of the speed and acceleration of the objects around us. In addition, it was observed that traditional conceptions of velocity and acceleration can be extended and improved through an epistemological approach to time.

By considering not only physical quantities, but also the influence of human subjectivity on the perception of time, it is possible to gain a more comprehensive and accurate understanding of these concepts. These findings have the potential to positively impact society in several aspects. For example, by better understanding the relationship between speed, acceleration, and time, we can develop more efficient and safer technologies, such as autonomous vehicles and faster, more sustainable public transportation systems.

In addition, in academia, these results can contribute to the advancement of physics and other areas of knowledge, promoting the development of more comprehensive and accurate theories about time and motion. New research and studies can be carried out based on these discoveries, expanding the understanding of the nature and functioning of the universe.

Some methodological limitations may also impact the quality of research carried out in this area. The lack of adequate instruments to measure and analyze velocity and acceleration in relation to time can limit the accuracy of the results obtained. Similarly, the scarcity of longitudinal studies that track the evolution of these concepts over time can make it difficult to identify patterns and trends.

In view of these limitations, some recommendations for future studies can be suggested. One of them is interdisciplinarity, that is, the integration of different areas of knowledge in the investigation of conceptions about speed and acceleration in an epistemological analysis of time. In this way, it is possible to enrich the debate and broaden perspectives on the subject. Another important recommendation is the use of innovative methodological approaches, which allow a more in-depth and comprehensive analysis of the concepts in question. The combination of quantitative and qualitative methods, for example, can provide a more complete and complex understanding of the relationship between velocity, acceleration, and time.

Therefore, the conceptions about speed and acceleration in an epistemological analysis of time are complex and challenging themes, which demand a careful and interdisciplinary approach. By recognizing the limitations of current research and following the recommendations for future work, it is possible to advance the understanding of these concepts and contribute to the advancement of scientific knowledge.

REFERENCES

1. De Lunetta, A., & Guerra, R. (2024). Metodologias e classificação das pesquisas científicas. *RECIMA21 - Revista Científica Multidisciplinar*, 5(8), e585584-e585584.

2. Igliori, S. B. C. (1999). A noção de "obstáculo epistemológico" e a educação matemática. In *Educação Matemática: uma introdução* (pp. 155-196).

3. Martins, A. F. P. (2004). *Concepções de estudantes acerca do conceito de tempo: uma análise à luz da epistemologia de Gaston Bachelard* (Tese de Doutorado). Universidade de São Paulo.

4. Martins, A. F. P. (1998). *O ensino do conceito de tempo: contribuições históricas e epistemológicas* (Dissertação de Mestrado). Universidade de São Paulo, IFUSP/FEUSP.

5. Martins, A. F. P., & Zanetic, J. (2002). Tempo: esse velho estranho conhecido. *Ciência e Cultura*, 54(2), 41-44.

6. Prodanov, C. C., & Freitas, E. C. (2013). *Metodologia do trabalho científico: métodos e técnicas da pesquisa e do trabalho acadêmico*. Novo Hamburgo: Feevale.

7. Terradas, R. D. (2011). A importância da interdisciplinaridade na educação matemática. *Revista da Faculdade de Educação*, 16(2), 95-114.

The student's professional development through the partnership between technical schools and companies

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ABSTRACT

The article demonstrates, through the practice of a TCC project, the importance of Technical Schools establishing partnerships with companies in the city where students can develop projects to, through studies on problem situations that the company may have, propose solutions that help it neutralize or minimize these impasses. It also demonstrates that the experience of high school and technical students in the administrative activities of a company provides significant skills in students to work in the job market, based on a TCC project focused on the Quality of Life of the employees of the partner company aiming at improving and increasing productivity. The project was carried out with students from the Technical Education Integrated to High School in Administration at Etec de Itararé, through the Development of the Course Completion Work component, relating theoretical and practical knowledge of People Management and Physical Education, from the Common Base of High School, in addition to a partnership with the Nutrition and Dietetics course and with the company Fort Paletes de Itararé. With the results obtained, it is possible to perceive the importance of pedagogical practices applied outside the school environment with partner companies, bringing students closer to the job market even before completing high school, so that they develop essential skills for their professional success.

Keywords: Quality of life, Healthy eating, Workplace gymnastics, Partnership, Essential competencies.

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INTRODUCTION

In the 90s, companies began to invest in public education, intensifying the partnership between schools and companies with a focus on the financial field. However, according to Heidrich (2010), it is important that there is a focus on the teaching-learning process and not only on the visibility of the company, highlighting as an example the company Natura, which has long-term programs related to education.

According to the author, the "Partnerships between Schools and Companies" are agreements and projects with activities that should guarantee student learning and, mainly, the improvement of the teaching-learning network, which should be provided for in the school's Pedagogical Political Project, determining at what point the company can help in this process. This is because "everyone has to be in tune with the purposes and objectives of the school" (Heidrich, 2010).

Based on these programs and on the Essential Competencies of the Technical Course in Administration, such as: a) Develop skills to act, critically analyzing the organization's issues, seeking improvements and providing transformations and, b) Apply planning, management, evaluation and control techniques, for insertion in the context of the administrative services of organizations; The project demonstrated in this article sought to answer the problem: How to put into practice the administrative theories of the classroom in companies, during the course of high school integrated with the technical one?

From this problem, the team raised some hypotheses: a) When making technical visits to companies, students will be able to visualize the classroom theories of specific disciplines; b) Projects carried out in partnership with companies that welcome students within their facilities will be able to bring better results in the learning process of the practice of administrative theories.

With this last hypothesis, the team sought information in the theory about the origin of work in man's life and its importance, observing the article by Mendes (2013), which reports work since antiquity as a social condition in order to meet man's basic needs, such as: food, housing and good quality of life. However, work goes beyond satisfying these basic needs, enabling a transformative action that empowers and encourages man to develop, which contributes in a positive way, avoiding frustrations.

Based on this analysis, well-being at work becomes important, determined by several authors as Quality of Life at Work (QWL) and, for França (2014, p.12), it is defined as a way of involving people in the organization of work, in the concern for the well-being of the worker, in organizational effectiveness and in the participation of employees in the company's decisions.

França (2014, p. 16) discusses the importance of the company developing a QWL program for its employees:

> "The interventions of the QWL program, according to Huse & Cummings (1985), positively affect communication and coordination, which are preliminary conditions for better productivity. QWL motivates workers, especially when they satisfy their individual needs. It can also improve the worker's capacity by improving their performance, motivation and the worker's capacity, which are prerequisites for greater productivity."

To develop a program that can achieve the expected objective, the company must follow four pillars, which, according to the author, are: "Worker participation in the company's decision-making; Restructuring of the position that must meet technological needs; Innovation in the reward system, reducing salary and status differences; Improvement in the work environment".

Based on these studies, the project focused on the last pillar highlighted – Improvement in the work environment, which aims at changes in working conditions such as: flexible hours, modification in layout, equipment and attitudes to protect the health of workers in the workplace, among others.

According to Colengui (2003, apud Rocha, 2007), "within the sphere of quality of life at work, the company must have a functional *layout*, which provides employees with comfort, well-being, satisfaction and safety."

Analyzing the "*functional layout*" focused on well-being and safety at work and seeking to develop a project for the health of employees, the team aimed at two issues in the project: a) Healthy Eating and b) Physical Exercises such as Workplace Gymnastics in companies.

Food, according to Ferraz. et al (2009), plays a fundamental role in the performance of a company's employees, as an unbalanced diet full of "heavy" foods can generate indisposition, influencing the performance of workers after lunch. The ideal for employees to earn more is to encourage them to have a healthy diet, favoring vegetables and legumes.

Workplace Gymnastics, according to Melatti (2014), are exercises practiced in the workplace itself, which provide relaxation, good physical conditions and well-being and are directly related to the quality of life of the organization.

With the proposal to encourage these two practices within the company, the team sought to bring improvement both to the company's productivity and, mainly, to the quality of life of employees.

OBJECTIVE

The article brings two proposals as a central objective, both of which are important for the development of the student, especially in technical schools:

1. Demonstrate, through the practice of a TCC project, the importance of Technical Schools establishing partnerships with companies in the city where students can develop projects, proposing solutions to problem situations that can help neutralize or minimize them.

2. Provide the experience of High School and Technical students in the administrative activities of a company, based on a TCC project focused on the Quality of Life of the employees of Fort Paletes de Itararé, aiming at improving and increasing the company's productivity.

MATERIALS AND METHODS

In order to provide pedagogical practices that would bring students closer to the job market, a partnership was established between Etec de Itararé and the company Fort Paletes, in 2016, in order to develop a project based on a problem-situation of the company, involving classroom theory with business practices.

For the construction of the project, four students from the High School Integrated with the Technician in Administration at Etec de Itararé, partnered with the school's Nutrition and Dietetics course to create a balanced menu with healthy foods for employees. In addition, the following components were integrated: People Management, Physical Education, Planning and Development of the Course Completion Work (PDTCC).

The project was developed and applied in 2016 during the DTCC classes in which the theoretical part was developed and in August it began to be put into practice. Thus, the activities were carried out in the company through surveys with those responsible for the Human Resources and Occupational Safety sectors, to collect data on: sectors of the company with its production and recreation layout, employees and activities performed, workload and survey of knowledge on the topics dealt with in the project, through a questionnaire.

After this first study, the team developed the project and presented it to those responsible for validation, authorization and application, based on a schedule according to the availability of the company and the students, as shown below:

Figure 1: Project Timeline

ACTIVITY	DATA	TIME
Lecture with students about: Quality of life in organizations Participation: Human Resources and Physical Education Professionals	**10/10/2016** SIPAT-Internal Week for the Prevention of Accidents at Work	Time: 4:00 pm Duration: 50 min.
Application of Workplace Gymnastics by students with a Physical Education professional	Monday - Assembly Sector = 17, 24 and 31/10 Wednesday - Machining Sector = 19 and 26/10 and 03/11 Friday - Cape Machine Sector = 21st and 28th October and 04th November	Time: 08:00 Duration: 15 min.
Application of questionnaire to employees about: Lecture, Healthy Eating Menu and Workplace Gymnastics	**10/11/2016**	12:00 to 13:00 (Lunch time)
Feedback to the company on the results obtained	**24/11/2016**	14h30m

Figure 1 Source: Developed by the authors

RESULTS AND DISCUSSION

The classes of the PDTCC component focus on developing the following skills: Evaluate demands and problem situations within the professional area, propose solutions parameterized by technical and economic feasibility to the problems identified and analyze quality management methodologies in the professional context.

Based on these competencies and the students' choice of the theme Quality of Life at Work, the project was proposed in partnership with the company Fort Paletes.

First, at PTCC, planning and theoretical studies were carried out to support the project and research on the company's website on: products and services, strategic planning, main customers. On 08/18/16, the team went *on site,* in order to get to know the company, the sectors, the activities they perform and apply qualitative and quantitative surveys with employees, highlighting the data:

1. The company has 70 employees in the operational part, invests in security and training. The opening hours are from 08:00 to 18:00, with a break for meal and leisure from 12:00 to 13:10, where most stay in the company because they bring their own lunch from home,
2. Regarding food, employees are not used to consuming fruits, vegetables and legumes, but they consume water well during the day,
3. Regarding physical exercises, most do not perform any type of exercise and some only soccer on weekends,
4. It was found that most have headaches, leg and back pain after the workday, but employees do not perform any activity to relieve these symptoms, only the periodic medical exams requested by the company.

Based on the analysis of this data, the team developed the project focusing on Healthy Eating and Workplace Gymnastics, aiming to improve the quality of life of employees and increase productivity.

With the help of the Nutrition and Dietetics course, they made a banner with a Balanced Menu and, for the Workplace Gymnastics activities, they had the help of Physical Education Teacher Murilo Meneguela.

Figure 2 – Project Team and the Balanced Menu

Figure 1- Source: Developed by the authors

The second stage of the project was held in the company's cafeteria, on 10/10/16 at 4:00 pm, with the opening of the Internal Week for the Prevention of Occupational Accidents (SIPAT), where the team gave a lecture on the theme Quality of Life in Organizations to all employees and those responsible for the company.

Figure 3 – Opening of the SIPAT

Figure 2- Source: Developed by the authors

During the lecture, the team presented relevant concepts on the subject, the importance of Healthy Eating with the Menu adapted to the employees' daily work and the schedule of Workplace Gymnastics activities, shown in the figures below:

Figures 4 – Presentation: QWL Lecture with Workplace Gymnastics

Figure 3- Source: Developed by the authors

The third stage of the project was carried out in the Machining, Assembly and Cape Machine sectors, from 10/17/16 to 11/04/16 as shown in Figure 1 of the Schedule posted above. In these days, the team, together with the Physical Education Teacher, performed Workplace Gymnastics with specific exercises for those who require a lot of effort, focused on the arms, legs, spine, shoulders and neck, for a period of 3 weeks, for 30 minutes a day.

Figure 5 – Workplace Gymnastics with Employees

Figure 5 – Source Developed by the authors

The fourth and final stage aimed to evaluate the results of the project together with the company's employees and management. For this, a questionnaire and individual interviews were applied with some employees.

With the tabulation of the data, it is possible to perceive the satisfaction of the employees, especially with the application of Workplace Gymnastics, as it made them more willing to perform the work, reducing headaches, leg and spine pain, in addition to a significant increase in productivity, according to data from the administration.

Another important point found in the individual interview was that, based on the perception of the importance of Quality of Life, some employees started to practice physical exercises outside the company and implemented dietary changes.

FINAL CONSIDERATIONS

The article aimed to demonstrate the importance of partnerships between school and companies for the development of skills in students and to provide students with experience in the administrative activities of the company to develop essential skills in the labor market.

With the results obtained, it can be clearly seen that the students were able to develop these skills, as they were able to critically analyze the organization's issues and propose solutions focusing on the importance of healthy eating and physical exercise to improve the company's production process, as well as applying techniques of planning, management, evaluation and control of the activities developed in the project within the company's premises. This provided a better experience and interaction of the students with administrative activities, strengthened the partnership between the school and the company and, above all, promoted the improvement of the Quality of Life at Work of the employees and the increase in productivity.

Therefore, the article reinforces the importance of schools in establishing and maintaining partnerships with companies in the city and region and also of teachers providing projects with pedagogical practices applied outside the school environment, contributing to the full development of the teaching-learning process, related to the School Pedagogical Political Project.

REFERENCES

1. Ferraz, E. B. da S., et al. (n.d.). A saúde do trabalhador da estratégia saúde da família: Revisão na literatura dos fatores de risco relacionados a doenças ocupacionais. Retrieved May 24, 2016, from http://www.pergamum.univale.br/pergamum/tcc/Asaudedotrabalhadordaestrategiasaudedafamiliarevisaonaliteraturadosfatoresderiscorelacionadosadoencasocupacionais.pdf

2. França, A. C. L. (2014). *Práticas de Recursos Humanos PRH: Qualidade de vida, saúde e ergonomia*. São Paulo: ATLAS S.A.

3. Heidrich, G. (2018). Parcerias que funcionam. Retrieved May 20, 2018, from https://gestaoescolar.org.br/conteudo/581/parcerias-que-funcionam

4. Melatti, J. (2016). Ginástica laboral. Retrieved August 5, 2016, from http://www.infoescola.com/educacao-fisica/ginastica-laboral/

5. Mendes, G. (2016). O trabalho dignifica o homem. Retrieved May 22, 2016, from http://www.onacional.com.br/geral/cidade/37224/0+trabalho+dignifica+o+homem

6. Rocha, R. F. (2016). A qualidade de vida no trabalho em pequenas empresas: A mensuração rumo à melhoria – O caso Agromídia Software LTDA. Retrieved May 24, 2016, from https://mafiadoc.com/a-qualidade-de-vida-no-trabalho-em-pequenas-empresas-a-_59c67c441723dd810ee7a436.html

Humanization of the bond between doctor and patient: A look at maternal and child care

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ABSTRACT

Humanization consists of the set of techniques and actions that, built within its principles, promotes the quality of relationships between health professionals and patients in which the public, especially maternal and child, is lacking in this aspect in Brazilian hospitals. The purpose of this study is, based on the literature review, to condense information on the process of humanization in health in the maternal-child context in Brazil. The main difficulties encountered in making this theme effective in the context of health are the absence of maternal protagonism in childbirth, introspection of physicians when dealing with the newborn's family and the stressful environment of the Neonatal Intensive Care Unit. The importance of teaching about humanization in the country's universities for the training of human medical professionals in the care of Obstetrics and Neonatology is understood. It is verified that this article concludes that there is a lack of studies regarding the humanization of the doctor-patient relationship in the circumstance of maternal-child health and that, although there are hospitals that encourage the adoption of humanized behaviors in the country, it is still not a unanimous reality in Brazil.

Keywords: Humanization, Care, Look, Maternal, Infant.

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INTRODUCTION

The concept of humanization, in the doctor-patient context, assumes several variables, and is even more evident when it comes to professionals related to maternal and child health, since it is a double role facing the interface of technical knowledge. As a result, this relationship begins at the time of prenatal care, in which the patient is surrounded by physicians who - in various situations - are incisive in choosing not to respect the mother's decision regarding the conduct of the pregnancy, breaking this relationship of trust between physician and patient (HOTIMSKY; SCHRAIBER, 2005).

In addition, it is important to highlight that, although childbirth is a complex event that permeates preconceived judgments, communication with the obstetrician in charge linked to previous studies with scientific evidence by the mother make this moment more welcoming and humanized, showing that medical care is essential for the cultivation of affective maternal memories related to birth. However, the other facet of this theme involves professionals intimidated by the constant information circulating in common sense about the modes of delivery and the technologies used, which, innumerably, place the mother in the position of the exclusive holder of technical knowledge when in fact it should be a mutual exchange between the parties involved (SENS; STAMM, 2019).

According to Périco et al., (2006), it is essential that the child's subsequent consultations are based on empathy on the part of the specialized professional, taking into account the perception of mothers and children in care and, consequently, making them comfortable in a moment of tension. It is also necessary to emphasize that, in several facets, the theme is relevant to society because it is a preconception conceived by previous generations and related to inefficient care histories, but not openly exposed due to the hierarchization of medical knowledge and the lack of recognition of the patient's protagonism in the treatment offered.

Based on this, the work, with the methodology of bibliographic review, aims to identify the problems of public policies about the lack of humanization in maternal and child care conducted by obstetricians and pediatricians at the national level and justified in the interest of academics about humanization in the protagonism of mother and child in medical consultations. In addition, academic study can provide, together with numerous scientific studies in recent years, to add more to the theme and encourage scholars to promote public policies aimed at reducing the distance in the relationship between physician and maternal and pediatric patient, thus increasing the confidence and effectiveness of the treatments proposed to this target audience.

THE BIOMEDICAL MODEL OF PRENATAL CARE

Recent efforts by the Ministry of Health (such as the National Humanization Policy, of 2004) to promote the humanization of medical practices have been reformulating old habits of physicians. Despite this, the exercise of health in Brazil still remains intrinsically linked to the biomedical model

of care and treatment, making women a supporting player in the gestational process itself. This reality can be seen in the care of pregnant women by specialist professionals, such as obstetricians, who are fundamental to women's health from prepartum to postpartum. Such care is performed by adopting risk classification to measure the need for referral, since primary care (pregnant women's gateway to the SUS) is composed of general practitioners. This is one of the barriers that prevent the follow-up of an obstetrician throughout the prenatal care and that evidence the incorporation of the biomedical model in medical specialties (WARMLING et al., 2018; AMORIM; BRANT, 2021).

In this context, the study "Maternal and child care in a basic health unit: contributions of participatory management" brought a successful experience of female protagonism in pregnancy through participatory management. Through a group bringing together pregnant women and professionals within the *WhatsApp application*, women were able to actively act in their gestational process, either through communication with doctors and nurses present in the virtual environment or through the exchange of knowledge and experiences among the pregnant women themselves. In addition to participatory management as a way to place pregnant women in the position of co-manager of their health, it is of fundamental importance for physicians to exercise empathy during consultations, always prioritizing the understanding of the patient in her physiological, emotional and behavioral demands. This model of care requires humanization of the working professionals, aiming at the creation of bonds with women in the gestational process in order to provide a better dialogue between those involved and an effective dissemination of information (AMORIM; BRANT, 2021; SILVA et al., 2021).

An action similar to this was developed by a Colombian hospital, which created a *call center* for pregnant women with the objective of monitoring the gestational process, ascertaining the health situation of the mother and baby, as well as solving doubts about this life cycle. The calls were made weekly by health professionals, thus providing greater integration between the woman and the health facility team (MOLINA, 2019).

HUMANIZED CHILDBIRTH: AN ESSENTIAL AND BENEFICIAL ACT FOR LIFE

Historically, childbirth has always been understood as a natural process, which is a mobilizing and remarkable phenomenon in the history of all those involved, which is a great aggregator of multiple meanings in different cultures that is perpetuated for generations, an example is the celebration of birthdays, known as the first important milestone of life (FUJITA; SHIMO, 2014).

In addition, with the advent of medical advancement, the prevention of fatalities was sought, with this, there was a consequent mechanization of births in hospital environments under the responsibility of professionals, especially in Brazil where since the 80s the number of cesarean

deliveries has been increasing, representing 80% of births performed in private networks and 26% in the public health system. resulting in an overall average of 40%. Thus, Brazil is the country that performs the most cesarean deliveries in the world (NAGAHAMA; SANTIAGO, 2011).

Although more safety has been sought by mechanizing deliveries, cesarean delivery has been done in a massively unnecessary way, causing consequences such as: increased maternal mortality rates, infections, hemorrhages, possible complications resulting from anesthesia in mothers. In addition to impasses resulting from prematurity in children, such as: respiratory problems, hospitalizations and immunological immaturity (NAGAHAMA; SANTIAGO, 2011).

Faced with such implications for the irresponsible use of cesarean sections, the World Health Organization and the Ministry of Health expressed their concerns about the excessive use of unnatural childbirth and then, in 1996, published the Safe Maternity Report, which presents recommendations for good obstetric practices (FUJITA; SHIMO, 2014).

In addition to such practices, emotional support should be encouraged by the professionals involved, the offer of oral liquids, empathic support, respect, clarification of doubts about childbirth, massages and relaxation techniques, support and professional instruction for breastfeeding (according to WHO guidelines on breastfeeding) (MONTEIRO; HOLLAND; MELO, 2017).

Even so, currently a large number of maternity hospitals prioritize procedures that delay humanized childbirth. In most Brazilian maternity hospitals, the reality of childbirth care reflects a care marked by routine interventions such as venipuncture, use of oxytocytes, episiotomy, analgesia, tricotomy and intestinal lavage, valuing the medical professional more than benefits to the binomial. There is evidence that venipuncture, to hydrate the pregnant woman, hinders her walking and free movement; episiotomy generates a genital lesion that causes great discomfort because it reaches the muscle tissue and does not prevent perineal lacerations (AZEVEDO; SALVETTI; TORRES, 2017).

It is also important to emphasize the contribution of health education in order to demystify the pain present in natural childbirth, thus contributing to the empowerment of women at the time of childbirth, which would enable a paradigm shift through education. Finally, it should be made clear that pain is part of the physiology of childbirth and it is important that the parturient understands this, since labor pain stimulates the body to naturally release beta-endorphins that will act to control pain as a natural analgesic. The woman who understands this fact and all the uniqueness involved can make this moment a unique experience (AZEVEDO; SALVETTI; TORRES, 2017).

For this to occur, quality obstetric care is necessary, which is a right that must be guaranteed to any and all women who are in the gestational period, mainly due to the state of vulnerability that the woman is in (CARRILLO et al., 2016).

In this context, the challenges encountered in health services are related to the care provided to patients and the humanization of this relationship. The act of humanizing ranges from attention

and welcoming to respect for the rights and particularities of each individual (SAMPAIO; SILVA; MOURA, 2008).

"Women with positive experiences during the parturition process are more likely to exercise motherhood in a more pleasurable way than others who have suffered obstetric violence. They also bring important benefits to the newborn, such as the desire to breastfeed and protect him " (AZEVEDO; SALVETTI; TORRES, 2017, p.3).

The profile in which the most cases occur in which women are not treated in a humanized way during labor include adolescents, pregnant women with high-risk pregnancies, and lower-class women. Adolescents are the most vulnerable, since teenage pregnancy represents a public health problem, in addition to being at risk; followed by high-risk pregnancies, in which health professionals feel very pressured by the woman's own health condition, often leading to the mother's non-participation in the process; finally, women who have low financial status and who come from lower socioeconomic classes (MANRIQUE; CUERVO, 2017).

METHODS AND CARE IN THE PUERPERIUM

The kangaroo mother method presents itself as a practice, which increases intimate contact between mother and child, because through this skin-to-skin contact it is possible to feel temperature, breathing, sleep and contribute to the baby's weight gain, especially for premature babies, since it helps in breastfeeding as well as strengthens the feeling of love, affection and encourages protection between the puerperal woman and her child. It is essential to have a constant presence of health professionals in the treatment of the mother's health, especially with women's health programs, in order to promote more humanized care in this postpartum period (NEVES; RAVELLI; LEMOS, 2010).

Due to all this situation to which the mother is exposed in her puerperium, she can be the target of some illnesses, such as postpartum depression. Postpartum depression is a reality experienced by many women, often due to psychoaffective disorders, which accompanied them during their pregnancy period and that there was no adequate treatment, either due to lack of knowledge or follow-up by a specialist, in this way, these depressive symptoms manifest themselves after the birth of the child, becoming harmful to the baby, as well as for the family. For this reason, it is necessary to take a close look at this issue, since the puerperium presents itself as a stage of profound changes in the social, psychological and physical spheres of women, characterized as an unstable period, which demands the need for a deep knowledge of this stage in women's lives, since it is an essential factor in determining the threshold between health and disease (COUTINHO; SARAIVA, 2008).

According to Rattner (2009), for humanization in the care of births and births, it is essential to expand public policies for the pre- and post-birth period in order to promote a more humanized care through exams and constant care with doctors, nurses and professionals specialized in this area in order to promote greater care and a closer relationship between mother and child.

A HUMANIZATION APPROACH TO NEONATAL CARE

Pregnancy is a physiological process in which the woman, aware of her situation as a future mother of a baby, goes through physical and psychic changes whose transformations can be challenging to the point of feeling that pregnancy is a disease. In view of the numerous facets that involve this process, such as the awareness of maternal responsibility, women can still experience the challenge of high-risk pregnancy in which they can experience the anticipation of delivery and the prematurity of the newborn (GUIMARÃES; MONTICELLI, 2007).

The Neonatal Intensive Care Unit (NICU) is an environment whose convergence between the intense care of professionals and the physical technological space unites in favor of the health of the newborn, but other affective needs of this individual reappear in this context and the focus focused exclusively on the NICU machines with the purpose of providing a cure, care becomes depersonalized and not very human (SILVA; SILVA; CHRISTOFFEL, 2009).

According to a research carried out in three Neonatal Intensive Care Units of public hospitals in the Metropolitan Region of Vitória, professionals understand the importance of humanized care directed to newborns – such as minimizing sound stimuli and preparing the oral muscles for breastfeeding through non-nutritive sucking – however, resistance to practicing the actions is noticeable, since the stressful and rotating environment of the NICU prevents humanization practices. Based on this, humanized care in Brazil should result from a reorganization of the health service, linking technical knowledge and the human factor in the doctor-patient relationship (ROSEIRO; PAULA, 2015).

The possibility of cure, especially in the compartment of intensive care units, in the area of Neonatology is the result of the incorporation of technologies associated with the scientific knowledge of the health team and, thus, reduces the rates of complications in care. However, when it involves neonatal terminality, the family is weakened by the uncertainty of the treatment directed to the patient and the way the doctor interacts with the family members influences the way the pain process is experienced, consequently, the careful way of facial and gesticular expressions is essential for the news to be passed on in a less aggressive way (SILVA; MENDONÇA, 2010).

In this context, according to Brasil (2014), the National Curriculum Guidelines for the Undergraduate Medical Course determine that humanization in the doctor-patient relationship is an

agenda that should be discussed and executed from medical graduation, in which humanized care should be carried out considering all aspects inherent to the patient's life (DIAS et al., 2019).

Furthermore, the third principle of princimal bioethics applied in the neonatal area - autonomy - is based on the transfer of decision-making power to the family regarding the treatments offered and, as a result, reinforces the importance of strengthening the relationship between doctors and family members, as long as it is beneficial and humanized in order to offer technical and emotional support (SILVA; MENDONÇA, 2010).

According to Floss et al. (2013), the use of the figure of the clown in the "Recruits of Joy" project, developed by medical students from the Federal University of Rio Grande, alleviates the suffering of parents and hospitalized children caused by invasive treatment through playful games and children's theater, as well as encourages future professionals to observe the patient completely, respecting limits, life stories and individuality.

CONCLUSION

According to the studies obtained in the research, it was found that humanized treatment between pregnant women, babies and doctors is extremely important for the good development of pregnancy, including the physical, emotional and mental aspects of the future mother in this important life cycle. Despite the benefits, this practice is still little present in the daily routine of centers specialized in maternal and child care, in which the lack of empathy prevails in most cases, as well as the lack of interest in changing such a scenario.

It can be considered that despite so many difficulties, humanized treatment exists in the target population of this study, but in small proportions, thus requiring mechanisms that encourage the adoption of behaviors that overflow empathy, respect and security for the pregnant woman. This fact reflects on the debate on humanization in the doctor-patient relationship in the maternal-child aspect, which is still not widespread among the medical and scientific community, which makes this theme lacking in studies, as well as artifices that can provide resources for the implementation of measures that can change the current panorama.

In view of this, it is necessary that more research in this area be developed, so that complicity and integration are stimulated between the entire health team and patients and thus be a constant in the daily medical follow-up of pregnant women, puerperal women and neonates.

REFERENCES

1. Amorim, F., & Brant, L. C. (2021). Atenção materno-infantil em uma unidade básica de saúde: contribuições da gestão participativa. *Rahis- Revista de Administração Hospitalar e Inovação em Saúde, 18*(2), 1-19. https://doi.org/10.21450/rahis.v18i2.6664

2. Azevedo, D. M., Salvetti, M. G., & Torres, G. V. (2017). Qualidade da assistência em saúde mental: desenvolvimento de um instrumento de avaliação. *Revista de Enfermagem do Centro-Oeste Mineiro, 7*, 1-10. https://doi.org/10.19175/recom.v7i0.1685

3. Brasil. Ministério da Educação. Conselho Nacional de Educação. Câmara de Educação Superior. (2014). Resolução nº 3, 20 de junho de 2014. Diretrizes Curriculares Nacionais do Curso de Graduação em Medicina. Disponível em http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=15874-rces003-14&category_slug=junho-2014-pdf&Itemid=30192

4. Brasil. Ministério da Saúde. Secretaria-Executiva. Núcleo Técnico da Política Nacional de Humanização. (2004). *Humaniza SUS: política nacional de humanização: a humanização como eixo norteador das práticas de atenção e gestão em todas as instâncias do SUS*. Disponível em https://bvsms.saude.gov.br/bvs/publicacoes/humanizasus_2004.pdf

5. Carrillo, R. G., Castillo, M. M., Acuña, V. R., Lagunes, L. L. S., León, A. C., & Ramón, F. M. (2016). Satisfacción con la calidad de la atención en mujeres en periodo posparto de un hospital de tercer nivel. *Revista Conamed, 21*(1). Disponível em https://www.medigraphic.com/pdfs/conamed/con-2016/con161c.pdf

6. Coutinho, M. P. L., & Saraiva, E. R. S. (2008). Depressão pós-parto: considerações teóricas. *Estudos e Pesquisas em Psicologia, 8*(3), 759-773. Disponível em http://www.revispsi.uerj.br/v8n3/artigos/pdf/v8n3a14.pdf

7. Dias, L. F., Naves, G. R. C., Ferreira, N. M., Freitas, M. C., Araújo, A. F. R., & Santos, C. A. G. (2019). La enseñanza médica en el cuidado en salud materno-infantil: ambientes de práctica, estrategias y desafios. *Revista Família, Ciclos de Vida e Saúde no Contexto Social, 7*(3). Disponível em http://seer.uftm.edu.br/revistaeletronica/index.php/refacs/article/download/3446/pdf_2

8. Floss, M., et al. (2013). A humanização através do programa Recrutas da Alegria da FURG: um relato de experiência. *Revista Brasileira de Educação Médica, 37*, 464-470. https://doi.org/10.1590/S0100-55022013000300020

9. Fujita, J. A. L. M., & Shimo, A. K. K. (2014). Relato de experiência - parto humanizado: experiências no sistema único de saúde. *Rema: Revista Mineira de Enfermagem, 18*(4). https://doi.org/10.5935/1415-2762.20140074

10. Guimarães, G. P., & Monticelli, M. (2007). (Des)motivação da puérpera para praticar o Método Mãe-Canguru. *Revista Gaúcha Enfermagem, 28*(1). Disponível em https://www.seer.ufrgs.br/rgenf/article/view/4687

11. Hotimsky, S. N., & Schraiber, L. B. (2005). Humanização no contexto da formação em obstetrícia. *Ciência & Saúde Coletiva, 10*(3). https://doi.org/10.1590/S1413-81232005000300020

12. Manrique, F. M. C., & Cuervo, G. M. N. (2017). Atención humanizada del parto: Diferencial según condición clínica y social de la materna. *Revista Colombiana de Obstetricia y Ginecología, 68*(2). http://dx.doi.org/10.18597/rcog.3022

13. Molina, J. F. G. (2019). Acciones de mejora para la humanización en los servicios del área materno infantil: Hospital San Marcos. *Con-Ciencia y Técnica, 3*. Disponível em http://revistas.sena.edu.co/index.php/conciencia/article/view/2405/2665

14. Monteiro, M. C. M., Holanda, V. R., & Melo, G. P. (2017). Análise do conceito de parto humanizado de acordo com o método evolucionário de Rodgers. *Revista de Enfermagem do Centro-Oeste Mineiro, 7*. https://doi.org/10.19175/recom.v7i0.1885

15. Nagahama, E. E. I., & Santiago, S. M. (2011). Parto humanizado e tipo de parto: avaliação da assistência oferecida pelo Sistema Único de Saúde em uma cidade do sul do Brasil. *Revista Brasileira de Saúde Materno Infantil, 11*(4). https://doi.org/10.1590/S1519-38292011000400008

16. Neves, P. N., Ravelli, A. P. X., & Lemos, J. R. D. (2010). Assistência humanizada ao recém-nascido de baixo peso (método mãe-canguru): percepção de puérperas. *Revista Gaúcha de Enfermagem, 31*(1), 48-54. https://doi.org/10.1590/S1983-14472010000100007

17. Organização Mundial da Saúde. (1996). *Maternidade segura: assistência ao parto normal: um guia prático*. Genebra: OMS. Disponível em https://saude.mppr.mp.br/arquivos/File/kit_atencao_perinatal/manuais/assistencia_ao_parto_normal_2009.pdf

18. Périco, G. V., Grosseman, S., Robles, A. C. C., & Stoll, C. (2006). Percepção de mães sobre a assistência prestada a seus filhos por estudantes de medicina da sétima fase: Estudo de caso no ambulatório de pediatria de um hospital universitário. *Revista Brasileira de Educação Médica, 30*(2). https://doi.org/10.1590/S0100-55022006000200007

19. Rattner, D. (2009). Humanização na atenção a nascimentos e partos: ponderações sobre políticas públicas. *Interface-Comunicação, Saúde, Educação, 13*, 759-768. https://doi.org/10.1590/S1414-32832009000500027

20. Roseiro, C. P., & Paula, K. M. P. (2015). Concepções de humanização de profissionais em Unidades de Terapia Intensiva Neonatal. *Estudos de Psicologia (Campinas), 32*, 109-119. https://doi.org/10.1590/0103-166X2015000100010

21. Sampaio, A. A., Silva, A. R. V., & Moura, E. R. F. (2008). Atención humanizada del parto de adolescentes: ¿norma, deseo o realidad? *Revista Chilena de Obstetricia y Ginecología, 73*(3). Disponível em https://scielo.conicyt.cl/pdf/rchog/v73n3/art08.pdf

22. Sens, M. M., & Stamm, A. M. N. F. (2019). Percepção dos médicos sobre a violência obstétrica na sutil dimensão da relação humana e médico-paciente. *Interface: Comunicação, Saúde, Educação, 23*. https://doi.org/10.1590/Interface.180487

23. Silva, F. G., Maia, I. S. L., Silva, L. M., Martins, I. A. A. M., Pereira, L. M. S., Nunes, K. V. Z., Silva, S. G., & Maciel, J. M. M. P. (2021). Gestar no SUS: entre humanização, autonomia e maternidades socialmente amparadas. *Brazilian Journal Of Development, 7*(8), 81237-81247. https://doi.org/10.34117/bjdv7n8-372

24. Silva, L. C., & Mendonça, A. R. D. A. (2010). Neonatologia e terminalidade da vida: as implicações bioéticas da relação equipe de saúde-paciente-família. *Revista Bioética, 18*(3), 677-690. Disponível em https://www.redalyc.org/pdf/3615/361533254013.pdf

25. Silva, L. J. D., Silva, L. R. D., & Christoffel, M. M. (2009). Tecnologia e humanização na Unidade de Terapia Intensiva Neonatal: reflexões no contexto do processo saúde-doença. *Revista da Escola de Enfermagem da USP, 43*, 684-689. https://doi.org/10.1590/S0080-62342009000300026

26. Warmling, C. M., Fajardo, A. P., Meyer, D. E., & Bedos, C. (2018). Práticas sociais de medicalização & humanização no cuidado de mulheres na gestação. *Cadernos de Saúde Pública, 34*(4), 1-11. https://doi.org/10.1590/0102-311x00009917

Design of a device for lifting a Grand Piano

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ABSTRACT
This article describes the process of designing a device to vertically elevate a grand piano together with the pianist. A device for this purpose has already been developed and applied in performances by the Swiss pianist Alain Roche abroad. The idea, with this project, is to do the same in Brazil, particularly in Brasilia, with the possibility, if there is interest, of expanding to other states. As the pianos, in order to be played, are positioned horizontally, it was necessary to adapt the action mechanism so that the piano could be played vertically. The project was developed within the scope of the discipline Project of Mechanical Systems of the Department of Mechanical Engineering of the University of Brasília – UnB and had the participation of thirteen students under the coordination of the professor of the discipline. Two types of devices have been developed, one that suits a particular grand piano that is being prepared for performances and another device that fits any grand piano, regardless of dimensions. The designed devices allow the pianist to be elevated vertically along with the piano comfortably and safely. Performances can be made outdoors or indoors that have the support of a lifting system to suspend the piano and the pianist. The project required an interdisciplinary approach, combining knowledge of mechanical engineering, ergonomics, music, safety and design, to ensure the technical and artistic feasibility of the device.

Keywords: Grand Piano, Lifting Device, Design, Art.

INTRODUCTION

The piano, an iconic instrument in the world of music, has a rich history and a fascinating structure that has captivated musicians and listeners over the centuries. Invented in the early eighteenth century by Bartolomeo Cristofori, an Italian harpsichord maker, the piano revolutionized Western music by introducing the ability to vary the intensity of the sound produced, a feature that was lacking in its predecessors, such as the harpsichord and the clavichord. This innovation was made possible by the key-operated hammer mechanism, which allows the pianist to control musical dynamics and expression with unprecedented precision. Figure 1 shows the piano invented by Bartolomeo Cristofori.

Figure 1: Piano inventado por Bartolomeo Cristofori

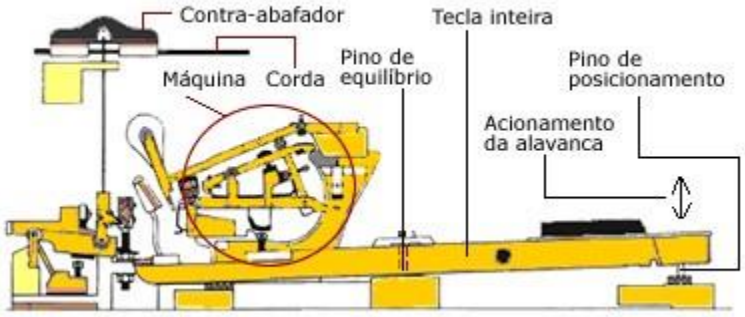
Source https://pt.wikipedia.org/wiki/Fortepiano

The operation of the piano is based on a complex system of strings stretched over a wooden or metal structure. When a key is pressed, a felt-coated hammer is triggered, striking the corresponding string and producing sound. The vibration of the strings is amplified by the soundboard, a crucial component for the richness and resonance of the piano sound. This mechanism, although apparently simple, is the result of centuries of technical development and refinement.

The main components of the piano are fundamental to its operation and sound quality. These components and their functions are described below:

- Keyboard: The piano keyboard usually consists of 88 keys, which include 52 white keys and 36 black keys. Each key is connected to a hammer that, when pressed, strikes a specific string. The piano keyboard is nothing more than a lever system, that is, a piece of wood (key), two pins (one for vertical fixation – balance – and the other for horizontal fixation – positioning). Figure 2 schematically shows the mechanism of a piano key.

Figure 2: Keyboard of a grand piano

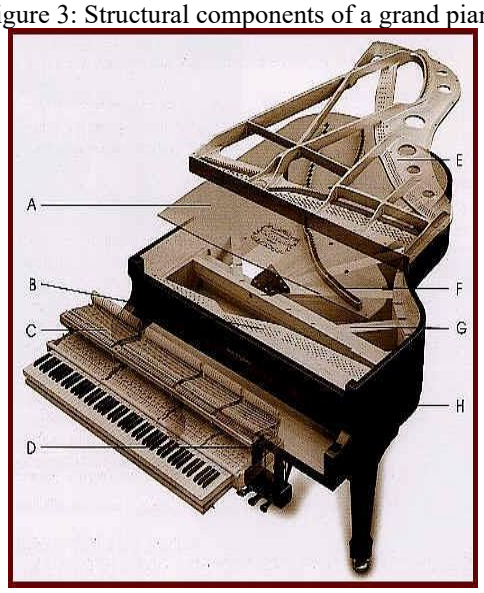


Source https://www.salaomusical.com/pt/content/17-historia-do-piano

- Hammers: Made of wood and coated with felt, hammers are responsible for striking the strings and producing sound. The quality of the felt and the precision of the mechanism are crucial to the dynamics and timbre of the piano. The hammer, after striking the string, returns to its position due to the effect of gravity, because the piano is positioned horizontally. In the case of the present project, as the piano will be played in an upright position, this mechanism had to be changed using springs so that the hammer returns to its original position after hitting the string. Without this modification, the piano simply wouldn't play.
- Strings: Piano strings are made of steel and vary in length and thickness to produce different tones. Thicker, longer strings produce lower notes, while thinner, shorter strings produce high notes.
- Pedals: The piano pedals, usually three (*sustain, una string, and sostenuto*), give the pianist greater control over the sound. The *sustain pedal* prolongs the vibration of the strings, the *una corda* softens the sound, and the *sostenuto* sustains certain notes while others are played normally.

To develop a device that will support the piano, it is important to know the main structural elements of a grand piano. Figure 3 shows each of them.

Figure 3: Structural components of a grand piano



Source https://www.salaomusical.com/pt/content/17-historia-do-piano

- A - Soundboard: Also known as a soundboard, usually made of spruce wood, it amplifies the vibrations of the strings, giving the piano its rich and full sound. It is essential for the acoustic quality of the instrument.
- B - Stump: The stump is the part of wood where the tuning pegs (tuning pins) are inserted. It is crucial for maintaining the piano's tuning, as the tuning pegs are adjusted to tension or relax the strings.
- C - Mechanism: The piano mechanism, also known as the "piano action", is the set of parts that translates the movement of the keys into sound. This mechanism is composed of several interconnected parts that guarantee the precision and response desired by the pianist (keys, hammers, repetition springs and other components).
- D - Lyre: The lyre is the structure that supports the piano pedals. In addition to providing a physical support, it transmits the actions of the pedals to the internal mechanism, allowing sound control.
- E - Plate: The plate, usually made of cast iron, is the structure that supports the tension of the strings. It is crucial for the durability and stability of the piano, as the strings exert enormous force. The strings of a piano tuned to the normal tuning fork 440Hz make a tension of about 22 tons at the ends.
- F - Bridge: Easels are pieces of wood that transmit the vibrations of the strings to the soundboard. They are positioned in such a way as to maximize the efficient transmission of vibrations, contributing to the sound richness of the piano.
- G - Beams: Beams are wooden beams that reinforce the structure of the piano. They help to withstand the tension of the strings and maintain the stability of the structure. The weight of a piano, whether upright or grand, is smaller when compared to the pressure to

which the instrument is subjected by the strings. The goal is to create reinforcements in the body of the piano that help it support not only the weight of all the internal components, but also all the great pressure imposed by the strings tuned on the tuning fork. Structural reinforcement is usually made up of solid logs of wood located at the back of the piano. In the following example, structural reinforcement is pointed out. Figure 4 shows the beams used in structural reinforcement.

Figure 4: Structural beams of a grand piano

Source https://www.salaomusical.com/pt/content/17-historia-do-piano

- H - Case: The piano case is the external structure that surrounds and protects all the internal components. It also contributes to acoustic quality by influencing the resonance and timbre of the sound.

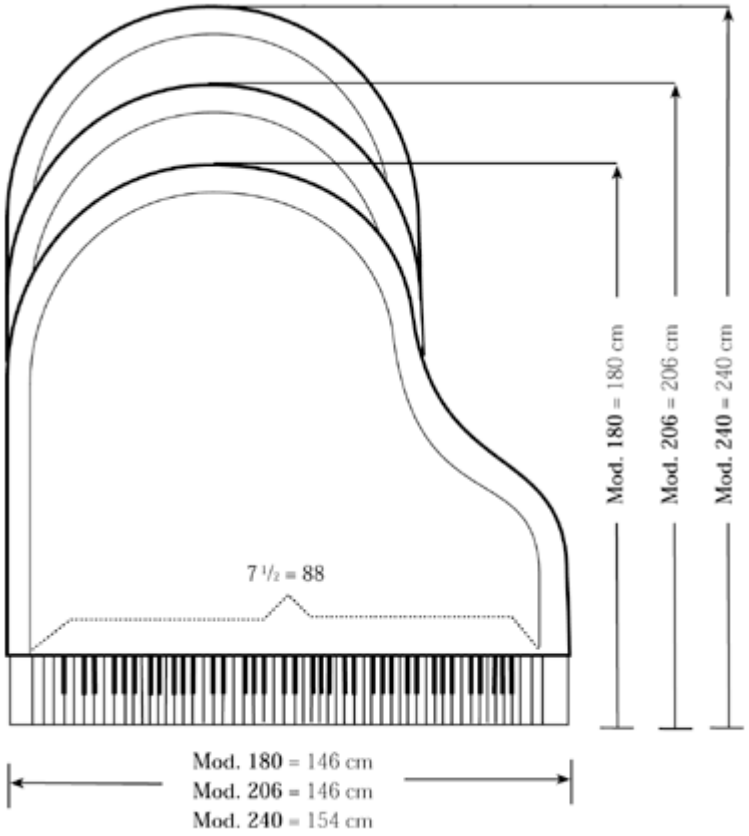
Grand pianos, a design element of this work, can come in different sizes, which adapt both to the needs of sound and to the space constraints that are often decisive in the choice of model. It is important to remember that the sound volume and timbre of a piano are related to the length of the strings and the size of the harmonic case, so some models are suitable for smaller environments, while others are ideal for large concert halls.

It is common to talk about full, 1/2 grand and 1/4 grand pianos. Obviously, the difference is in the size of the instruments. But there is no specific measurement standard and each manufacturer has developed unique designs for each model, because the longer the string, the greater the tension required to make it sound correctly, which requires a stronger and heavier structure.

On the other hand, and as a consequence, the instrument has a higher sound volume. Because of this, the so-called full-length grand pianos are the most suitable for concert halls, theaters and other environments where it is necessary to fill the space with their sound. There is also the fact that, in these environments, the piano is often accompanied by orchestras and groups of various

instruments, which requires more volume to balance the sound. The variations in average size are shown in figure 5.

Figure 5: Size variations of a grand piano



Source https://tienespianos.blogspot.com/2011/08/piano-de-cauda-tamanhos-e-medidas.html

Over the years, the piano has remained a central instrument in music education and performance, adapting to technological and cultural evolutions without losing its essence and importance. Understanding its history, functioning, and components is essential to fully appreciate this instrument that continues to inspire and thrill generations of musicians and music lovers. This project seeks to explore these aspects, offering a different way of appreciating and disseminating this instrument by uniting technology and art.

MOTIVATION AND PURPOSE

Casa do Piano, located in the Federal District, is a unique company, founded in 1982, with the objective of offering piano maintenance and restoration services, in addition to recreating old pianos. However, due to the passion and ingenuity of its founder, Casa do Piano also seeks to develop innovative projects in the area, including the "Itinerant Museum" and the "Piano for All", which takes a piano for a walk through the heart of Brasília, in Eixão do Lazer (figure 6).

Figure 6: Piano for all (monumental axis of Brasília)

Source: "Piano for all" project. [G1, 2023]

In this sense, the Casa do Piano team sought the Department of Mechanical Engineering of the University of Brasília – UnB, to design a device to hoist a grand piano together with the pianist in order to make presentations with the piano in an upright position. The inspiration came from a performance by Swiss pianist Alain Roche, who uses a similar device in his performances, elevating the piano and the artist in an open-air choreography. In it, a piano and the pianist are suspended by a crane, and the musical performance is performed 10 meters from the ground (figure 7). The pianist also performed at the closing ceremony of the Paris Olympics.

Figure 7: Pianist Alain Roche performing in Sion, Switzerland (2019)

Source: https://www.worldpianonews.com/event/piano-vertical/

The execution of an undertaking of this magnitude presented several challenges in the area of mechanical design and design. It was necessary to design a device that is capable of guaranteeing the suspension of the piano plus the pianist, totaling about 400 kg, without detracting from the design of the piano. In addition, ergonomic and safety aspects have been taken into account in the design of the chair in order to ensure the safety and comfort of the pianist, who must preserve his ability to perform musical pieces while suspended.

The project required an interdisciplinary approach, combining engineering, ergonomics, safety and design expertise, to ensure the technical and artistic feasibility of the device.

To make the project viable, the theme was addressed in the discipline Design of Mechanical Systems, a final course discipline, of the Department of Mechanical Engineering of UnB, and the participating students were divided into two groups. One group was responsible for designing a lifting device for a specific grand piano, provided by Casa do Piano and another group was responsible for developing a lifting device that would be adaptable to different sizes of grand pianos. The responsibility for the coordination, orientation and monitoring of the projects was the responsibility of the professor responsible for the discipline.

PRODUCT

NEEDS

The main need was to develop a robust and safe structure to attach to a grand piano, allowing it to be hoisted vertically by a lifting machine. This structure must guarantee the integrity of both the piano and the pianita as well as the proposed artistic performance, which consists of playing the piano vertically suspended. Safety is the most critical aspect, since the performance will be carried out in a suspended environment, requiring a construction that supports the weight of the piano and the pianist and the movements inherent to the musical performance.

In addition to safety, the structure was designed in such a way as not to interfere with the aesthetics of the piano and the sound quality during the performance. The attachment to the piano must be firm, but discreet, preserving the visual and functional integrity of the instrument.

By meeting these needs, the project sought to provide an innovative solution that allows for a unique artistic performance, highlighting both the musician's skill and the engineering involved in the design of the device.

CONCEPTUAL DESIGN OF THE LIFTING STRUCTURE

Three solution alternatives were evaluated based on technical criteria and submitted to a detailed analysis using a decision matrix.

For each design, factors such as the robustness of the structure, the ease of assembly and disassembly, the adaptability to different lifting scenarios, the lightness to facilitate transport, and the strength and durability of the materials used were taken into account. Initial development included the creation of 3D models, detailed structural calculations and numerical simulations to ensure that all proposed solutions were feasible and effective.

The importance of adopting a structured and comparative approach in the evaluation of different designs lies in the ability to ensure that the final solution not only meets technical requirements, but is also practical and cost-effective. An attempt was made to optimize the project in

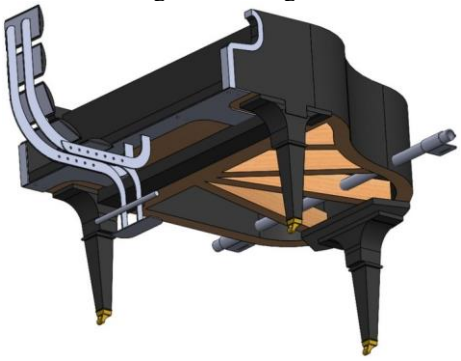
terms of safety, reliability and operational efficiency, ensuring that the chosen solution was the best possible for the specific context of the project.

Each of the three solutions adopted is detailed in the subsequent subtopics, providing a comprehensive overview of the alternatives considered and the rationale for choosing the final design used in the piano elevation project.

Design 1

Design 1, shown in figure 8, is based on a through tube that supports the weight of the piano, the pendant, and the lifting frame (containing the chair). The chair is fixed to the metal structure by welding and has a structure with two curved bars that receive vertical forces.

Figure 8: Design 1



Source: Authors.

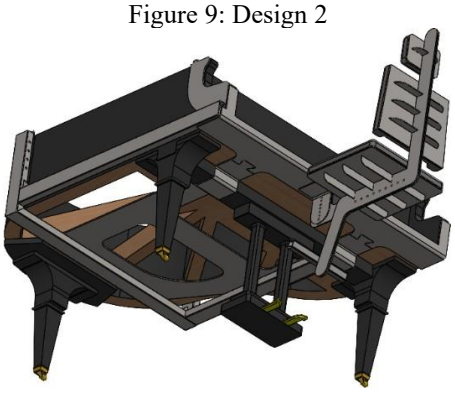
This design places high demands on the wooden structure of the piano, which can compromise its integrity, since the structural beams would have to be drilled for the tube to pass. Although the cost and weight are relatively low, the performance, reliability, and safety leave something to be desired.

Safety is the main requirement to be taken into account in the project, and design 1 could present flaws that would compromise the safety of the pianist and the piano.

Design 2

Design 2, shown in figure 9, consists of a structure of metal sheets and rectangular tubes to strengthen the structure.

Figure 9: Design 2



Source: Authors

This design offers increased reliability, performance, and safety. The use of sheet metal and rectangular tubes provides a solid and stable structure, capable of supporting loads safely. The piano frame will not be affected or used to support the full weight during lifting. The chair, being simpler and more ergonomic, guarantees the necessary comfort to the pianist, in addition to facilitating the manufacture and assembly.

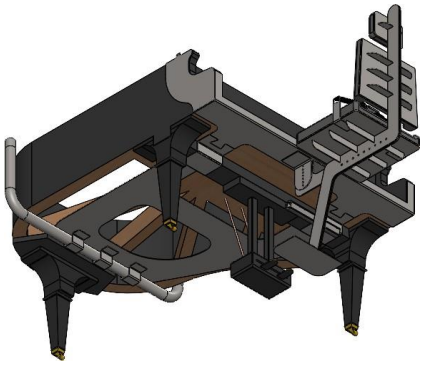
The cost of design 2, despite being higher than that of design 1, is justifiable by the additional benefits in terms of safety and reliability. It provides a robust structure that minimizes the risk of failure, ensuring high efficiency in lifting the piano, providing stability and control.

Design 3

Design 3, shown in figure 10, adopts a simpler structure with only a plate cortoning the piano and a curved tube that is attached welded by three clamps to the structural plate.

Some features of this design include: ease of implementation by the use of a single tube. Ease of production since only sheet metal with laser cutting and calendered tube will be used and low cost. As with design 2, the piano frame will not be affected or used to support the full weight during lifting.

Figure 10: Design 3



Source: Authors

To select the best design, the method proposed by Robert L. Norton (1999) was used, which is an effective approach to select the best solution when the technical analysis identifies several viable options. The decision matrix facilitates this choice by forcing the designer to consider a wide range of factors systematically. In this matrix, the possible solutions are listed in the first column, while the evaluation parameters are arranged in the top row. Each solution is then evaluated against each parameter, such as cost, ease of operation, efficiency, safety, and reliability, as per the specific needs of the initial problem. These factors are weighted according to their relative importance in the project. For example, in projects carried out in hard-to-reach places, reliability and ease of maintenance may be more important than aesthetics. The scores of each solution for each criterion are recorded in the body of the matrix, using an easy-to-manipulate scale, such as from 0 to 10. Table 1 presents the decision matrix with the criteria adopted for the design of the piano lifting structure.

Table 1: Decision Matrix for the Piano Elevation Project

	Cost	Safety	Visual	Confidence	Total
Weighting factor	0,30	0,35	0,10	0,25	1
Design 1	2,40 8	2,10 6	0,50 5	1,25 5	6,25
Design 2	1,80 6	3,15 9	0,70 7	2,25 9	7,90
Design 3	2,40 8	3,15 9	0,90 9	2,25 9	8,70

Source: Authors

It was decided to select design 3, for the safety, reliability and look that this solution provides. As discussed below, after the completion of the structural analysis, it was decided to use an interissa plate instead of a hollow plate, as shown in figure 10, which allowed to reduce its thickness.

The project was divided into three subsystems, structural plate, chair structure and lifting system.

CONCEPTUAL DESIGN OF THE PIANIST'S CHAIR STRUCTURE

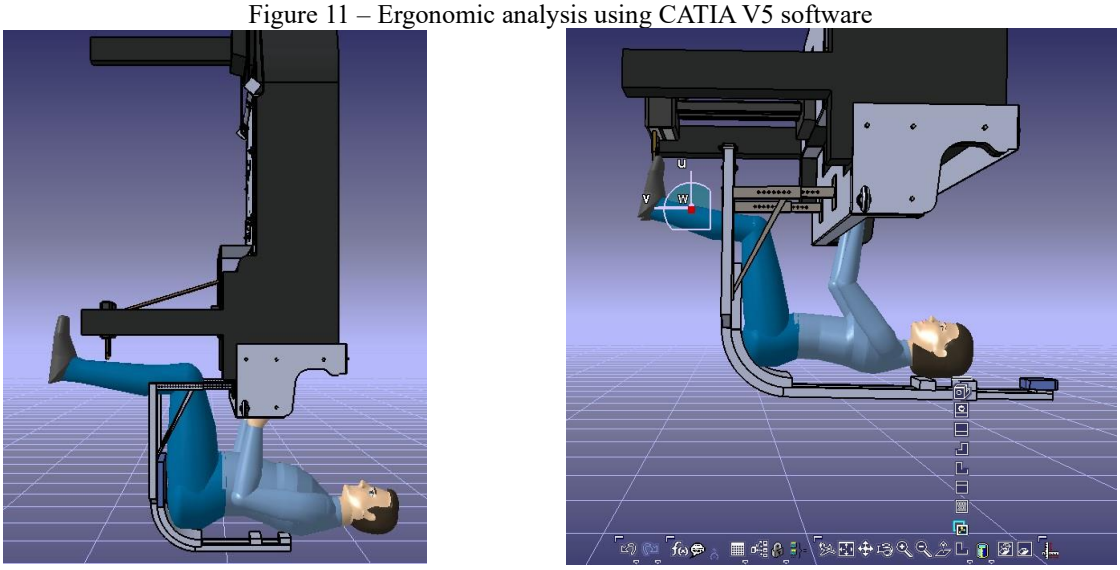
Another key element for the project is the pianist's chair. The structure of the chair, in addition to having to support its own weight and that of the pianist, must contemplate ergonomic aspects, so that the pianist is comfortable during the performance, taking into account that he will be performing vertically. The structure must support the weight of the pianist, which may vary, as well as allow an adjustment in the height of the seat and headrest. It should also provide supports for the pianist's legs and feet, to enable him to properly use the pedals and to rest when he is not performing. In addition, it should be aesthetically and visually discreet, harmonizing with the whole as a whole.

Ergonomic Analysis

For the ergonomic analysis, the CATIA V5 software was used, which has specialized modules for ergonomic simulation. The RULA tool integrated into CATIA V5 was instrumental in identifying and assessing the risks of repetitive strain injuries and poor postures.

To ensure that the design was adaptable to different sizes of pianists, the ergonomic analysis was performed considering the two extremes of size of the individuals available in the *software*: the 100% male percentile and the 0.01% female percentile. This approach ensures that the structure is inclusive and can comfortably accommodate both the largest and smallest pianists possible.

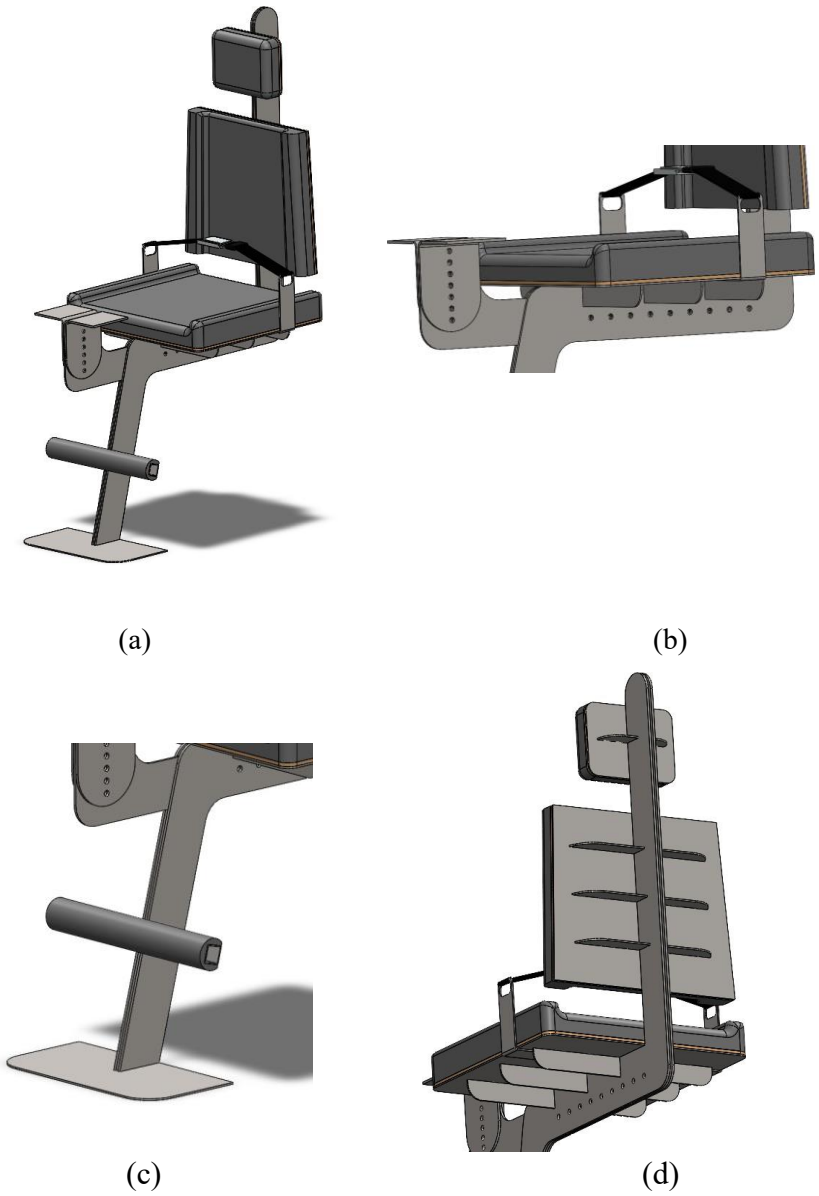
Figure 11 – Ergonomic analysis using CATIA V5 software



Source: Authors

After analyzing several layout proposals, the solution shown in figure 12 was reached.

Figure 12 – Chair structure with the necessary adjustments. (a) final layout, (b) longitudinal and height adjustment, (c) calf and foot support, and (d) structural reinforcement



Source: Authors

Thinking about the pianist's safety, a two-point buckle seat belt was added, as shown in figure 12 (b), the same used in airplanes. It allows easy adjustment and its safety *clip* can only be released if there is complete opening of the buckle mechanism, allowing greater safety for the pianist. Also, aiming at the safety of the pianist, a ring was welded to the structure of the chair from which a steel cable will come out that will be anchored directly to the hook of the lifting machine. If the chair were to detach from the structure, the pianist would be suspended by the cable.

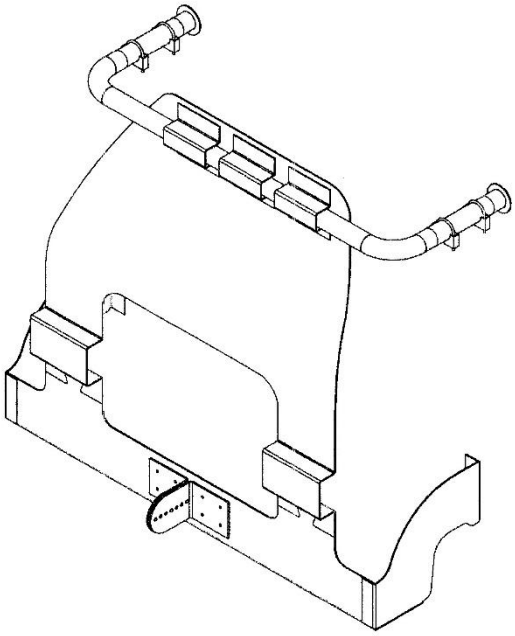
The manufacture of the chair's upholstery was designed to be simple, comfortable and low cost. There will be three layers .. The first layer is the steel sheet, the structural part of the seat, the

second layer is a 6 mm mdf board, on top of which a layer of foam will be glued together with the fabric that will be stapled to the mdf.

ANALYSIS OF THE STRUCTURAL PLATE USING FINITE EELEMENTS

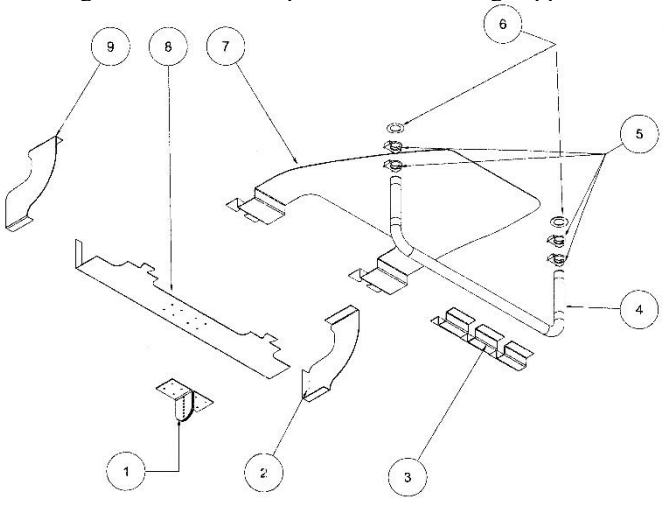
Figures 13 and 14 show details of the structure of the piano support plate analyzed using finite elements.

Figure 13: Structural plate with the lifting support.



Source: Authors.

Figure 14: Structural plate with the lifting support.



Source: Authors

Figure 18 has the following descriptions:

1 – Chair fixing plate on the structural plate. 1020 steel with 3.18 mm thickness.

2 and 9 – Side plates in 1020 steel with 3.18 mm thickness.

3 – Tube fixing plates to the structural plate. 1020 steel with 3.18 mm thickness.

4 – Steel tube with an external diameter of 55 mm and a wall thickness of 3.0 mm.

5 – Clips for positioning the piano's support cable.

6 – 1020 steel washers, with a thickness of 3.18 mm to be welded at the end of the tube.

7 – Structural plate made of 1020 steel with a thickness of 3.18 mm.

8 - Front support plate, made of 1020 steel with a thickness of 3.18 mm.

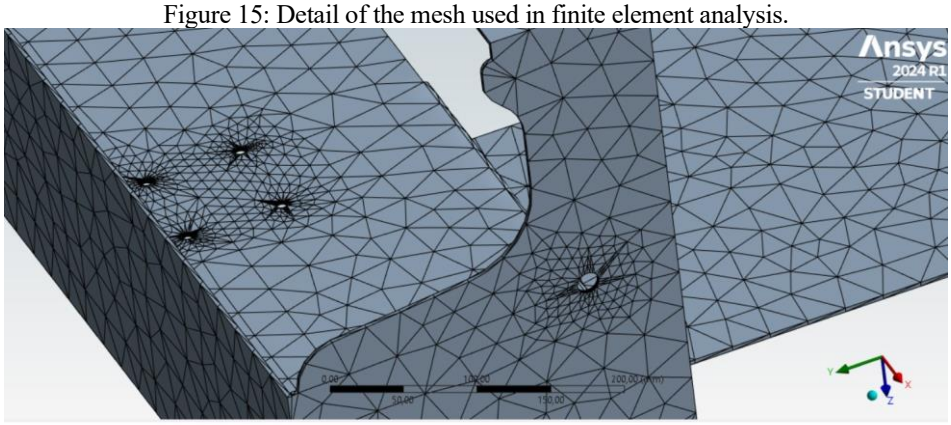
The numerical analysis aimed to validate the project developed in 3D CAD. The analysis was done statically using the Ansys R1 2023 software.

The procedure involved the following steps: elaboration of the mesh, establishment of boundary conditions and, finally, critical analysis of the results found.

ELABORATION OF THE MESH

Figure 15 shows details of the mesh used in finite element analysis. In regions close to the holes, the mesh was refined,

Figure 15: Detail of the mesh used in finite element analysis.

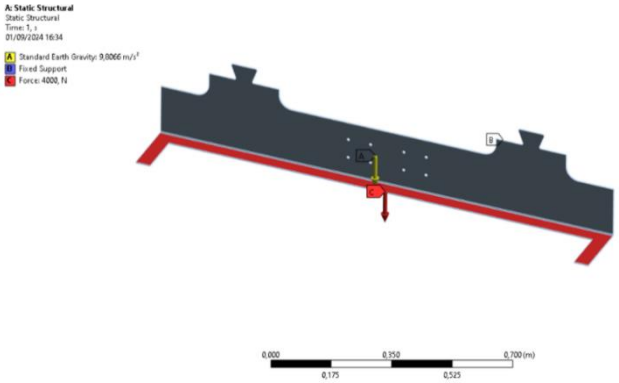


Source: Authors.

BOUNDARY CONDITIONS

The typical condition of use of the structure that will support the piano is in the lifting situation, where the following forces are acted: weight of the piano, weight of the pianist and weight of the structure together with the chair. The total force applied in a distributed way in the model is 4,000 N, with 2,800 N referring to the weight of the piano and 1,200 N referring to the maximum weight of the pianist. The boundary conditions adopted in the structural plate that will support all the elements are shown in figure 16.

Figure 16: Boundary conditions adopted.



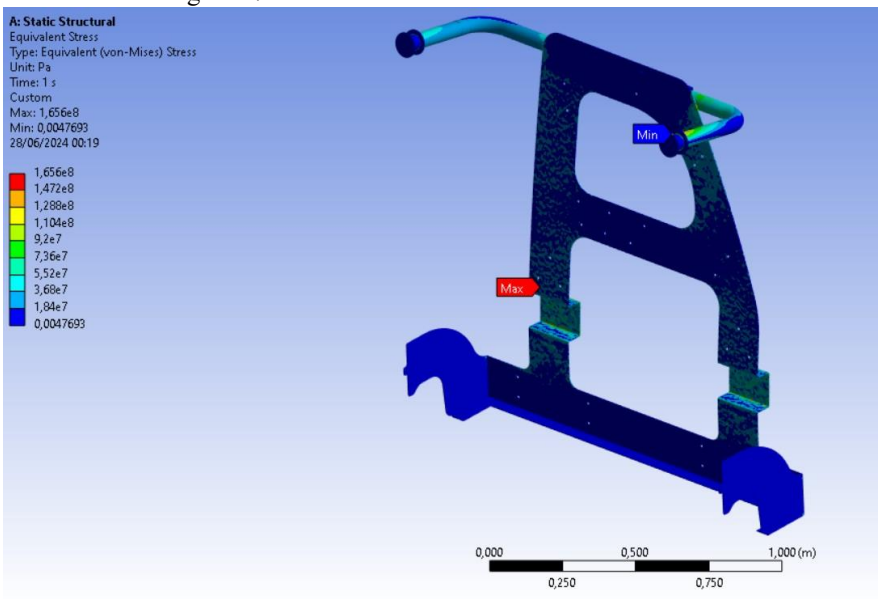
Source: Authors.

RESULTS FOUND IN THE SIMULATION

The material used in the analyses was SAE 1020 HR steel (hot rolled) with tensile strength of 380 MPa and yield strength of 210 MPa (Budynas, 2016). This steel was used because it is the most common and, therefore, is easy to acquire.

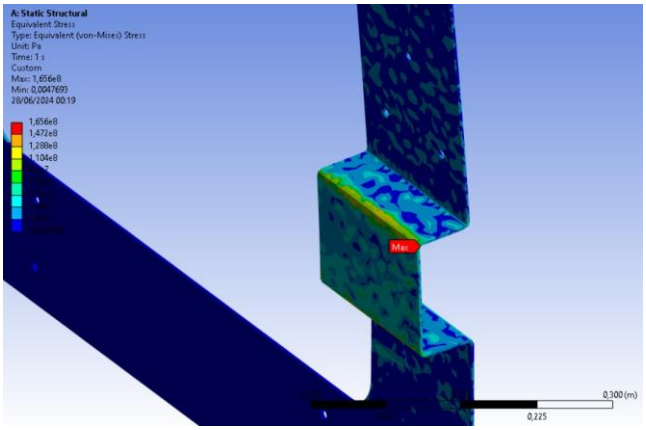
Figure 17 shows the maximum stresses that will act on the structural plate. The maximum value found was 168 MPa in the region shown in figure 18, a value below the yield limit of the material used in the analysis.

Figure 17: Result of the stresses found in the structure



Source: Authors.

Figure 18: Location of the maximum achievable stress in the structure.

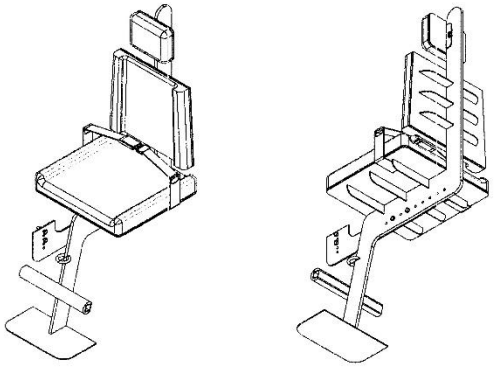


Source: Authors.

ANALYSIS OF CHAIR STRUCTURE USING FINITE ELEMENTS

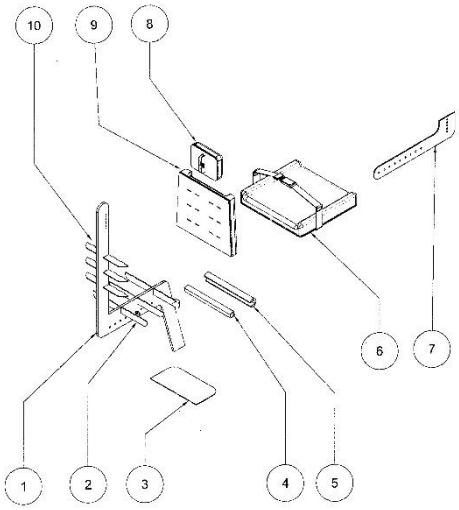
Figures 19 and 20 show details of the structure of the chair analyzed using finite elements.

Figure 19: Chair frame



Source: Authors

Figure 20: Splendid view showing details of the chair elements



Source: Authors

Figure 20 has the following descriptions:

1 – Central structure of the chair in 1020 steel sheet with a thickness of 12.70 mm;

2 and 10 – Reinforcement plates for the backrest and seat of the chair, 1020 steel plate with 3.18 mm thickness.

3 – Footrest plate. 1020 steel sheet with 3.18 mm thickness.

4 and 5 – Calf support structure. Metalon 30x30x2 mm in 1020 steel.

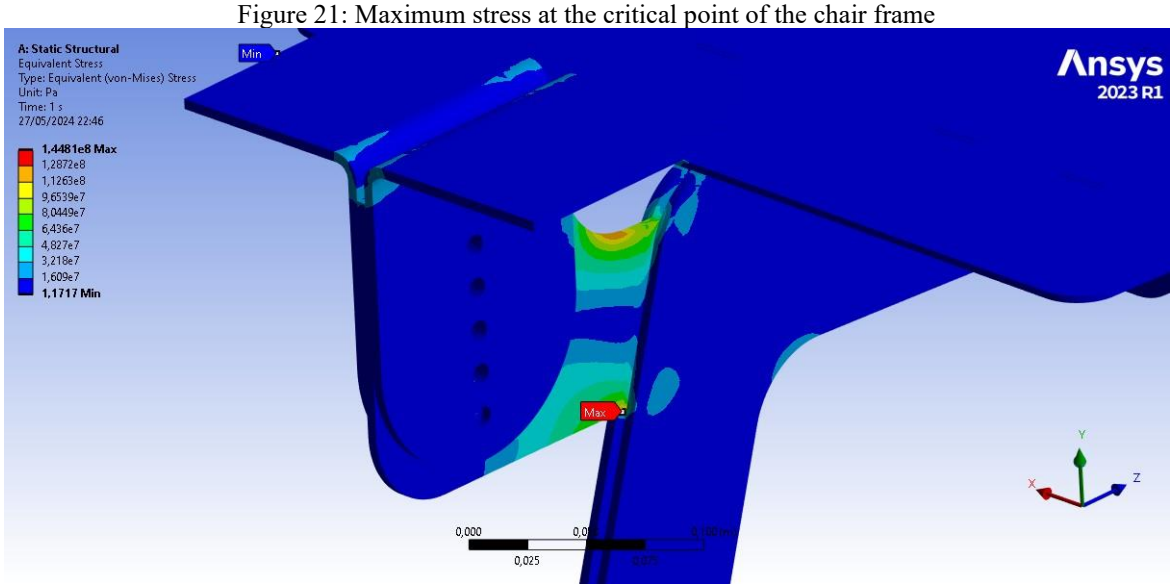
6 – Chair seat made of 1020 steel sheet with 3.18 mm thickness, mdf with 6 mm thickness, covered by a layer of foam and fabric.

7 – Connection plate between the chair and the structural plate. 1020 steel with 4.75 mm thickness.

8 and 9 – Head and back rest, respectively, made of 1020 steel sheet with 3.18 mm thickness, MDF with 6 mm thickness, covered with a layer of foam and fabric.

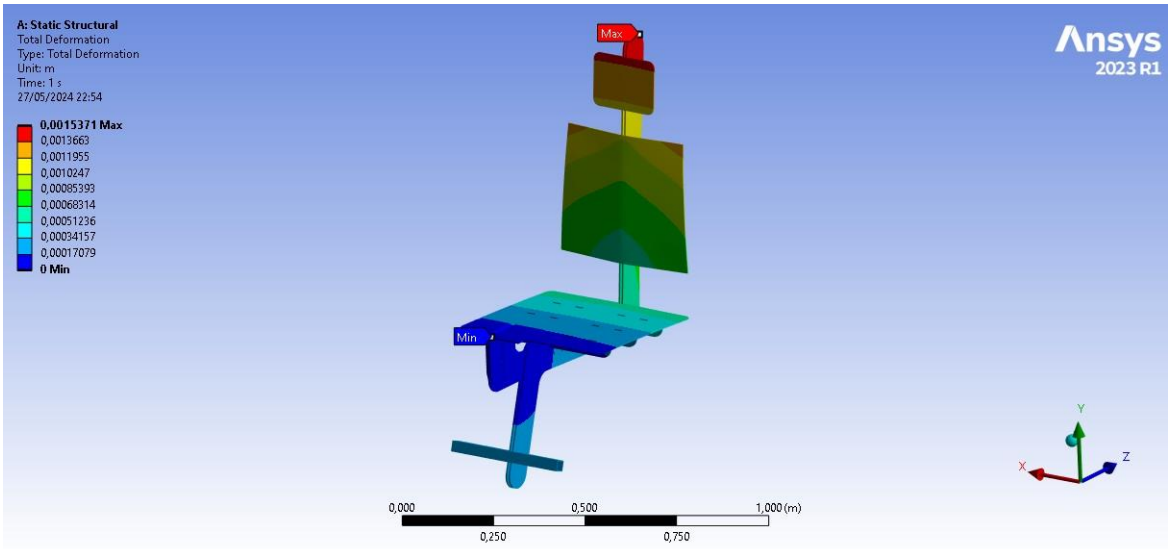
The analysis carried out on the bank's structure took into account the accommodation of a person with a maximum weight of 160 kg. The results referring to the general deformation of the structure and the distribution of stresses are presented in figures 21 and 22, respectively. The results showed, respectively, that the minimum safety factor found was 1.75, the maximum strain was less than 1.0 mm and the stresses found are below the yield stresses of the material used in the analysis. With these results, it can be considered that the dimensions of the chair (sheet thicknesses and geometry) are adequate for the intended use.

Figure 21: Maximum stress at the critical point of the chair frame



Source: Authors

Figure 22: Deformations in the chair structure



Source: Authors

SELECTION OF LIFTING ELEMENTS

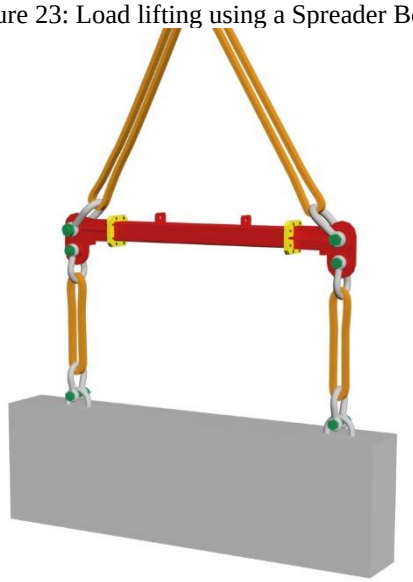
To lift the piano with the pianist, the appropriate elements were selected, which guarantee safety and efficiency throughout the operation. According to the ABNT NBR 15.637-1:2017 (version corrected in 2021) and ABNT NBR ISO 9001:2015 standards, the team must use appropriate equipment for lifting, such as lifting straps and shackles. These materials must have identification labels that contain information about the length, capacity in tons, safety factor, name of the manufacturer, type of material and capacities in different forms of use.

The lifting strap selected was the Sling Type manufactured by BUDIN TOOLS in 100% Polyester, according to the NBR-15637 Standard, having the following characteristics: For the piano and pianist lifting project, the choice of the strap is a crucial factor to ensure safety and efficiency. We chose to use the yellow Sling Type Lifting Strap manufactured by Budim Tools in 100% Polyester, according to the NBR-15637 Standard, having the following properties: the maximum working load is 3 tons, width 90 mm, 3 m long, safety factor 7:1 and weight of 0.655 kg/m. This strap is ideal for replacing steel cables and chains in situations that require greater flexibility, adjustment and care of the transported material.

The Spreader Beam was also selected, which is an essential device for lifting operations that require the uniform distribution of the load weight. It consists of a long bar that keeps two straps separate, distributing the weight over two or more attachment points. This equipment is essential to improve stability, safety and accuracy during the lifting of heavy loads and irregular shapes.

Figure 23 shows a scheme using this type of load lifting.

Figure 23: Load lifting using a Spreader Beam.



Source; Authors.

A two-pronged aviation seat belt with quick release technology was also selected to secure the pianist while hoisting the piano, which offers numerous benefits. These include superior safety, ease of use, comfort, compliance with stringent regulations, versatility and proven reliability. Integrating this belt into the lifting process not only increases the safety of the pianist but also contributes to the efficiency and success of the operation, ensuring a smooth and safe experience for everyone involved.

In addition to the seat belt attached to the chair frame, the pianist will use a climbing chair, anchored directly to the hook of the lifting machine by means of a steel cable, providing an extra layer of safety. The climbing chair, which can be seen in figure 24, is ideal for the safety of the pianist in the event of a failure of the chair structure. Made of high-strength materials such as nylon and polyester, the car seat distributes weight evenly, reducing the risk of discomfort or injury. In addition, it has multiple adjustment points, ensuring a comfortable and secure fit for different body sizes and shapes, even over long periods of use.

Figure 24: Chair used in climbing

Source: Alpimonte Escalada, 2024

CONCLUSIONS

The proposed project presented challenges in both the arts and engineering domains. From the perspective of the teams involved in the process, overcoming the various obstacles that arose during the development of the device brought an immense range of knowledge and engineering techniques, which enriched the training of the students involved.

The first challenge to be overcome was to develop a structure that would be able to surround and support the piano, whose unique geometry presented particularities to be overcome. Another issue to be overcome was the attachment of this structure to the piano, so that the instrument itself would not be altered or modified, ensuring safety and harmonization during performances. Several design alternatives were analyzed and one of them was selected using the decision matrix technique. Subsequently, using the finite element method, the structural plate was designed in order to ensure the safety of the system and at the same time, minimizing its weight. The results found allow us to affirm that the structural plate will safely withstand the forces present during the elevation of the device together with the piano and the pianist. The final weight of the structural plate was estimated at 60 kg.

Another key point for the project was the choice of the bench, which in addition to supporting the pianist, must have the ergonomic and dimensional characteristics necessary to allow an adequate performance. To ensure this functionality, simulations of seat ergonomics were performed using the CATIA V5 software for different profiles of pianists.

The chair's structure was also designed using finite elements. In the same way as the structural plate, the chair structure was designed to ensure the safety of the system while minimizing its weight. The results found allow us to affirm that the chair will safely support the efforts present during the elevation of the device together with the piano and the pianist. The final weight of the chair was estimated at 40 kg.

Next, the safety and manufacturing requirements of the device were analyzed. Thus, the various safety systems to be used were detailed, such as the seat belt and the climber's chair anchored, by means of a steel cable, directly to the winch that will lift the piano together with the pianist. If the chair happens to detach from the structural plate, this system will allow the pianist to be suspended by the hook anchored to the lifting machine.

At the end, the manufacturing drawings were prepared, which were made available to the Casa do Piano. The prototype of the device is in the process of being manufactured and it is planned to be tested at the University of Brasilia in October and November 2024 to be put into the field by the end of 2024.

The device is part of an artistic and innovative project, which invites the public to rethink the limits of artistic performances. Also in the context of the university-society interest, the importance of innovation and creativity is noted, which, combined with the scientific method and the engineering process, enable the creation of unique and challenging products.

Figure 25 shows several views of the projected device (structural plate and chair) integrated into the piano.

Figure 25: Views of the projected device integrated into the piano.

Source: Authors.

REFERENCES

1. ABNT NBR 15637-1-2017 (versão corrigida em 15/03/2021). Cintas têxteis para elevação de cargas - Parte 1: Cintas planas manufaturadas, com fitas tecidas com fios sintéticos de alta tenacidade formados por multifilamentos.

2. Alpimonte. (2024). Cadeira basic club confort escalada rapel e aventura Alpimonte. Disponível em: https://www.alpimonte.net/cadeirinhas/rapel-e-escalada/6009b375badfb

3. Budynas, R. G., & Nisbett, J. K. (2016). *Elementos de máquinas de Shigley* (10ª ed.). Porto Alegre: AMGH Editora Ltda.

4. Crombie's, D. (2024). Word Piano News, Piano Vertical: Uma performance como nenhuma outra! Disponível em: https://www.worldpianonews.com/event/piano-vertical

5. Fortepiano. (2024). In *Wikipedia: A enciclopédia livre*. Disponível em: https://pt.wikipedia.org/wiki/Fortepiano

6. G1 DF e TV Globo. (2023). Um piano de 400 kg, puxado por uma bicicleta, leva música às ruas de Brasília [vídeo]. Disponível em: https://g1.globo.com/df/distrito-federal/noticia/2023/09/24/video-um-piano-de-400-kg-puxado-por-uma-bicicleta-leva-musica-as-ruas-de-brasilia.ghtml

7. Salão Musical de Lisboa. (2024). História do piano: A evolução do piano. Disponível em: https://www.salaomusical.com/pt/content/17-historia-do-piano

8. Tienes Piano Ltda. (2011). Piano de cauda: Tamanhos e medidas. Disponível em: https://tienespianos.blogspot.com/2011/08/piano-de-cauda-tamanhos-e-medidas.html

Influence of quality of life on work productivity: A narrative literature review

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ABSTRACT

Quality of life is a relevant topic in the business context, highlighting the active role of organizations in implementing this concept, following victories achieved through labor movements. Elements such as emotional well-being, work-life balance, motivation, and continuous development of employees are identified as fundamental to creating an environment conducive to increasing work productivity. Investing in quality of life not only benefits individuals but also generates positive impacts on organizational dynamics, fostering excellence and the achievement of goals. The objective of this study is to examine a possible correlation between quality of life at work and productivity. For this purpose, a narrative literature review is conducted to investigate how studies address this correlation in the literature, as well as how quality of life at work affects organizational outcomes. The selected databases were ProQuest, SciELO, and Scopus. The results show that the influence of quality of life on work productivity highlights the relationship between workers' well-being and performance, emphasizing the importance of organizational policies for overall success. It is concluded that a work environment becomes healthy and balanced through social support and opportunities for personal development, boosting employee efficiency. Investing in well-being reduces absenteeism, increases talent retention, and enhances corporate image. Caring for employees not only benefits them individually but also promotes long-term organizational success, becoming an essential competitive.

Keywords: Environment of work, Job satisfaction, Organizational performance, Productivity at work, Quality of life at work.

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INTRODUCTION

In agreement with Ceballos and Santos (2013), the concept of well-being has expanded into various areas of society, including the workplace, where the relationship between the individual and their work environment is being examined. Well-being in the workplace is described as a positive subjective experience. This occurs when positive feelings during work outweigh the negative ones, while also providing opportunities for the development of individual skills and achieving personal fulfillment (Warr 2007).

Job satisfaction is a multifaceted phenomenon that reflects the emotional state of professionals in relation to their work activities (Vieira; Silva; Teixeira, 2020; Simões; Teixeira; Gouveia, 2021). Influenced by factors such as personal expectations, working conditions, and alignment with individual values, job satisfaction plays a crucial role in employee productivity and overall well-being (Subgashini *et al*., 2014; Teixeira; Silva; Brito, 2021; Spector, 2022). Research indicates that meeting employees' needs and understanding the determinants of this satisfaction are essential for organizational growth and talent retention (He *et al*., 2018; Afzai; Abid, 2021; Rus *et al*., 2023).

According to Maringoni (2013), historically, at the end of the Empire in 1889, Brazil had a large number of workers and newly freed slaves who were employed in small workshops and a few large factories. However, the employers saw no reason to offer decent wages or grant significant rights to the workers.

At that time, according to Maringoni (2013), there were reports of some labor demands aimed at improving working conditions, which directly impacted the quality of life of workers. The predominant demands included wage increases, the reduction of working hours (which often ranged from 12 to 16 hours per day), the fight against the exploitation of minors and women, and the pursuit of improvements in overall working conditions, among other demands.

It is a fact that significant changes have occurred in the business environment, affecting labor relations and continuing to impact people's lives to this day, such as productive organization, national cultures, and the global economy. Limongi-França (2004) asserts that there are two sides to this current scenario: on one side, the intensification of competition and competitiveness at any cost; on the other, the growing awareness of workers, consumers, and citizens regarding stress and the increasing importance of quality of life at work, as well as new labor market conditions and, above all, environmental and social responsibility issues, which pose immense challenges to organizational management.

Dessen and Paz (2010) argue that work plays a crucial role in people's lives, being vital for their survival and adaptation to the world. After all, a significant portion of life is spent in the workplace. For this reason, it is essential that individuals feel well in this context to ensure healthy

and productive functioning. Based on this premise, quality of life (QoL) is recognized as a relevant topic for companies.

According to Dal Forno and Finger (2015), organizations have actively participated in the discussion and implementation of this concept, seeking to plan, implement, and evaluate production options that promote greater satisfaction, well-being, and health for their employees.

The relationship between quality of life and work productivity has gained prominence in contemporary discussions on business management. Various authors, such as Walton (1973), Westley (1979), Werther and Davis (1983), Hackman and Oldham (1975), Lippitt (1978), Nadler and Lawler (1983), and Huse and Cummings (1985), have studied the importance of promoting work environments that foster employee well-being as a key factor in increasing efficiency and professional satisfaction.

Frederick Herzberg (1968) investigated factors that generate satisfaction and dissatisfaction at work, creating the Two-Factor Theory. In his findings, Herzberg identified that factors associated with the job itself or the nature of the tasks performed by an individual are considered motivational factors, as they are influenced by the environment in which the individual is immersed and relate to the conditions under which they perform their work. These factors primarily serve to prevent dissatisfaction and are classified as maintenance or hygiene factors.

Herzberg (1968) emphasizes that motivational factors, such as recognition and personal achievement, play a crucial role in job satisfaction. The presence of quality of life at work, in an environment where these factors are nurtured, becomes a catalyst for professional success. He concludes that professional success is a determining factor for having quality of life at work.

The pursuit of quality of life at work is not just a matter of acceptance but an essential strategy for optimizing productivity and promoting a sustainable work environment (Teixeira; Teixeira, 2023). In this context, this study addresses the guiding question: How can quality of life contribute to work productivity? It is based on the hypothesis that providing employees with a healthy, balanced, and stimulating work environment can directly enhance various aspects that drive work productivity.

Certain elements are fundamental for creating an environment conducive to increasing work productivity, such as emotional well-being, work-life balance, motivation, and the continuous development of employees. Investing in quality of life not only benefits the individual by promoting satisfaction and fulfillment but also generates positive impacts on organizational dynamics, fostering an environment conducive to excellence and goal achievement.

The objective of this study is to review the literature to understand what studies indicate about the correlation between quality of life at work and productivity, and to explore how these

topics are interconnected, how this correlation is outlined, and how quality of life at work impacts organizational outcomes. To achieve this, a narrative literature review will be conducted.

QUALITY OF LIFE AT WORK

According to Garcia (2010), the origin of Quality of Life at Work (QWL) emerged in the private business context, which has historically and progressively become more competitive. Thus, this topic has frequently been used to enhance employee satisfaction, aiming to increase their commitment to organizational processes and objectives.

Initially, quality of life is associated with better facilities, physical conditions, salary claims, workload reduction, benefits, among other factors. This implies additional costs, increased expenses, and changes. Thus, obstacles arise for the implementation of QWL programs due to budget management issues, as highlighted by Bohlander (1979). The importance of continuing research in this area is evident when Fernandes (1996) notes that QWL can be seen as a flexible and adaptive management of the physical, sociological, psychological, and technological elements that permeate the work structure within the organization. These elements influence culture and impact the work environment, directly affecting employee productivity and satisfaction.

Authors such as Walton (1973), Westley (1979), Werther and Davis (1983), Hackman and Oldham (1975), Lippitt (1978), Nadler and Lawler (1983), and Huse and Cummings (1985) are considered pioneers in the scientific approach to QWL. Although their propositions have been subject to criticism in subsequent years, they are widely recognized as fundamental references in QWL. Their theories, regarded as both classic and modern and comprehensive, are frequently cited in the literature, and their models are applied in research on the topic (Ferreira; Alves; Tostes, 2009; Garcia, 2010; Limongi-França, 2008; Stefano *et al*., 2006; Veloso; Schirrmeister; Limongi-França, 2007).

The concept of QWL began in the 1950s in England, when Eric Trist and his team from the Tavistock Institute conducted studies on the relationships within the individual-work-organization triad. They developed a socio-technical approach to work organization with the aim of improving workers' quality of life through task restructuring (Fernandes, 1996; Rodrigues, 1999 apud Dal Forno *et al*., 2015).

However, it was only in the 1960s that the concept gained attention, driven by the development of studies on the most effective practices for task execution, with a focus on health and overall well-being of workers (Angrad, 2012). Scientific studies highlighted factors influencing productivity increases, emphasizing indicators related to personal needs and aspirations. This shift in focus occurred in response to the challenge of seeking productivity and strong economic-

financial performance of companies, driven by international competitiveness (Monteiro *et al*., 2011).

In Walton's (1973) studies, an increased interest in reconfiguring the nature of work through QWL was observed, driven by two main concerns. The first was the lack of attention to humanistic values and environmental issues in the face of advancing technology, industrial productivity, and economic growth. The second concern was the feasibility of increasing competition among companies in the global market.

Hackman and Oldham (1975) share these concerns, which are further intensified by the authors' perception of the relative effectiveness of strategies for implementing job redesign projects. In response, they propose that this redesign be conducted using a diagnostic tool called the "job diagnostic survey." In other words, the authors argue that by conducting a diagnosis of work conditions, it is possible to identify strengths and weaknesses to be addressed, aiming to achieve a higher balance between the individual and their work.

Lippitt (1978) argues that the conception of QWL needs to transcend a purely technical focus. He advocates for an ideological and political shift within the organizational environment. However, the key elements highlighted by this author, which include aspects such as the work itself, the individual, labor production, and organizational structure, appear to focus more on instrumental dimensions rather than on effective political and ideological transformations related to the treatment and recognition of people within the organization.

Westley (1979) outlined four challenges arising from the nature of work in industrial society organizations, which workers face and which affect both performance and the humanization of these individuals: insecurity, injustice, alienation, and anomie. Therefore, QWL models that propose ways to mitigate these four dimensions would likely result in increased employee satisfaction.

On the other hand, Nadler and Lawler (1983, cited in Bowditch & Buono, 1992; Garcia, 2010) describe the revival of interest in Quality of Work Life (QWL) in the United States up until the mid-1970s as the first cycle. During this period, other concerns, such as inflation control and energy costs, diverted researchers' attention, resulting in a decrease in interest in the topic. According to these authors, the resurgence, or the second cycle of interest in QWL, began in 1979, driven by the conviction that improving productivity was necessary in light of intensified international competition, highlighted by new managerial models such as the Japanese model.

In the early 1980s, Quality of Work Life (QWL) regained its prominence as a topic of interest and concern in the national landscape of the United States (Bowditch & Buono, 1992). During this period, various lines of research emerged with the purpose of elucidating its meaning and exploring the ways it could be applied for the benefit of organizations (Garcia, 2010).

PRODUCTIVITY AND WELL-BEING AT WORK

Fleury (1980) notes that there are three basic theoretical approaches concerning the organization of industrial work: task rationalization, job enrichment, and semi-autonomous groups. Each approach has a distinct proposal, but all are based on the assumption of increasing productivity.

According to Fleury (1980), the first approach pertains to Scientific Management as proposed by Frederick W. Taylor. It focuses on finding the optimal way to perform a task, separating the planning from the execution of the task, selecting the best worker for the task, the employees' desire to maximize their monetary gains, and the need to avoid work groups.

The second approach deals with Job Enrichment, as described by Fleury (1980), which is divided into several techniques: job rotation, involving the rotation of employees within the work system; horizontal and vertical enlargement, referring to grouping tasks of the same and different natures into a single job, respectively; and job enrichment, which incorporates both enlargements into a single job. In summary, this approach aims to expand the job responsibilities by diversifying the tasks performed and gradually delegating part of the responsibilities.

The third and final approach, according to Fleury (1980), involves semi-autonomous groups, a concept that emerged from experiments with various work methods. A semi-autonomous group consists of employees who collaboratively perform assigned tasks without predefined roles for its members. In essence, the group is given a task with broad guidelines, provided with the necessary resources, and granted autonomy to structure the task throughout the development process.

Quality of life has a significant impact on worker productivity (Pacoal & Silva, 2019). When employees are able to balance work and personal life and have access to essential resources, their overall well-being improves, positively reflecting on productivity (Vieira *et al*., 2018). Employers can contribute to this quality of life by providing access to healthcare, childcare support, and career development opportunities, which enhances employees' quality of life, resulting in increased productivity and job satisfaction. By focusing on employees' quality of life, companies can foster a more engaged and motivated workforce, leading to better business outcomes.

Research indicates that employees who receive support to maintain a healthy work-life balance tend to experience higher job satisfaction and greater commitment to their roles. Offering flexible hours and remote work options can help employees manage family responsibilities alongside their professional obligations. Additionally, providing wellness programs and fostering a positive work environment can reduce stress and enhance overall well-being. A 2023 report by the International Labour Organization revealed that increased work flexibility—such as varied start times, shift sharing, and remote work options—leads to higher productivity and better work-life balance (Moss, 2023).

In addition to these initiatives, employers might consider offering comprehensive health benefits, on-site childcare, and professional development opportunities. These measures not only enhance employees' quality of life but also directly impact their productivity and performance. As organizations recognize the link between quality of life and productivity, investing in employee well-being strategies will become increasingly crucial for maintaining a competitive edge in the market. According to Mendoza-Ocasal *et al*. (2022), the relationship between Quality of Work Life and well-being helps organizations design strategies for success.

According to Mendoza-Ocasal *et al*. (2022), Quality of Work Life and happiness in the workplace are crucial aspects for a company and providing optimal conditions to improve these factors has been a challenge. Several strategies are being employed to promote these aspects, such as flexible working hours, incentives and benefits, and health promotion. These incentives contribute to creating a balance between employees' personal and professional lives (Salas-Vallina & Alegre, 2021).

Mendoza-Ocasal *et al*. (2022) mention that the department responsible for managing and retaining talent is Human Resources, which has become a strategic partner for organizations in promoting quality of life by developing policies related to employee happiness and well-being.

Deloitte (2022) argues that a strategic trend in companies is to focus on strengthening each employee's talents through effective market positioning, influenced by the team's sense of belonging to the company. This approach enables organizations to achieve greater commitment from employees and better attainment of objectives.

There is a certification called Great Place to Work, which can be obtained through consultancy services that support organizations in achieving better results by fostering a culture of trust, high performance, and innovation (Great place to work, 2024). Mendoza-Ocasal *et al*. (2022) note that companies with higher scores in the ranking are considered the best places to work, which helps build a favorable image for organizations and attracts qualified talent.

According to Seligman (2011) as cited in Mendoza-Ocasal (2022), workplace happiness is promoted by five key elements. These include positive emotions, which enhance overall perceptions of life and work; positive relationships, which are crucial for our social nature and emphasize the importance of cultivating effective interpersonal connections for optimal team performance through clear communication. Additionally, commitment to tackling company challenges and fostering employee loyalty, a focus on achievement orientation, which is crucial for self-motivation and work productivity, and a sense of purpose or meaning directed towards personal and organizational goals, are essential for achieving success (Mendoza-Ocasal *et al*., 2022).

METHODOLOGY

Rother (2007) states that review articles, along with other types of scientific articles, represent a form of research that relies on bibliographic or electronic sources to gather the results of previous studies conducted by other researchers, with the aim of providing a theoretical foundation for a specific objective.

There are three types of literature reviews: systematic reviews, integrative reviews, and narrative reviews. The latter will be used in this article, as it is suitable for providing the theoretical foundation for scientific works such as articles, theses, dissertations, and capstone projects, as described by Cavalcante and Oliveira (2016).

According to Ribeiro (2014), narrative reviews are categorized as a form of literary analysis that aims to provide comprehensive and narrative syntheses of previously published information. This research method serves as an educational tool, being highly beneficial due to its organization and systematization of information. It is widely used in the discussion and description of various topics across multiple fields of knowledge.

The Narrative Review distinguishes itself from the other two types of reviews by focusing solely on mapping the knowledge generated in a specific area, without adhering to systematic criteria for searching, selecting articles, and extracting information (Cordeiro *et al*., 2007; Rother, 2007; Soares *et al.*, 2013).

This type of review generally explores topics in a broader manner, lacking specificity. These analyses are primarily based on the author's interpretation and include journals, books, and articles. Consequently, it is a subjective method, susceptible to variations depending on the researcher's experience and perspective. Sanches *et al.* (2021) notes that current narrative literature reviews play a crucial role in ongoing education by allowing readers to quickly acquire and/or update their knowledge. For the selection of studies, the search focused on: quality of work life and productivity. The selected databases were ProQuest, SciELO, and Scopus, with a priority given to the investigation and analysis of peer-reviewed scientific articles in Portuguese.

RESULTS AND DISCUSSION

Table 1 provides an overview of the studies researched for this work and reflects on the influence of quality of life on work productivity.

Author/year	Journal	Title	Main findings
Salgado (2015)	Revista do Serviço Público	Quality of Work Life: Evolution and Analysis at the Managerial Level	The evolution of the concept of "quality of work life" and its various connotations over time, influenced by changes in work relationships and the continuous socioeconomic transformations since the Industrial Revolution.
Carneiro e Bastos (2020)	Arquivos Brasileiros de Psicologia	Work-Related Well-Being: Analysis of Concepts and Measures	The aim of this article was to analyze both conceptually and practically how work-related well-being is being addressed in Brazil.
Dal Forno e Finger (2015)	Revista Brasileira de Qualidade de Vida	Quality of Work Life: Concept, History, and Relevance for People Management	The evolution of the concept of Quality of Work Life (QWL) and its relevance for contemporary organizations.
Dessen e Da Paz (2010)	Psicologia: Teoria e Pesquisa	Personal Well-Being in Organizations: The Impact of Power Configurations and Personality Traits	The aim of this study was to investigate the growing interest in fulfilling individuals' needs and desires while performing their roles within the organization. The literature indicates that both organizational and individual characteristics influence occupational well-being.
Fernandes e Gutierrez (1988)	Revista de Administração	Quality of Work Life (QWL) – A Brazilian Experience	Innovative experiences in various developed countries, aimed at improving organizational health through new ways of organizing work, are widely discussed under the term "Quality of Work Life (QWL)." In Brazil, the topic has garnered interest among entrepreneurs and managers due to its contribution to increasing employee satisfaction and business productivity.
Ferreira, Alves e Tostes (2009)	Psicologia: Teoria e Pesquisa	Management of Quality of Work Life (QWL) in the Federal Public Service: The Discrepancy Between Issues and Managerial Practices	The central aim of the article was to understand the Quality of Work Life (QWL) practices in federal public agencies.
Fleury (1980)	Revista de Administração de Empresas	Productivity and Work Organization in Industry	Research was conducted on the characteristics of work organization processes in industrial production systems, with a focus on the organizational aspects

			directly related to productivity.
Herzberg (2003)	Harvard Business Review	One More Time: How Do You Motivate Employees?	The author discovered that the factors motivating employees differ from those causing dissatisfaction. True motivation comes from intrinsic factors, such as interesting work and challenges. These findings have influenced managers.
Mendoza-Ocasal *et al*. (2022)	Polish Journal Of Management Studies	Subjective well-being and its correlation with happiness at work and quality of work life: An organizational vision	Economic crises and changes faced by organizations impact people's lives. Understanding the relationship between quality of life at work and happiness is essential for companies, as this relationship will help organizations develop strategies that enable them to succeed.
Monteiro (2011)	Revista de Administração da UEG	The Impact of Quality of Life at Work (QWL) on the Revenue of Metallurgical Industries in the State of Pará	This article presented the results of a management research that examines the impact of Quality of Life at Work on the revenue of metallurgical companies in the State of Pará.
Pilatti (2012)	Revista Brasileira de Qualidade de Vida	Quality of Life at Work and Herzberg's Two-Factor Theory: The Limits and Possibilities for Organizations	This study evaluated the possibilities for organizations to promote quality of life at work for their employees, using Frederick Herzberg's Two-Factor Theory as the analytical model.
Silva *et al*. (2021)	Gestão e Desenvolvimento	Managing the Change Process in Healthcare Organizations: A Narrative Review of the Literature	Healthcare organizations are complex, dynamic, and constantly changing environments. With rapid technological advancements and the process of globalization, it is crucial for them to adopt change management strategies to stay current and address daily needs.
Santos e Ceballos (2013)	Psicologia em Estudo	Well-Being at Work: A Review Study	The emphasis on well-being at work reflects changes in human resources and organizations, which now recognize the health risks associated with neglecting this aspect. The goal is to transform the workplace into a space for human development, moving beyond a limited perspective and promoting positive impacts on both individual and collective well-being.

Stefano (2006)	Revistas Gerenciais	Job Quality of Life Satisfaction in Relation to Biopsychosocial and Organizational Factors: A Comparative Study Between Public and Private University Faculty	The aim of this article was to explore in greater detail the level of satisfaction among university faculty in the public sector with job quality of life (QWL), compared to those in the private sector.
Veloso; Schirrmeister; Limongi-França (2007)	Revista Administração e Diálogo	The Influence of Quality of Life at Work in Professional Transition Situations: A Case Study on Voluntary Resignation.	The aim of this study was to investigate the relationships between voluntary resignation and the perception of quality of life at work, as well as to analyze the influence of QWL during professional transitions.

It is evident that the benefits of quality of life at work on labor productivity are numerous and significant. When workers enjoy a good quality of life at work, it translates into various positive aspects for the organization, such as greater engagement with company tasks, lower absenteeism rates, increased talent retention, improved organizational climate, enhanced creativity and innovation, and an improved company image among employees.

In general, it is observed that the influence of quality of life on labor productivity addresses the relationship between workers' well-being and their job performance. It examines how factors such as a healthy work environment, work-life balance, social support, and personal development directly impact productivity. Furthermore, it highlights the importance of organizational policies and practices aimed at improving employees' quality of life, focusing not only on individual well-being but also on the overall success of the company.

CONCLUSION

The relationship between quality of life and labor productivity is a topic of growing importance in the contemporary world. Studies have shown that workers who enjoy a healthy work environment, work-life balance, social support, and opportunities for personal development tend to be more productive. This is because a satisfied and well-cared-for employee has greater motivation, energy, and focus to carry out tasks efficiently.

Additionally, companies that invest in promoting their employees' quality of life typically experience reduced absenteeism, increased talent retention, and improved corporate image—factors that significantly contribute to long-term organizational success. Thus, the pursuit of strategies that promote employee well-being becomes not only an ethical issue but also an essential competitive advantage for companies.

Employee well-being is an essential component in promoting productivity within organizations. When employees feel valued, respected, and supported in their work environment, they are more likely to dedicate themselves with greater enthusiasm and commitment to their tasks. Furthermore, a state of physical and mental well-being directly contributes to workers' concentration, creativity, and decision-making abilities—crucial elements for efficiency and effectiveness in performing their duties.

On the other hand, professional environments characterized by high levels of stress, lack of recognition and support, and poor work-life balance tend to generate dissatisfaction and demotivation, negatively impacting productivity. Therefore, investing in employee well-being is not just a humanitarian issue but also a smart strategy to boost organizational performance and results.

It was highlighted that academic literature shows a deficiency in providing research that evidences the continuous implementation of measures to improve productivity through quality of life at work. Due to market changes caused by technological advancements that impact the professional environment, it is necessary for employers to continuously contribute to maintaining a healthy work environment, promoting work-life balance, recognizing and rewarding employees, maintaining clear and objective communication, and fostering professional development.

The relationship between quality of life and labor productivity is a relevant topic in the current context. Studies have shown that workers who enjoy a healthy work environment, work-life balance, social support, and opportunities for personal development tend to be more productive. This is because a satisfied and well-cared-for employee exhibits greater motivation, energy, and focus to perform tasks efficiently and effectively. Furthermore, companies that invest in promoting their employees' quality of life typically experience reduced absenteeism, increased talent retention, and improved corporate image—factors that significantly contribute to long-term organizational success. Therefore, future studies should systematically seek strategies that promote employee well-being, which is essential both from an ethical standpoint and as a competitive advantage for companies, especially in the educational context.

REFERENCES

1. Afzal, H., & Abid, S. (2021). Factors affecting job satisfaction of employees: The case of a public sector university, Islamabad. *South Asian Journal of Education and Social Studies, 4*(2), 288-294.

2. Salgado, V. A. B. (2015). Qualidade de vida no trabalho: Evolução e análise no nível gerencial. *Revista do Serviço Público, 45*(2), 251-252. https://doi.org/10.21874/rsp.v45i2.817. Retrieved from https://revista.enap.gov.br/index.php/RSP/article/view/817

3. Associação Nacional dos Cursos de Graduação em Administração. (2012). Qualidade de vida no trabalho e qualidade de vida: Uma proposta integradora. Retrieved from http://www.angrad.org.br/_resources/files/_modules/producao/producao_502_20121205183422 8e9c.pdf

4. Bowditch, J. L., & Buono, A. F. (2016). *Elementos de comportamento organizacional*. Cengage.

5. Carneiro, L. L., & Bastos, A. V. B. (2020). Bem-estar relacionado ao trabalho: Análise de conceitos e medidas. *Arquivos Brasileiros de Psicologia, 72*(2), 121-140. Retrieved from http://pepsic.bvsalud.org/pdf/arbp/v72n2/09.pdf

6. Cavalcante, L. T. C., & de Oliveira, A. A. S. (2016). Métodos de revisão bibliográfica nos estudos científicos. *Psicologia em Revista*.

7. Cordeiro, A. M., Oliveira, G. M., & Rentería, J. M. (2007). Revisão sistemática: Uma revisão narrativa. *Revista do Colégio Brasileiro de Cirurgiões, 34*(6), 428-431. https://doi.org/10.1590/S0100-69912007000600003. Retrieved from: https://www.scielo.br/j/rcbc/a/CC6NRNtP3dKLgLPwcgmV6Gf/abstract/?lang=pt

8. Dal Forno, C., & Finger, I. da R. (2015). Qualidade de vida no trabalho: Conceito, histórico e relevância para a gestão de pessoas. *Revista Brasileira de Qualidade de Vida, 7*(2), 103-112. https://doi.org/10.21874/rbqv.v7n2a3015. Retrieved from: https://revistas.utfpr.edu.br/rbqv/article/viewFile/3015/2089

9. Dantas, H. L. de L., Costa, C. R. B., Costa, L. de M. C., Lúcio, I. M. L., & Comassetto, I. (2022). Como elaborar uma revisão integrativa: Sistematização do método científico. *Revista Recien - Revista Científica de Enfermagem, 12*(37), 334-345.

10. Dessen, M. C., & Paz, M. das G. T. da. (2010). Bem-Estar pessoal nas organizações: O impacto de configurações de poder e características de personalidade. *Psicologia: Teoria e Pesquisa, 26*(3), 549-556. https://doi.org/10.1590/S0102-37722010000300014. Retrieved from: https://www.scielo.br/j/ptp/a/dYRfjX8jmm4LSBnb6cT64Lc/?format=pdf&lang=pt

11. Equipe Editorial. (2020). Editorial. *Interações, 21*(4), 681-684. https://doi.org/10.20435/inter.v21i4.3203. Retrieved from: https://interacoesucdb.emnuvens.com.br/interacoes/article/view/3203

12. Fernandes, E. (1996). *Qualidade de vida no trabalho: Como medir para melhorar* (5th ed.). Casa da Qualidade.

13. Fernandes, E. C., & Gutierrez, L. H. (1988). Qualidade de vida no trabalho (QVT) — Uma experiência brasileira. *Revista de Administração, 23*(4), 29-38. https://doi.org/10.1590/S0034-

75901988000400003. Retrieved from: https://www.revistas.usp.br/rausp/article/view/179990/166564

14. Ferreira, M. C., Alves, L., & Tostes, N. (2009). Gestão de qualidade de vida no trabalho (QVT) no serviço público federal: O descompasso entre problemas e práticas gerenciais. *Psicologia: Teoria e Pesquisa, 25*(3), 319-327. https://doi.org/10.1590/S0102-37722009000300011. Retrieved from: https://www.scielo.br/j/ptp/a/m8Wc9XQSSBkSQSjG3vJ8CgB/abstract/?lang=pt

15. Fleury, A. C. C. (1980). Produtividade e organização do trabalho na indústria. *Revista de Administração de Empresas, 20*(3), 19-28. https://doi.org/10.1590/S0034-75901980000300002. Retrieved from: https://www.scielo.br/j/rae/a/GmMHzcQ5dGcwMhvWhS7d6Vn/?lang=pt&format=pdf

16. Flor, T. D. O., et al. (2021). Revisões de literatura como métodos de pesquisa: Aproximações e divergências. In *Anais do VI CONAPESC* (pp. 1-10). Realize Editora. Retrieved from: https://editorarealize.com.br/artigo/visualizar/76913

17. Garcia, E. O. P. (2010). O conteúdo significativo da qualidade de vida no trabalho para funcionários públicos de uma secretaria de saúde. *Revista Eletrônica Gestão e Serviços, 1*(1), 76-94. Retrieved from: https://www.researchgate.net/publication/276249943_O_Conteudo_Significativo_da_Qualidade_de_Vida_no_Trabalho_para_Funcionarios_Publicos_de_uma_Secretaria_de_Saude

18. Great Place to Work. (2024). Retrieved from https://gptw.com.br/

19. Hee, O. C., et al. (2018). Factors influencing employee job satisfaction: A conceptual analysis. *International Journal of Academic Research in Business and Social Sciences, 8*(6), 331-340.

20. Herzberg, F. I. (1968). One more time: How do you motivate employees? *Harvard Business Review, 46*(1), 53-62. Retrieved from: https://hbr.org/2003/01/one-more-time-how-do-you-motivate-employees

21. Limongi-França, A. C. (2004). *Qualidade de vida no trabalho – QVT* (2nd ed.). Atlas S.A.

22. Maringoni, G. (2013). A longa jornada dos direitos trabalhistas. *IPEA: Desafios do Desenvolvimento*. Retrieved from: https://www.ipea.gov.br/desafios/index.php?option=com_content&id=2909:catid=28

23. Mattos, P. C. (2015). Tipos de revisão de literatura. Retrieved from: https://www.fca.unesp.br/Home/Biblioteca/tipos-de-evisao-de-literatura.pdf

24. Mendoza-Ocasal, D., et al. (2022). Subjective well-being and its correlation with happiness at work and quality of work life: An organizational vision. *Polish Journal Of Management Studies, 25*(1), 202-216. https://doi.org/10.17512/pjms.2022.26.1.13

25. Monteiro, E. M. Á., Diniz, F. J. L. de S., França, A. C. L., & Carvalho, J. V. de F. (2011). O impacto da qualidade de vida no trabalho (QVT) no faturamento das indústrias metalúrgicas do estado do Pará. *Revista de Administração da UEG, 2*(1), 18-33.

26. Moss, J. (2023). Creating a happier workplace is possible — and worth it. *Harvard Business Review*. Retrieved from: https://hbr.org/2023/10/creating-a-happier-workplace-is-possible-and-worth-it

27. Pascoal, P. A. G., & Silva, P. C. D. (2019). Riscos psicossociais da atividade docente e análise do discurso: Uma investigação acerca da saúde e segurança do professor de educação básica a partir dos princípios da ergonomia. *Research, Society and Development, 8*(1), e4181619. https://doi.org/10.33448/rsd-v8i1.4181619

28. Pilatti, L. A. (2012). Qualidade de vida no trabalho e teoria dos dois fatores de Herzberg: Possibilidades-limite das organizações. *Revista Brasileira de Qualidade de Vida, 4*(1), 18-24. Universidade Tecnológica Federal do Paraná (UTFPR). http://dx.doi.org/10.3895/s2175-08582012000100003. Retrieved from: https://periodicos.utfpr.edu.br/rbqv/article/view/1195

29. Rother, E. T. (2007). Revisão sistemática X revisão narrativa. *Acta Paulista de Enfermagem, 20*(2), v–vi.

30. Rus, M., et al. (2023). The relationship between motivation and job satisfaction. *Anuarul Universitatii Petre Andrei din Iasi-Fascicula: Asistenta Sociala, Sociologie, Psihologie, 29*, 377-406.

31. Silva, S. F. da, et al. (2021). Gestão do processo de mudança nas organizações de saúde: Revisão narrativa da literatura. *Gestão e Desenvolvimento*, 483-504. Retrieved from: https://revistas.ucp.pt/index.php/gestaoedesenvolvimento/article/view/10227

32. Santos, G. B., & Ceballos, A. G. da C. (2013). Bem-estar no trabalho: Estudo de revisão. *Psicologia em Estudo, 18*(2), 247-255. Retrieved from: https://www.redalyc.org/pdf/2871/287128992006.pdf

33. Simões, A. C., Teixeira, R. L. P., & Gouveia, L. L. de A. (2021). Paradigmas curriculares, novas tecnologias e a engenharia. *Revista de Casos e Consultoria, 12*(1), e23983. https://doi.org/10.5935/rcc.v12n1a6

34. Spector, P. E. (2022). *Job satisfaction: From assessment to intervention*. Routledge.

35. Stefano, S. R., et al. (2006). Satisfação da qualidade de vida no trabalho com relação aos fatores biopsicossociais e organizacionais: Um estudo comparativo entre docentes das universidades pública e privada. *Revista Gerenciais, 5*(2), 35-44.

36. Subhashini, S., et al. (2014). A study on job satisfaction among spinning mill workers with special reference to Tirupur district, Tamilnadu. *Journal Impact Factor, 5*(2), 42-48.

37. Teixeira, R. L. P., Silva, P. C. D., & Brito, M. L. de A. (2021). Gamificação para o ensino de engenharia no contexto da indústria 4.0: Metodologia estratégica para a motivação dos estudantes. *Revista de Casos e Consultoria, 12*(1), e23964. https://doi.org/10.5935/rcs.v12n1a4

38. Teixeira, R. L. P., & Teixeira, C. H. S. B. (2023). Building a sustainable future: The relationship between industrial production and sustainability. *Concilium, 23*(11), 330-349.

39. Veloso, E. F. R., Schirrmeister, R., & Limongi-França, A. C. (2007). A influência da qualidade de vida no trabalho em situações de transição profissional: Um estudo de caso sobre desligamento voluntário. *Revista Administração em Diálogo, 9*(1), 35-58.

40. Vieira, G. C., et al. (2018). Satisfação laboral e a repercussão na qualidade de vida do profissional de enfermagem. *ABCS Health Sciences, 43*(3).

41. Vieira, G. B., Silva, P. C. D., & Teixeira, R. L. P. (2020). O nível de motivação/satisfação e a respectiva influência na qualidade do trabalho docente a partir da análise linguístico-discursiva da construção do ethos: Um estudo de caso em uma universidade federal brasileira. *Revista de Casos e Consultoria, 11*(1), e11128. https://doi.org/10.5935/rcs.v11n1a1

Eco-based polymers: A review concerning bioplastics with greater manufacturing potential

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ABSTRACT

Currently, it is almost impossible to imagine a world without plastics. These are widely used in various sectors of the economy, such as packaging, construction, transport, healthcare, and electronics, due to their low cost, versatility, durability, and high strength/weight ratio. However, the durability of plastics after use becomes an environmental problem, as a large part of plastic waste ends up in landfills, is incinerated, or discarded illegally, contaminating ecosystems and contributing to global warming. A promising alternative to mitigate these impacts is the development of bioplastics, which are bio-based, biodegradable materials, or both. Bioplastics include poly(lactic acid) (PLA), polyhydroxyalkanoates (PHA), bio-based polyamide (PA), and polypropylene (PP), which have the potential to replace conventional plastics in various applications. Global production of bioplastics is growing, estimated to reach 7.43 million tons by 2028, driven by demand for more sustainable alternatives. Despite challenges, such as high production costs and even inferior properties compared to synthetic plastics, investments in research and development promise to improve these materials. This scope reviews the bioplastics with the most significant manufacturing potential in the coming years. With technological advancement and growing environmental awareness, bioplastics are expected to be crucial in transitioning to a low-carbon circular economy.

Keywords: Bioplastics, Poly (lactic acid), Polyamide, Polyhydroxyalkanoates, Polymers, Polypropylene.

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INTRODUCTION

Plastics are increasingly present throughout the economy, serving as an essential enabler for sectors as diverse as packaging, construction, transportation, healthcare, and electronics, and have brought enormous economic benefits to these sectors, thanks to the combination of low cost, versatility, durability and high strength/weight ratio. The success of plastics is reflected in the exponential growth of their production over the last half-century and the increasing substitution of other packaging materials (Neufeld et al., 2016).

The word "plastic" refers to a group of synthetic materials made from hydrocarbons, materials formed through polymerization, which consists of a series of chemical reactions with organic raw materials, mainly natural gas and crude oil. Different types of polymerization allow the production of plastics with specific properties, such as hard or soft, opaque or transparent, flexible or rigid (Zamora et al., 2020).

Plastic is considered by many to simplify modern life due to its usability and ease, but its outstanding post-use durability makes it a severe problem. A significant portion of plastic waste is incinerated in landfills, causing more pollution and contributing to global warming. Another portion of this waste is illegally discarded on streets, beaches, rivers, and oceans, contaminating ecosystems. In the oceans, plastic degrades into microplastics that marine fauna ingests, often captured and sold for human consumption. An excellent alternative to these problems would be to increase the use of plastic through recycling; however, its quality deteriorates with each reuse cycle. This implies that sooner or later, waste needs final disposal (Zamora et al., 2020).

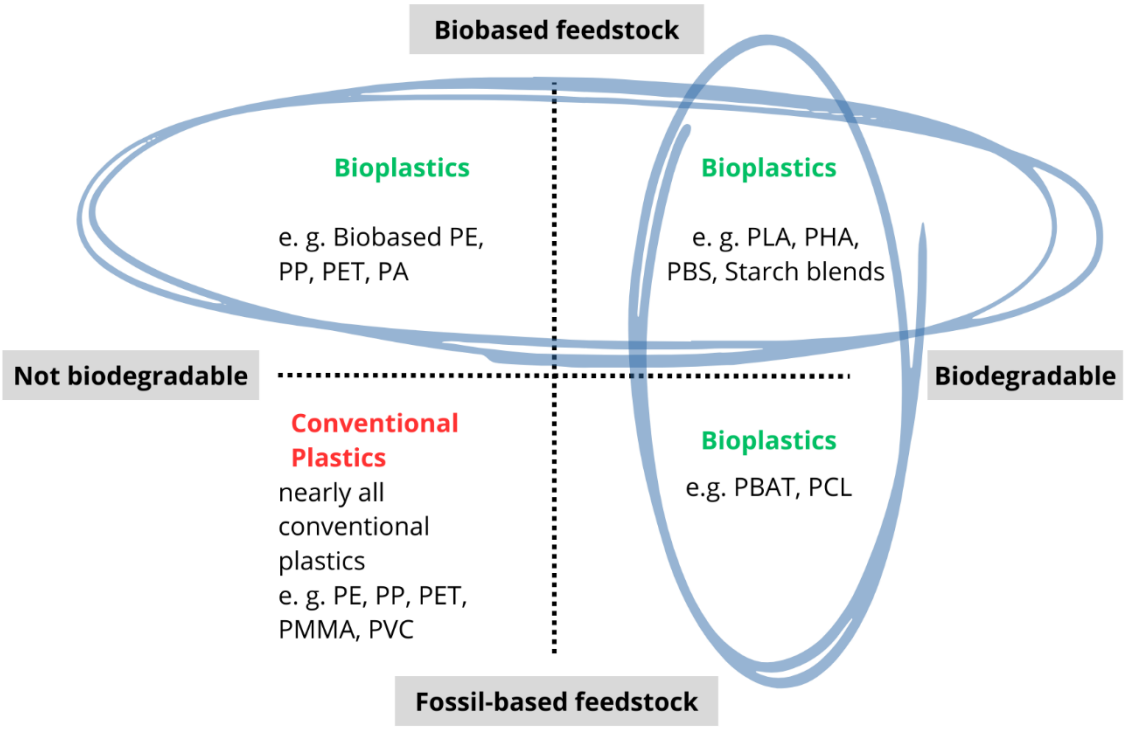
Thus, biodegradable polymers represent an alternative to deal with the problems above. These materials combine the expected properties of plastics, allow efficient processing and usability of products, and are, at the same time, biodegradable (Šprajcar et al., 2012).

Polymers are high molecular mass compounds built through the interconnection of perennial basic blocks called monomers. Living organisms in metabolic processes synthesize different polymers that they need to perform various functions such as transporting genetic information (DNA), providing rigidity in cell walls (cellulose), storing energy (in some microorganisms, polyester), etc. In addition to the natural polymers mentioned, numerous synthetic polymers are, in principle, more or less similar to natural ones. Still, they are artificially produced by man and do not exist in nature. This group is responsible for almost all the plastics we use, with around 75% of all global plastic production being represented by polyethylene terephthalate (PET), polypropylene (PP), polystyrene (PS), and polyethylene (PE) (Šprajcar et al., 2012).

Bioplastics, in turn, comprise a whole family of materials with different properties and applications. According to European Bioplastics, a plastic material is defined as bioplastic if it is bio-based, biodegradable, or has both properties. The term “biobased” means that the material or product

is derived from biomass, such as corn, sugar cane, or cellulose. The term “fossil base” or “fossil origin” means that the material or product is derived from petroleum. Thus, there are three groups of bioplastics, as shown in Figure 1: bio-based (or partially bio-based) plastics, bio-based and biodegradable plastics, and plastics based on fossil resources and biodegradable (European Bioplastics, 2022).

Figure 1 - Material coordinate system for bioplastics

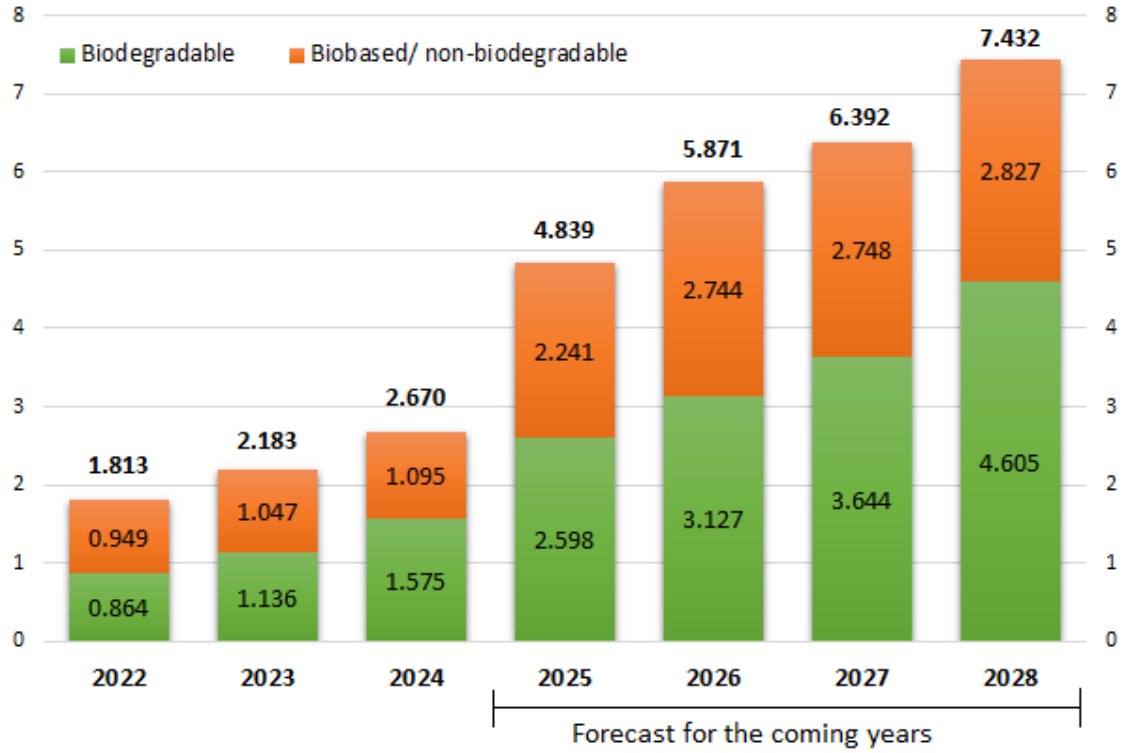


Source: Adapted from European Bioplastics (2022).

The rampant increase in the production and consumption of plastic materials, inadequate disposal, and growing concern about microplastic pollution are driving people and industry to seek more sustainable alternatives. In this context, the manufacture of bioplastics is gaining prominence, as, according to European Bioplastics, in 2022, the global production capacity of these materials reached 1.81 million tons, and it is estimated that this number will reach 7.43 million tons by 2028.

These new plastic materials can be processed into various products using conventional plastic processing technologies. The bioplastics industry is a young and innovative sector with notable economic and ecological potential, being able to use resources more efficiently, helping in the transition to a low-carbon circular bioeconomy. The global bioplastics market is estimated to grow continuously in the coming years, surpassing the two percent mark of global plastics production (European Bioplastics, 2022). Figure 2 presents the growing estimate of the worldwide production capacity of these materials, divided between non-biodegradable plastics made from renewable sources and biodegradable plastics.

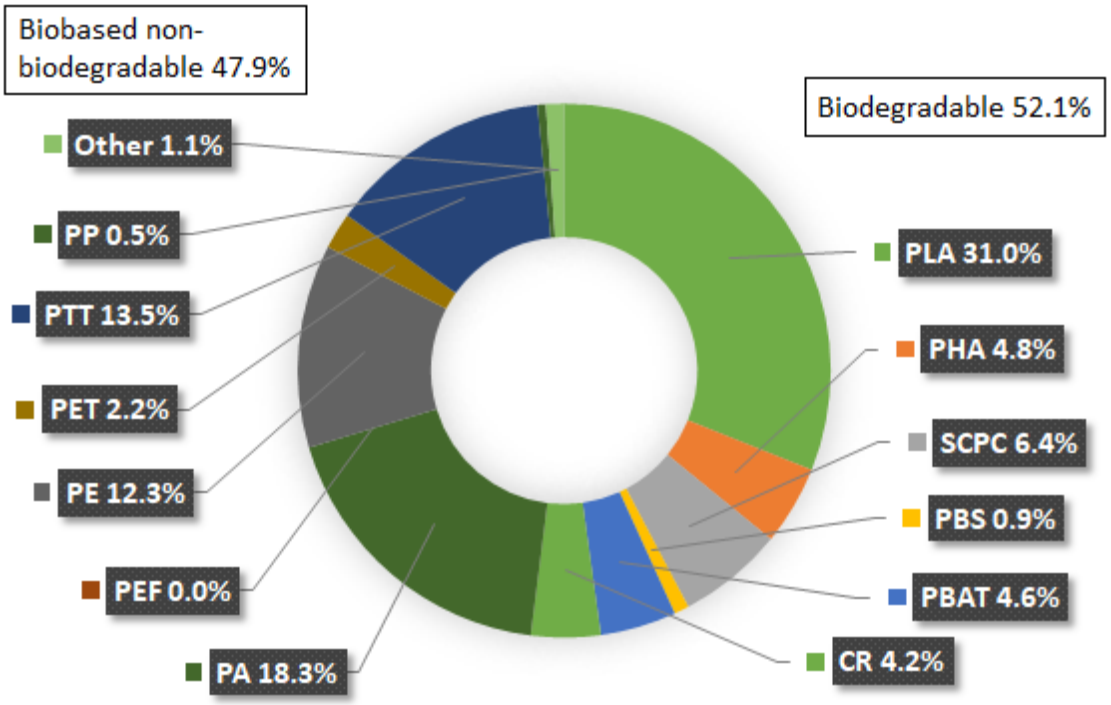
Figure 2 - Global bioplastics production capacities 2022-2028 at 1 million tons



Source: Adapted from European Bioplastics (2022).

Bioplastic alternatives exist for almost all conventional plastic materials and their corresponding applications. Due to the strong development of polymers such as poly(lactic acid) (PLA), polyhydroxyalkanoates (PHA), polyamides (PA), as well as a steady growth of polypropylene (PP), production capacities will continue to increase significantly over the next five years. Bioplastics are used for an increasing variety of applications, from packaging and consumer products to electronics, automotive, and textiles. Packaging continues to be the largest segment of these products, with 43% (934 thousand tons) of the total bioplastics market in 2023. Figure 3 shows the types of bioplastics most produced in 2023, according to European Bioplastics (2023).

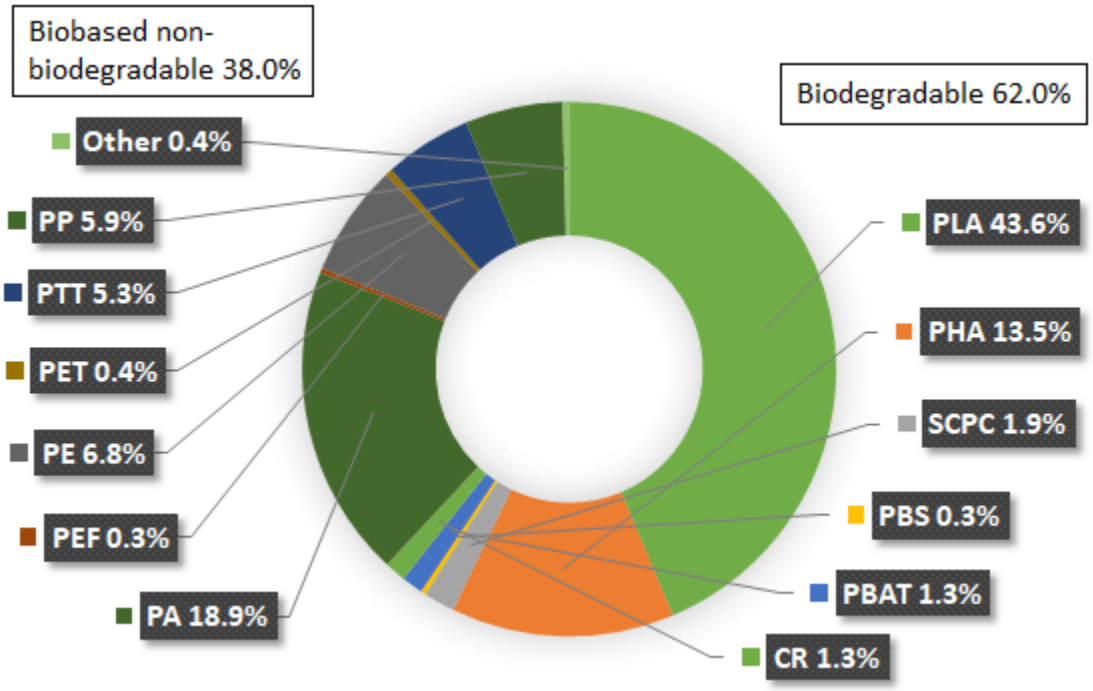
Figure 3 - Global bioplastics production capacities in 2023 by material type.



Source: Adapted from European Bioplastics (2023).

Next, Figure 4 shows the bioplastics that will potentially be the most produced in 2028 (European Bioplastics, 2023). Based on this information, a review of the literature is presented on the bioplastics that will probably have the highest production capacities in 2028: Poly (lactic acid) (PLA), Polyhydroxyalkanoates (PHA), and Polyamide (PA). In addition, Polypropylene (PP) is expected to increase from just 0.5% of global production capacity in 2023 to 5.9% in 2028.

Figure 4 - Estimated global bioplastic production capacities in 2028 by type of material.



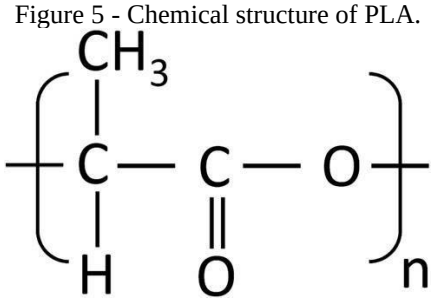
Source: Adapted from European Bioplastics (2023).

The methodology used in this study was bibliographic and exploratory research, where an extensive search for material was carried out in scientific articles and books published between 2000 and 2024, and the databases used in this research were CAPES Periodicals, Google Scholar, and ScienceDirect. The following topics were investigated from these databases: plastics, bioplastics, and bio-based polymers.

POLY (LACTIC ACID) (PLA)

Poly(lactic acid) (PLA) is currently the market leader in the bio-based and biodegradable plastics segment. At the same time, polymer is often considered to be closest to conventional plastics in terms of production costs. PLA is a thermoplastic aliphatic polyester obtained by polymerizing lactic acid from renewable resources such as corn starch, tapioca roots, and sugar cane. The general chemical structure of PLA is shown in Figure 5.

Figure 5 - Chemical structure of PLA.



As a thermoplastic polyester, it softens when heated and hardens when cooled. It can be cooled and heated several times without changing its mechanical and chemical properties. This allows the material to be shaped and processed by liquefaction and molding techniques and then recycled by similar processes. Due to its physical and chemical properties, flexibility, brightness, and light transmittance, PLA can technically compete with conventional plastics comparable to PE, PP, PVC, PS, and other plastics (Wellenreuther et al., 2022).

PLA is mainly used in the food industry to prepare disposable tableware, such as cups, cutlery, trays, plates, containers, and packaging for sensitive food products (Atiwesh et al., 2021). It has high strength but low toughness, so additives are necessary to balance stiffness and toughness, along with acceptable heat resistance (Nagarajan et al., 2016). Several commercial grades of PLA are explicitly designed for thermoforming and extrusion/injection molding processes. It can also be used for soil retention coatings, agricultural films, shopping bags, and packaging material. Additionally, PLA can be converted into fibers by spinning and used to manufacture disposable and biodegradable fabric items such as clothing, feminine hygiene products, and diapers (Atiwesh et al., 2021).

PLA production generally involves the following process steps: raw material extraction, glucose extraction, fermentation, and polymerization. PLA can be prepared by direct condensation of

lactic acid or by ring-opening polymerization of cyclic lactide dimers (Elsawy et al., 2017). The exact process routes differ in the choice of biological raw materials used as a starting point in producing these polymers. Different production steps and inputs are required depending on the raw material, affecting process costs. Under natural conditions, PLA can be degraded into water and carbon dioxide in a controlled time and without causing severe environmental pollution, unlike petroleum-based plastics (Wellenreuther et al., 2022).

Figure 6 represents the life cycle of a PLA-based product. The initial process is photosynthesis (1). Then, starch is extracted from corn and other grains (2), which is fermented into lactic acid (3), which undergoes polymerization to produce PLA (4). This plastic is used to manufacture tableware packaging, among other products (5). After the use phase, PLA can be treated and disposed of in an environmentally friendly way (6). Through composting, PLA undergoes biodegradation (6), releasing water and carbon dioxide, which are essential for photosynthesis to occur (1), restarting the cycle (Peng and Sun, 2017).

Figure 6 - PLA production and degradation cycle

Source: Adapted from Peng and Sun (2017).

Choosing the raw material for PLA production is crucial both economically and technologically. Corn and sugar cane dominate the plant sources used for PLA, but new resources are

being explored for lactic acid production. These include agricultural and industrial waste, such as straw and sugarcane bagasse, and byproducts from the food industry, such as cheese whey and food processing waste. Furthermore, there is a growing trend to exploit marine resources for raw materials such as algae. Production costs depend on raw material prices, technological progress, and process scaling costs. Political measures and fluctuations in oil prices also influence the demand for bio-based plastics and the expansion of PLA production capabilities (Wellenreuther et al., 2022).

Table 1 compares the results of some studies and presents the average production cost for one ton of PLA in US dollars. The values range from 1,048 to 3,558 USD per ton of PLA. The main cost factors identified in the studies were raw materials, energy, labor, and capital (Wellenreuther et al., 2022).

Table 1 - Comparison of literature results on PLA costs.

Reference	Raw material(s)	Annual production capacity (t)	Average cost per ton PLA (USD)
Chiarakorn et al. (2014)	Cassava	100,000	2,515
Jim Lunt & Associados (2010)	Potato; Wood	50,000	2,393
Kwan et al. (2018)	Waste of food	10,624	3,558
Manandhar e Shah (2020)	Corn grain	100,000	1,048
Sanaei e Stuart (2018)	Triticale	100,000	1,204

The wide variation in results arises from different process approaches, with differences in raw material selection and assumptions about the production process. Therefore, the results are not directly comparable. The choice of raw material is a crucial factor that influences not only the direct costs associated with its input but also impacts the subsequent stages of the process. Furthermore, the energy use and technology involved, especially in the PLA refinery, are significant for production costs, mainly when innovative raw materials are used. Additive and waste disposal costs also vary depending on the raw material chosen and the subsequent stages of the technological process (Wellenreuther et al., 2022).

Table 2 presents the average price per type of plastic of fossil origin (petroleum) per ton. There is a price range between 1,045 and 1,274 USD, depending on the type of plastic. Comparing Tables 1 and 2, it can be seen that although PLA can compete with conventional plastics from a technical point of view, PLA prices still cannot keep up with those of traditional plastics. PLA production costs exceed or, at most, equal the production costs of fossil-based plastics.

LA-based bioplastics are biodegradable under industrial composting conditions and anaerobic digestion but are hardly biodegradable in soil and aquatic environments. PLA requires specific high-temperature conditions and degrades through abiotic hydrolysis. Therefore, it is labeled as compostable in most Western countries (Choe et al., 2021).

At the same time, bioplastics also have environmentally friendly characteristics. For example, producing PLA saves two-thirds of the energy needed to make traditional plastics. Furthermore, it has been scientifically established that there is no net increase in carbon dioxide gas during the biodegradation of PLA bioplastics. This was evidenced by the fact that the plants from which they were produced absorb, through photosynthesis, the same amount of carbon dioxide released during the biodegradation of these plastics. Notably, PLA emits 70% fewer greenhouse gases when degraded in landfills. Other studies also cite that replacing traditional plastic with corn-based PLA bioplastics can reduce greenhouse gas emissions by 25%. Such examples assure that future production of new bioplastics can be realized through renewable energy and, at the same time, substantially reduce greenhouse gas emissions (Atiwesh et al., 2021).

Table 2 - Comparison of the costs of different types of fossil plastic.

Type of Plastic (fossil)	Average price per ton in 2019 (USD)
HDPE film	1,110
LDPE Film	1,045
PP homopolymer fiber	1,092
PS crystal	1,259
EPS (styrofoam)	1,274

PLA has many applications in Brazil, including food service utensils, films, and sheets; thermoformed rigid packaging; fibers; three-dimensional printing; and durable products. Unlike conventional petroleum-based plastics, this material can be recycled economically.

Although biodegradable, PLA cannot be disposed directly in nature or landfills. The product must be discarded in composting plants together with other organic waste. Thus, within 180 days and under ideal conditions, it will convert 90% of its mass into CO2 (carbon dioxide) and water and 10% into biomass that can be used as fertilizer for gardens, vegetable gardens, and crops.

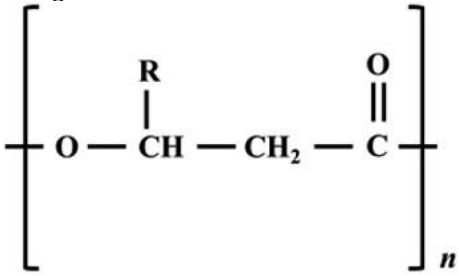
In short, PLA is a promising alternative to conventional plastics, as it is obtained from renewable resources, has properties similar to petrochemical plastics, and is biodegradable under specific conditions. The bioplastics industry's continued development, technological advances, and favorable policies could allow PLA to become a more competitive alternative to conventional plastics, favoring the transition to a more sustainable economy.

POLYHYDROXYALKANOATES (PHA)

Some bacteria can produce bioplastics as a way of storing energy and carbon. These bioplastics are biocompatible and, as they are edible by microorganisms, they are entirely biodegradable. They are produced by bacterial fermentation of lipids or sugar. Polyhydroxyalkanoates (PHA), polyhydroxybutyrate (PHB), and their byproducts are the most widely produced microbial bioplastics (Kumar et al., 2024).

PHAs are hydroxyalkanoate (HA) polyesters, and their chemical structure is shown in Figure 7. They are synthesized by different microorganisms inhabiting different ecological niches. This synthesis occurs in the cell under adverse conditions, such as a shortage of oxygen and essential nutrients such as phosphorus or nitrogen. However, the presence of a carbon source is a prerequisite for the biosynthesis of PHAs (Behera et al., 2022).

Figure 7 - Chemical structure of PHA



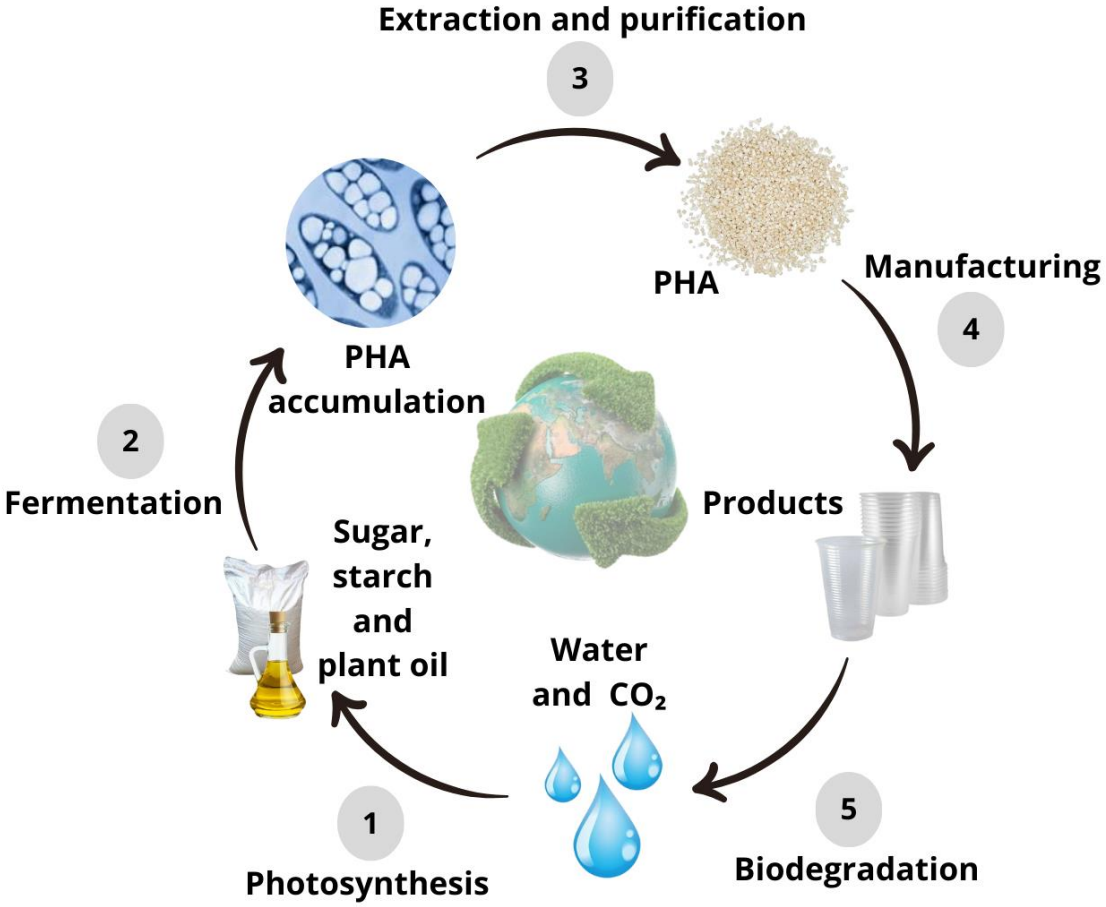
In particular, PHA can be produced from methane released from feedstock in wastewater treatment facilities, landfills, composting facilities, waste haulers, and biorefinery operators. In this way, successful and low-cost commercial PHA production can be achieved. PHA can also be produced from biomass from wood, grass, and crop residues rather than the more expensive biomass obtained from edible crops. This new technology separates biomass from water and uses heat instead of acids, solvents, or enzymes to produce bioplastics. Thus, PHA can be used commercially in bioplastic packaging, shampoo bottles, or polyester fibers combined with natural clothing materials. Marine microorganisms can naturally digest PHA bioplastics and reach the ocean when broken down into methane. At the end of its life cycle, the developed bioplastic can be decomposed into virgin plastic, as it is compostable and degradable in the sea (Atiwesh et al., 2021).

Although chemical and biological approaches can be applied to synthesize PHA, those with higher molecular weight can be quickly produced by biological means compared to chemical methods. The metabolic pathway for PHA production varies significantly between different microbial groups. These biopolymers are synthesized in the stationary and exponential phases of microbial growth. PHAs are produced under favorable, balanced growth conditions in the exponential phase. In the stationary phase, limiting nutrients such as nitrogen, phosphorus, oxygen, and excessive carbon sources leads to the synthesis and accumulation of PHAs. Excess nutrients are

stored by microbial cells in the form of PHAs and are then mobilized upon the advent of favorable growth conditions (Behera et al., 2022).

Figure 8 represents the life cycle of a PHA-based product. The initial process is photosynthesis (1). Through it, vegetables produce sugar, starch, or oil, fermented by microorganisms (2). Microbial accumulation of PHA occurs due to hydrocarbon degradation. After this accumulation, PHA is extracted and purified (3), giving rise to bioplastic used in industrial, biomedical, and environmental applications (4). At the end of the product's useful life, the PHA is discarded, undergoing biodegradation (5), producing biomass, water, and carbon dioxide that will later be consumed during the photosynthesis process (1), restarting the cycle (Choiniere, 2015).

Figure 8 - PHAs production and degradation cycle



Source: Adapted from Choiniere (2015).

Characteristics such as biodegradability, biocompatibility, non-toxicity, and other mechanical properties make PHAs suitable for various applications in diverse sectors. The industrial application of these biopolymers includes their use as packaging material, coating, and ecological bags. The reported antibacterial properties of polymers have led to increasing interest in their use in sanitary products, including diapers, feminine hygiene products, and cosmetic containers. The biocompatible nature of these polymers is beneficial for their use in biomedical sectors, including implants, bone

grafts, tissue engineering, and drug delivery systems. It is possible to use PHA as a matrix for the controlled release of drugs such as antibiotics, immunogens, contraceptives, hormones, and other active substances (Behera et al., 2022). The continuous use of synthetic plastics has been one of the main reasons for environmental pollution, so that PHAs can be an excellent substitute.

PHAs are biodegradable in soil under aerobic and anaerobic conditions; therefore, their use in agriculture is promising. They are often used in agricultural nets, mulch films, and grow bags. PHAs produced in biofilms or bioplastics for mulch are used not only to protect crops but also to increase their yield (Saravanan et al., 2022).

PHAs are very promising polyesters as a source of biofuels, as they do not need to be of high purity. Thus, PHAs can be obtained from crops, activated sludge, or nutritious wastewater, making them cost-effective while addressing the controversies between food versus fuel and fuel versus land. After being used as bioplastics, PHAs can undergo methyl esterification in biofuels, which further expands their application value. However, much research is still needed to make them profitable. PHA-based biofuels can be an alternative to existing biofuels, such as biodiesel, ethanol, methane gas, and hydrogen. Furthermore, biorefineries can produce several other metabolites with PHAs (Riaz et al., 2021).

Different microorganisms produce PHA with various molecular structures, monomer ratios, and molecular weights. Poly-3-hydroxybutyrate (PHB) stands out as the most abundant and extensively studied, synthesized by many bacteria, including Gram-negative *Cupriavidus necator*, *Ralstonia eutropha*, *Halomonas bluephagesis* and certain Gram-positive *Bacillus* and *Streptomyces* sp. Approximately 92 bacterial genera have demonstrated the ability to produce PHA under anaerobic and aerobic conditions, with more than 160 PHA monomers known. New synthetic monomers are added yearly (Park et al., 2024).

Several factors contribute to the environmental impact of PHA and other biomaterials. As mentioned previously, PHA brings benefits in terms of environmental impact due to its biodegradability and renewable origin using green raw materials. Energy consumption during the fermentation process to produce PHAs is considered less intense than traditional plastic production, which involves the extraction and refining of fossil fuels. Petrochemical processes emit significant greenhouse gases and consume substantial amounts of energy. Minimizing energy expenditure and using aggressive chemicals during downstream processing of PHA production is essential to reduce the environmental impact of this biomaterial. More research is needed to reduce the costs of this processing (Park et al., 2024).

Commercial production of value-added PHAs has been achieved using microorganisms such as bacteria, microalgae, and fungi. The chemical-mechanical properties of these biopolymers can be

changed by copolymerization. Thus, various PHAs exhibiting modified physical properties can be synthesized by varying their chemical composition (Behera et al., 2022).

However, the microbial synthesis of PHAs has not yet been fully explored. A wide range of microorganisms with vast potential for large-scale production of these biopolymers remains unexplored. The main obstacles in the microbial production of PHAs include efficient strain selection, the high cost of carbon sources, the energy required for the cultivation and fermentation process, and the choice of efficient and environmentally friendly extraction methods. The development of advanced and energy-efficient strategies and the use of renewable carbon sources could be helpful for the economical production of these biodegradable materials. Furthermore, the development of genetically modified microorganisms can increase PHA yield. Using these biopolymers as plastic substitutes can ultimately reduce environmental pollution caused by petroleum-based plastics (Behera et al., 2022).

The cost of production remains a challenge, and PHA remains more expensive than petroleum-based polymers. The demand for PHA in different industries, especially high-end applications, can strategically reduce production costs. As demand for sustainable and biodegradable alternatives increases, economies of scale and technological advances could help make PHAs more cost-competitive with traditional plastics (Park et al., 2024).

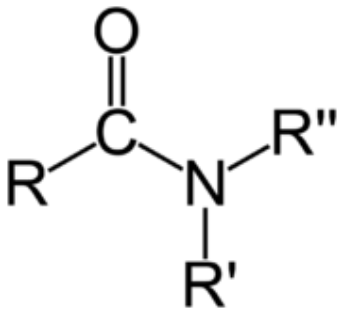
More than 25 companies, producing 30 different brands, integrate PHA into their production processes or final products. However, despite extensive research, only a limited selection of PHAs have achieved successful large-scale production and are commercially available as biodegradable materials (Koller and Mukherjee, 2022).

In summary, PHAs are produced by microorganisms from renewable carbon sources and represent a promising alternative to conventional plastics due to their sustainable and versatile properties. Continued research and development can help make their production and use even more efficient in the future.

POLYAMIDE (PA)

Polyamides (PAs) are probably best known by the colloquial name “nylon,” originating from the widely successful introduction of PA66 for women's pantyhose in the 1940s. Although the name “nylon” was initially limited to the trademark PA66, it has since become synonymous with the nomenclature of all polyamides. Polyamide resins are linear condensation polymers with a high degree of crystallinity with repetitions of amide bonds (–CO–NH–) in their molecular chain (Brehmer, 2013). Figure 9 shows the chemical structure of the organic amide function.

Figure 9 - Chemical structure of the amide



Currently, most polyamide raw materials are synthesized from petrochemical resources. With the increasing depletion of these sources, research into bio-based polyamides is becoming increasingly important. The production cost of bio-based aromatic monomers is high, and the performance of bio-based aromatic polyamides still has a particular gap compared with traditional petroleum-based aromatic polyamides. Currently, industrially produced bio-based polyamides are still limited to aliphatic polyamides. In general, if the source of polymer monomers contains materials derived from biomass and is obtained through biomanufacturing, it can be called a bio-based polyamide. Fortunately, with the development of metabolic engineering and biocatalysis, more and more raw materials can come from biology. Although polyamides can be synthesized and produced using bio-based monomer raw materials, this does not guarantee their biodegradability. Only PA-4 and itaconic acid-derived PA have been reported as biodegradable polyamides (Zheng et al., 2024).

Bio-based aliphatic polyamides (bio-PAs) are PAs fully or partially synthesized from renewable resources such as vegetable oils, fatty acids, cellulose, and lignin. Bio-PAs are obtained by several methods: (i) from raw or chemically modified natural polymers; (ii) through the reaction of a mixture of monomeric raw materials obtained from biomass and petroleum; (iii) through the polymerization of chemically tailored monomers that are entirely obtained from biomass feedstocks after complex chemical transformations to synthesize bio-PAs. The low solubility of these natural polymers limits their processing and applications, and it is challenging to remove various organic impurities and undesirable chemical compounds, which negatively influence their properties. Bio-PAs synthesized from mixtures of petroleum-based and bio-based resources or exclusively bio-based resources are more applicable routes in this field. Vegetable oils and fats have long been the primary biomass raw materials for bio-PA synthesis. Oil was the oldest known source of monomeric raw material obtained from its chemical transformation process (Khedr, 2023).

Castor oil from the Ricinus communis plant is used as the primary biomass feedstock in commercially available bio-PA production. This oil has long been considered a raw material for manufacturing essential consumer products such as soaps, lubricants, and coatings. Today, castor oil

appears as a valuable raw material for biorefineries. It is non-edible and non-competitive in the food chain, making it suitable for manufacturing biofuels, biochemicals, and biopolymers (Khedr, 2023).

It has recently been discovered that bio-based polyamides 4,4 and 5,4, consisting of 1,4-diaminobutane, 1,5-diaminopentane, and succinic acid, which are produced by recombinant bacteria, are degraded by Brevundimonas vesicularis. They have emerged as practical solutions to current plastic problems, while polyamides produced in recent decades have shown low biodegradability due to their hydrogen bonds between polyamide molecular chains. These discoveries have opened a new chapter in the production of bio-based polyamides, suggesting the possibility of using them as recyclable polyamides and, as a result, providing environmental benefits through recycling. Therefore, producing polyamide monomers such as diamines, amino carboxylic acids, and diacids from renewable resources is also expected to impact the bioplastics industries significantly. However, the bio-based processes for producing these platform chemicals are still in the research and development phase (Son et al., 2023).

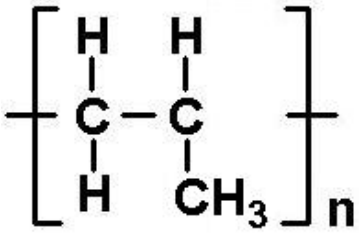
Towards the immediate replacement of petroleum-derived monomers with biomass-derived monomers, ongoing efforts are to develop a complete biorefinery process – a superior microbial cell factory and efficient pilot-scale fermentation and purification processes. With this step fully developed, a hybrid biochemical process for the biological production of polyamide monomers can be envisaged through bio-based monomers' chemical conversion. Furthermore, this process can be improved by identifying and developing enzymes that efficiently catalyze the reaction of ring formation, ring-opening polymerization, and polyamide degradation to establish microbial chassis for the production of fully sustainable bio-based and biodegradable polyamide (Son et al., 2023).

In short, bio-based “nylons” can be totally or partially derived from renewable sources, exhibiting excellent mechanical, thermal, and water absorption properties. They offer a path to reducing a company's carbon footprint while meeting consumer expectations for more sustainable products and materials.

POLYPROPYLENE (PP)

Polypropylene (PP), as a polymer catalytically prepared from propylene, was discovered in 1954 and gained strong popularity very quickly due to its lowest density among commercial plastics. The general chemical structure of PP is shown in Figure 10. It is one of the most widely used thermoplastics, offering an advantageous combination of toughness, tension, tear, flexural strength, and chemical resistance to heat and moisture (Gijsman and Fiorio, 2023).

Figure 10 - Chemical structure of polypropylene



Furthermore, PP can be processed using the most relevant techniques, such as injection molding, film and fiber extrusion, thermoforming, and blow molding. PP has been extensively used as a fundamental polymeric material, covering automobiles, cosmetics, textiles, and consumer packaging due to its excellent processability, chemical resistance, and moisture barriers. Almost a quarter of the world's thermoplastic demand is polypropylene (Gijsman and Fiorio, 2023).

PP is the second most popular base plastic in the petrochemical industry; however, more than 90% of its environmental impacts are attributed to the manufacturing phase, according to a recent life cycle assessment (LCA) of PP products. Consequently, continuous efforts are being made to produce bio-based PP at an industrial level through environmentally friendly processes. Biopolypropylene (bio-PP) is still in the pilot production phase and has not been fully commercialized, accounting for 1.9% of the bioplastics market. Sustainable methods of obtaining propylene from renewable biological resources are being investigated to reduce the environmental effect and depletion of fossil fuels (Wang et al., 2023).

Propylene can be generated in several ways from biological sources. The most popular is the fermentation of sugar cane to produce bioethanol, one of the primary intermediates for bio-PP synthesis. In this process, bioethanol is first converted into ethylene through dehydration, which is subsequently transformed into butene through dimerization. Finally, propylene monomer is obtained by metathesis of ethylene and butene. Another approach is through a thermochemical process, which employs different carbon-rich biomass feedstock (e.g., corn, grass, agricultural waste, etc.) that could be gasified to generate synthetic biogas. However, the gasification approach has much higher capital expenditure than the fermentation route. Furthermore, hydrotreatment of vegetable oil or used cooking oil can also be used to produce green propylene (Wang et al., 2023).

The main challenge faced by bio-PP producers is the development of process technologies that are cost-competitive with PP produced from fossil fuels. As large-scale production of bio-based PP began in 2019, the market is still in its early stages. Due to its versatile and diverse properties, bio-PP is predicted to become more widespread across several end-use sectors. Based on its application, the packaging sector mainly dominates the market due to strong demand in various industries, including food and beverage, consumer products, and automobiles. This material can also

be used in the construction sector to manufacture panels, tubes, insulating, or flame retardant materials (Wang et al., 2023).

Kikuchi et al. (2017) carried out a life cycle assessment to verify the reduction in greenhouse gas emissions due to replacing products derived from fossil fuels with products derived from biomass. The results show reduced greenhouse gas emissions when using bio-PE and bio-PP resins. However, the reduction rate of bio-PE is higher than that of bio-PP because the reaction steps are increased and consume additional energy in the synthesis of propylene. Bio-based PP would be an immediate solution, featuring the same technical properties and recyclability found in the current PP portfolio today with the added benefit of a negative carbon footprint. It can be summarized that bio-PP is still in the pilot production phase, accounting for a small fraction of the bioplastics market. Its development faces significant challenges, including cost competition with conventional PP. However, bio-PP is expected to gain popularity across sectors due to its versatile properties and sustainability.

FINAL CONSIDERATIONS

Advances in the research and development of bio-based polymers such as poly(lactic acid) (PLA), polyhydroxyalkanoates (PHAs), polyamide (PA), and polypropylene (PP) represent a significant shift in the plastics industry toward more flexible materials. Sustainable and environmentally friendly, these polymers are finding new applications in various industrial sectors, with growing demand driven by environmental and regulatory concerns.

Although biopolymers represent a promising alternative to traditional plastics, they face several significant challenges. Firstly, its large-scale production is still more expensive than conventional plastics. Furthermore, some bio-based polymers may have inferior properties to their synthetic counterparts. Another critical point is that the output of certain biopolymers can compete with food production due to the use of the same raw materials. These factors combined create considerable obstacles to society's widespread adoption of these new polymers.

However, investments in research and development have the potential to lead to advances that not only lower production costs but also improve the performance of bio-based polymers. Collaborations between companies, academic institutions, and government entities can catalyze innovation and speed up the adoption of sustainable polymers. Additionally, educating consumers about the advantages of biopolymers and highlighting the importance of recycling can foster greater acceptance of these materials.

Therefore, bio-based polymers, such as PLA, PHAs, PA, and PP, offer a promising alternative to traditional plastics derived from fossil fuels. With the continued advancement of technology and

increased focus on sustainability, these materials are expected to play a vital role in transitioning to a greener and more circular economy.

LIST OF ABBREVIATIONS

Not applicable

DECLARATIONS

NOVELTY STATEMENT

This review offers a promising alternative to traditional plastics derived from fossil fuels. With the continued advancement of technology and increased focus on sustainability, these materials are expected to play a vital role in transitioning to a greener, more circular economy.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable

CONSENT FOR PUBLICATION

All authors agreed with this publication.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated for this study are available upon request from the corresponding author.

COMPETING INTERESTS

There are no competing interests

FUNDING

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AUTHORS' CONTRIBUTIONS

LR, NSV: research of paper and manuscript organization.

AM, HT: research coordinators

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REFERENCES

1. Atiwesh, G., Mikhael, A., Parrish, C. C., & Le, T. T. (2021). Environmental impact of bioplastic use: A review. *Heliyon, 7*(9). https://doi.org/10.1016/j.heliyon.2021.e07918.

2. Behera, S., Priyadarshanee, M., Vandana, & Das, S. (2022). Polyhydroxyalkanoates, the bioplastics of microbial origin: Properties, biochemical synthesis, and their applications. *Chemosphere, 294*, 133723. https://doi.org/10.1016/j.chemosphere.2022.133723.

3. Brehmer, B. (2013). Polyamides from biomass derived monomers. In *Bio-Based Plastics: Materials and Applications* (pp. 275–296). https://doi.org/10.1002/9781118676646.ch10.

4. Choe, S., Kim, Y., Won, Y., & Myung, J. (2021). Bridging three gaps in biodegradable plastics: Misconceptions and truths about biodegradation. *Frontiers in Chemistry, 9*, 671750. https://doi.org/10.3389/fchem.2021.671750.

5. Choiniere, P. (2015). Development of polyhydroxyalkanoate nanoparticles for cancer therapy. [Thesis, Syracuse University].

6. Elsawy, M. A., Kim, K., Park, J., & Deep, A. (2017). Hydrolytic degradation of polylactic acid (PLA) and its composites. *Renewable and Sustainable Energy Reviews, 79*, 1346–1352. https://doi.org/10.1016/j.rser.2017.05.143.

7. European Bioplastics. (2023). *Market data report 2023*. Disponível em: https://docs.european-bioplastics.org/publications/market_data/2023/EUBP_Market_Data_Report_2023.pdf. Acesso em: 23 abr. 2024.

8. European Bioplastics. (2022). *What are bioplastics?: Material types, terminology, and labels – an introduction*. Disponível em: https://docs.european-bioplastics.org/publications/fs/EuBP_FS_What_are_bioplastics.pdf. Acesso em: 23 abr. 2024.

9. Gijsman, P., & Fiorio, R. (2023). Long term thermo-oxidative degradation and stabilization of polypropylene (PP) and the implications for its recyclability. *Polymer Degradation and Stability, 208*, 110260. https://doi.org/10.1016/j.polymdegradstab.2023.110260.

10. Khedr, M. S. F. (2023). Bio-based polyamide. *Physical Sciences Reviews, 8*(7), 827–847. https://doi.org/10.1515/psr-2020-0076.

11. Kikuchi, Y., Oshita, Y., Mayumi, K., & Hirao, M. (2017). Greenhouse gas emissions and socioeconomic effects of biomass-derived products based on structural path and life cycle analyses: A case study of polyethylene and polypropylene in Japan. *Journal of Cleaner Production, 167*, 289–305. https://doi.org/10.1016/j.jclepro.2017.08.179.

12. Koller, M., & Mukherjee, A. (2022). A new wave of industrialization of PHA biopolyesters. *Bioengineering, 9*, 74. https://doi.org/10.3390/bioengineering9020074.

13. Kumar, R., Lalnundiki, V., Shelare, S. D., Abhishek, G. J., Sharma, S., Sharma, D., Kumar, A., & Abbas, A. (2024). An investigation of the environmental implications of bioplastics: Recent advancements on the development of environmentally friendly bioplastics solutions. *Environmental Research, 244*, 117707. https://doi.org/10.1016/j.envres.2023.117707.

14. Nagarajan, V., Mohanty, A. K., & Misra, M. (2016). Perspective on polylactic acid (PLA) based sustainable materials for durable applications: Focus on toughness and heat resistance. *ACS

Sustainable Chemistry and Engineering, 4*(6), 2899–2916. https://doi.org/10.1021/acssuschemeng.6b00321.

15. Neufeld, L., Stassen, F., Sheppard, R., & Gilman, T. (2016). *The new plastics economy: Rethinking the future of plastics*. World Economic Forum.

16. Park, H., He, H., Yan, X., Liu, X., Scrutton, N. S., & Chen, G. (2024). PHA is not just a bioplastic! *Biotechnology Advances, 71*, 108320. https://doi.org/10.1016/j.biotechadv.2024.108320.

17. Peng, T., & Sun, W. (2017). Energy modelling for FDM 3D printing from a life cycle perspective. *International Journal of Manufacturing Research, 12*(1), 83–98. https://doi.org/10.1504/IJMR.2017.10003722.

18. Plastic Portal. (2024). *Weekly commodity price report*. Disponível em: https://www.plasticportal.eu/en/cenove-reporty/. Acesso em: 23 abr. 2024.

19. Riaz, S., Rhee, K. Y., & Park, S. J. (2021). Polyhydroxyalkanoates (PHAs): Biopolymers for biofuel and biorefineries. *Polymers, 13*, 253. https://doi.org/10.3390/polym13020253.

20. Saravanan, K., Umesh, M., & Kathirvel, P. (2022). Microbial polyhydroxyalkanoates (PHAs): A review on biosynthesis, properties, fermentation strategies and its prospective applications for a sustainable future. *Journal of Polymers and the Environment, 30*, 4903–4935. https://doi.org/10.3390/polym13020253.

21. Son, J., Sohn, Y. J., Baritugo, K., Jo, S. Y., Song, H. M., & Park, S. J. (2023). Recent advances in microbial production of diamines, aminocarboxylic acids, and diacids as potential platform chemicals and bio-based polyamides monomers. *Biotechnology Advances, 62*, 108070. https://doi.org/10.1016/j.biotechadv.2022.108070.

22. Šprajcar, M., Horvat, P., & Kržan, A. (2012). *Biopolymers and bioplastics: Plastics aligned with nature*. Ljubljana: National Institute of Chemistry.

23. Wang, S., Muiruri, J. K., Soo, X. Y. D., Liu, S., Thitsartarn, W., Tan, B. H., Suwardi, A., Li, Z., Zhu, Q., & Loh, X. J. (2023). Bio-polypropylene and polypropylene-based biocomposites: Solutions for a sustainable future. *Chemistry – An Asian Journal, 18*(2), e202200972. https://doi.org/10.1002/asia.202200972.

24. Wellenreuther, C., Wolf, A., & Zander, N. (2022). Cost competitiveness of sustainable bioplastic feedstocks – A Monte Carlo analysis for polylactic acid. *Cleaner Engineering and Technology, 6*, 100411. https://doi.org/10.1016/j.clet.2022.100411.

25. Zamora, A. M., et al. (2020). *Atlas do plástico: Fatos e números sobre o mundo dos polímeros sintéticos*. Rio de Janeiro: Fundação Heinrich Böll no Brasil.

26. Zheng, L., Wang, M., Li, Y., Xiong, Y., & Wu, C. (2024). Recycling and degradation of polyamides. *Molecules, 29*(8), 1742. https://doi.org/10.3390/molecules29081742.

Influence of density on bending resistance of wooden beams under fire situation and proposal of a new equation

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ABSTRACT

Targeting to identify the correlation between density, charring rate and bending resistance, the different methods presented by Eurocode 5 to verify wooden beams under fire exposure were compared, with the use of the software Abaqus/CAE to obtain the isotherms of the beams in the advanced calculation method, and then proposed a new equation to obtain their charring depth according to time of fire exposure. It was confirmed that the density of the wood is inverse to its charring rate and its bending resistance loss, and the advanced calculation method presents less conservative results than the simplified methods. The equation that was proposed in this study had slightly more conservative results than the advanced calculation, proving to be suitable in relation to time spent in calculation, computational effort and economy.

Keywords: Density, Charring, Fire, Eurocode 5, Advanced calculation.

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INTRODUCTION

Important historic buildings with timber structure were damaged by fire this century, among which can be highlighted the roof of Notre-Dame Cathedral in Paris, one of the most iconic cathedrals in the world, and the National Museum in Rio de Janeiro, America Latina's largest natural-history museum. Massive destructions in cultural and historical fields are caused by events like these, enhancing the importance of granting fire-resistance to the structures of buildings. Furthermore, they raise the skepticism of constructors and designers when it comes to timber structures under fire situation [1].

On the other hand, a growth in utilization of timber as the main material of building structures is noticed currently [2], being strongly related to its industrialization, which, along with its renewable and carbon-stocking characteristics, makes this material a good alternative to create sustainable construction systems, easing to reach the Sustainable Development Goals of the UN [3]. The raise in area of planted forests – optimizing cost, quality, and durability – also brings interest to construction [4], making the fire subject extremely important to be addressed.

Instead of burning directly, wood is affected by the effect of pyrolysis, in which high temperatures (around 300 ºC) generated by the fire decompose the material into char – producing then combustion [5]. The char forms a layer of protection when it comes to temperature raise in the interior of the timber section, as its thermal conductivity is lower than the found in ambient-condition wood [5]. Due to the variability of its natural composition, the char depth is plausible to be slightly different in each section (including sections of the same specimen, mainly in sawn or solid timber) [5].

Being the importance of understanding the behavior of timber structures under fire considered, it is reasonable to find alternatives to experimental tests, which tend to have a high cost attached. A convenient option is the Finite Element Method (FEM), that presents realistic results in cheaper yet efficient operations [6]. Eurocode 5 (EC5) indicates values to be used in what it calls advanced calculation methods [7] and different authors [6; 8] attested these numbers by running numerical analysis and comparing their results to experimental ones, even though it is known that experts may disagree with the accuracy of the values suggested by it [6].

THI et al (2016) compared experimental tests with numerical analysis based on five different approaches. One numerical analysis was built on thermal characteristics of heated wood given by EC5 using the ISO 834 curve of temperature vs time, while the others used a regression curve with four different sets of thermal properties described by different sources: EC5, Janssens, Fredlund, and Knudson. The author affirms that, due to the significant dispersal of results in the experimental tests, the five methods can be accepted [6]. However, it is essential to be stated that both EC5 analysis

were similar to each other, being noticeably different from the analysis based on the other authors – which were also alike among themselves.

Although EC5 presents the advanced calculation methods to find accurate results, it also suggests simplified procedures – reduced cross-section method and reduced properties method – with constant and pre-defined charring rates as an alternative to find the residual cross-section of a timber member, giving different steps to reach its final resistance [7]. Simplified methods tend to present less accurate results when compared to FEM ones, but they are a faster way to find them, being reasonable to simple cases. The simplified procedures given by EC5 do not consider the density of the wood directly, even though experimental studies [9; 10] demonstrated it to be a characteristic that impacts the charring rate of timber.

NJANKOUO et al. [11] contrasted experimental results of the charring rate of different wood species with the recommended by the simplified values of the previous version of EC5. When comparing to the current version (0,70 mm/min for softwoods and 0,55 mm/min for hardwoods), their results showed a reasonable safety – 3 out of 20 specimens presented a higher charring rate in experimental tests, being one of a softwood species (0,71 mm/min) and two of hardwood species (0,58 and 0,59 mm/min). The tests also confirmed lower charring rates for denser wood species.

CACHIM & FRANSSEN [12] affirm that the charring rate depends on various factors, as wood species, density, moisture content, direction of burning (parallel or perpendicular to the grain), etc.; however, for practical purpose, only some of them can be deemed. In their study, they defined the charring rates of softwoods with different densities using an advanced calculation method, comparing them with the charring rates of the simplified methods. The authors state that there is an inconsistency between simplified and advanced calculation methods presented by EC5, as the second takes into account the influence of density. Their numerical analysis demonstrated higher densities of wood to result in lower charring rates, converging with the inverse relationship between density and thermal diffusivity, showing that the simplified methods suggested by EC5 may neglect a significant correlation of it with the mechanical degradation of the timber – different from the Australian Standards, for example, that uses the density of the wood as the main characteristic to obtain its charring rate for simplified procedures.

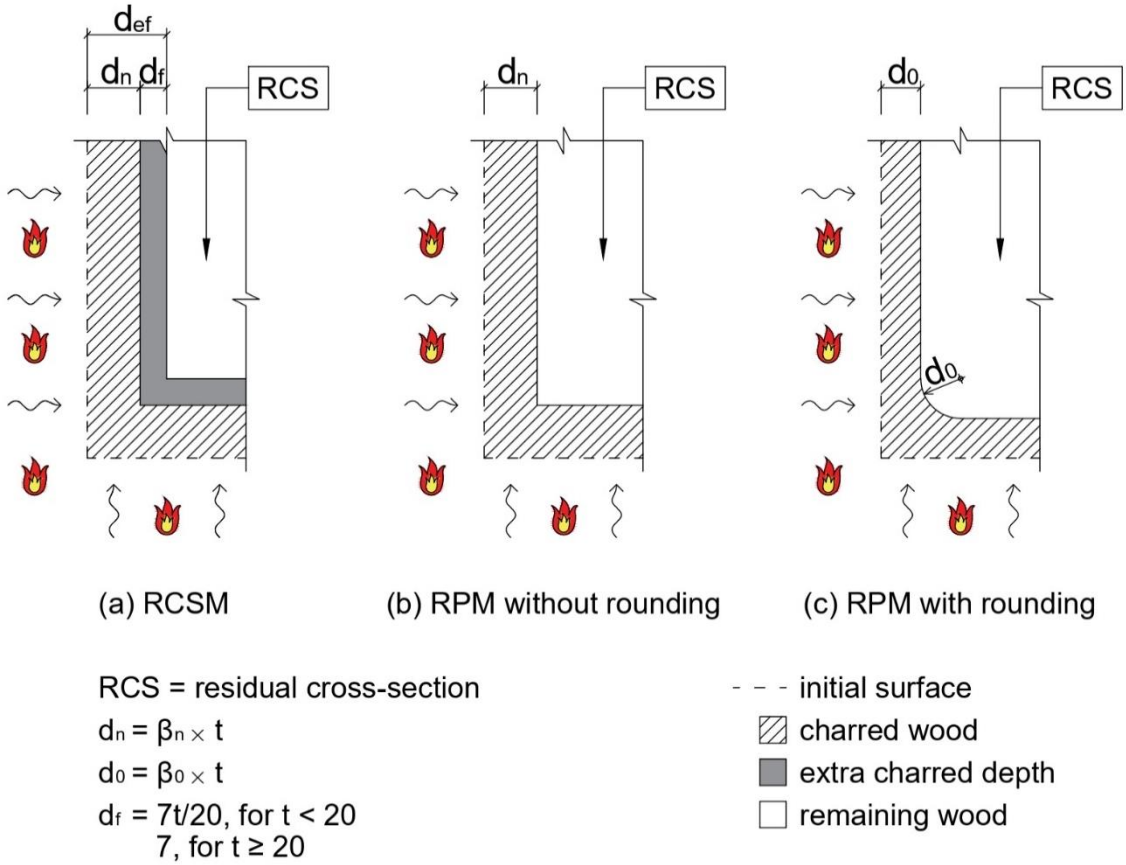
This study, more than obtaining the charring rate based on EC5 orientation for advanced calculation, compared the results of bending resistance loss on timber beams of four wood species with distinct densities in different durations of fire. It was identified the degree of conservatism adopted by the simplified methods and a new equation was proposed contemplating the influence of the wood density. The software Abaqus/CAE was used to determine the temperature isotherms on the beam sections in the different durations of fire.

EUROCODE 5 METHODS TO VERIFY RESISTANCE UNDER FIRE SITUATION

EC5 defines two simplified methods for verifying linear structural timber elements (columns, beams) under fire situation. The reduced cross-section method (RCSM) consists in determining a charring depth based on the notional charring rate (β_n) and the time of fire occurrence, adding to it an extra depth to be reduced from the cross-section (7 mm for fires lasting 20 or more minutes); the verification is made using the reduced cross-section and considering integral properties for the wood. The reduced properties method (RPM) also takes into account the charring rate and the time of fire exposure, considering a modification factor ($k_{mod,fi}$) to compensate the change in the properties of wood in high temperatures; $k_{mod,fi}$ depends on the perimeter and area of the residual cross-section and for bending strength it is given by Eq. (1). The reduced properties method can be used with two different charring rates: the notional charring rate (β_n), which is higher to compensate not considering the rounding effect of the corners, and the one-dimensional charring rate (β_0), that must consider the rounding effect. Fig. 1 demonstrates the particularities of each method, considering unprotected timber members.

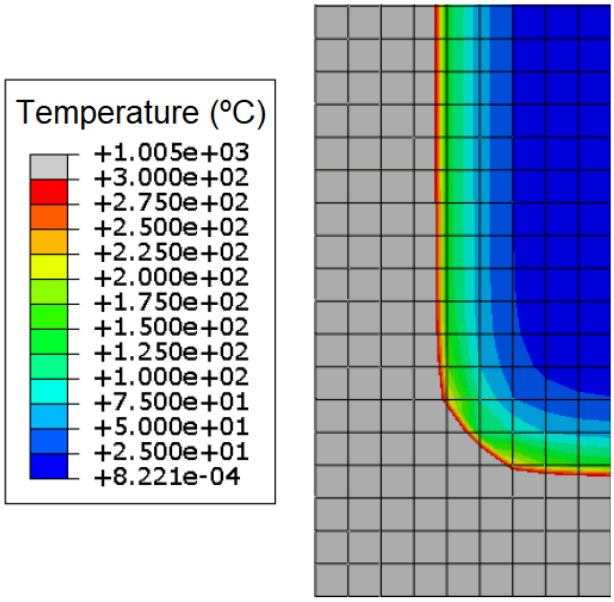
$$k_{mod,fi} = 1{,}0 - p \div (200 \times A_r) \qquad \text{Eq. (1)}$$

Fig. 1: Particularities of each simplified method proposed by Eurocode 5



Among the options that EC5 gives for advanced calculation methods, there is one that conducts to obtaining the charring depth by using the finite element method (FEM) and introducing this depth within the RPM. In this case, the FEM is used for thermal analysis and the results are presented by a software in the form of isotherms. Fig. 2 illustrates an example obtained in this study, for which the software Abaqus/CAE was used for modelling the timber element and the fire scenario proposed by EC5. The gray area – representing 300ºC or higher –, indicates the charred or faded wood, being disregarded in the calculation procedure.

Fig. 2: Result of thermal analysis on timber element with FEM modelling



DETERMINATION OF THE CHARRING DEPTH

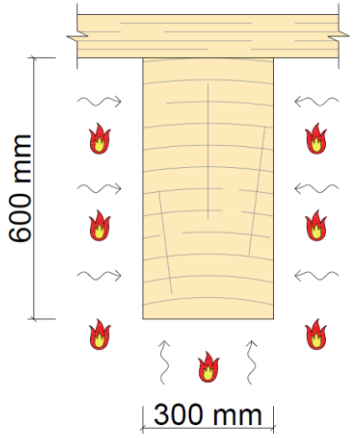
To confront the results of the simplified methods, this study used two species of softwood (*Pinus elliotti* – SW1; *Pinus taeda L.* – SW2) and two species of hardwood (*Eucalyptus saligna* – HW3; *Tabebuia serratifolia* – HW4) to determine the charring depth and the residual cross-section by FEM analysis, with the species being of distinct densities in order to enable the discussion over the influence of density on charring rate and on bending resistance. The density values used were obtained from the Brazilian Standards [13] and are shown in Tab. 1, with their respective thermophysical properties for different temperature values according to EC5.

Tab. 1: Thermophysical properties of species of wood according to Eurocode 5

Temperature (ºC)	Density				Conductivity (W/m.K)	Specific heat (kJ/kg.K)
	SW1	SW2	HW3	HW4		
20	560	645	731	1068	0,12	1530
99	560	645	731	1068		1770
99	560	645	731	1068		13600
120	500	575,9	652,7	953,6		13500
120	500	575,9	652,7	953,6		2120
200	500	575,9	652,7	953,6	0,15	2000
250	465	535,6	607	886,8		1620
300	380	437,7	496	724,7		710
350	260	299,5	339,4	495,9	0,07	850
400	190	218,8	248	362,4		1000
500					0,09	
600	140	161,3	182,8	267		1400
800	130	149,7	169,7	247,9	0,35	1650
1200	0	0	0	0	1,5	1650

The charring depth was determined for fire durations of 30, 60, 90, 120 and 150 min, being also considered a “zero-minute fire”, representing the instant of ignition, in which the calculation method considers the integral initial cross-section with fire-verification procedures, so there is no discrepancy in the development of the resistance loss due to different adopted modification factors. A rectangular cross-section of 300 mm x 600 mm was chosen and the fire incidence considered on three of the four sides of the structural element, simulating a slab leaning on the thinner side of a beam, as shown in Fig. 3.

Fig.3: Cross-section with corresponding fire incidence



The results of the charring depth for the simplified methods are shown in Tab. 2, Tab. 3 and Tab. 4. It can be seen that results are not determined by species, but by their class, and the charring depth is higher for hardwoods, as EC5 adopts lower charring rate values for this class.

Tab.2: Charring depth for the Reduced Cross-Section Method

Beam	Charring depth (mm) – RCSM				
	30’	60’	90’	120’	150’
SW1/SW2	31	55	79	103	127
HW3/HW4	23,5	40	56,5	73	89,5

Tab.3: Charring depth for the Reduced Properties Method without rounding effect

Beam	Charring depth (mm) – RPM without rounding effect				
	30’	60’	90’	120’	150’
SW1/SW2	24	48	72	96	120
HW3/HW4	16,5	33	49,6	66	82,5

Tab.4: Charring depth for the Reduced Properties Method with rounding effect

Beam	Charring depth (mm) – RPM with rounding effect				
	30’	60’	90’	120’	150’
SW1/SW2	19,5	39	58,5	78	97,5
HW3/HW4	15	30	45	60	75

On the other hand, results from calculation with FEM show that density plays an important role in determining the loss of wooden material of timber beams, agreeing with different authors [9 – 12, 14] and with the AS 1720.4 [15]. Tab. 5 presents the charring depth values found with the numerical analysis, while Fig. 3, Fig. 4, Fig. 5 and Fig. 6 compare them with the results of the simplified methods.

Tab. 5: Charring depth for the Finite Element Modelling numerical analysis

Beam	Charring depth (mm) – FEM				
	30’	60’	90’	120’	150’
SW1	18	36	51	65	78
SW2	17	34	47	60	73
HW3	16	31	45	57	68
HW4	15	26	36	46	56

Fig. 4: Charring depth of SW1 for the different methods

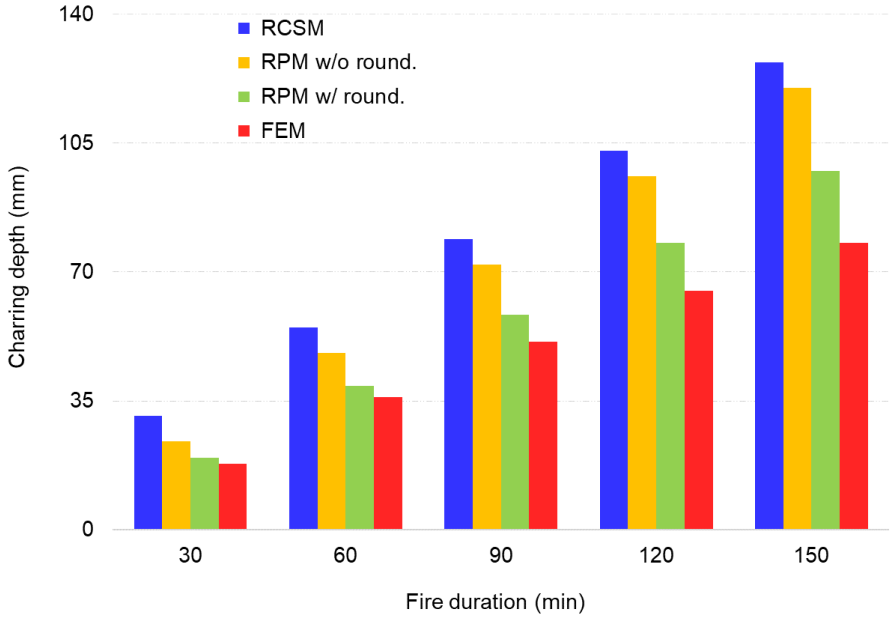


Fig. 5: Charring depth of SW2 for the different methods

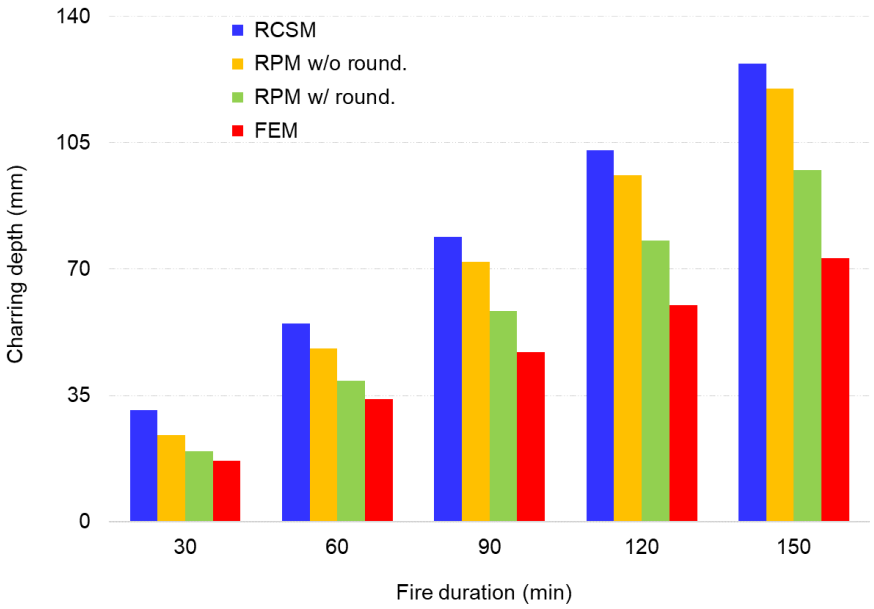


Fig. 6: Charring depth of HW3 for the different methods

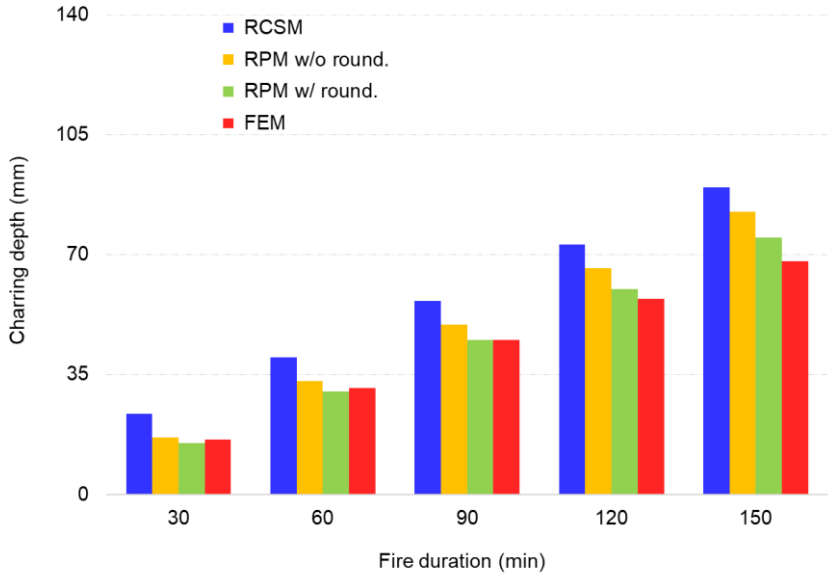
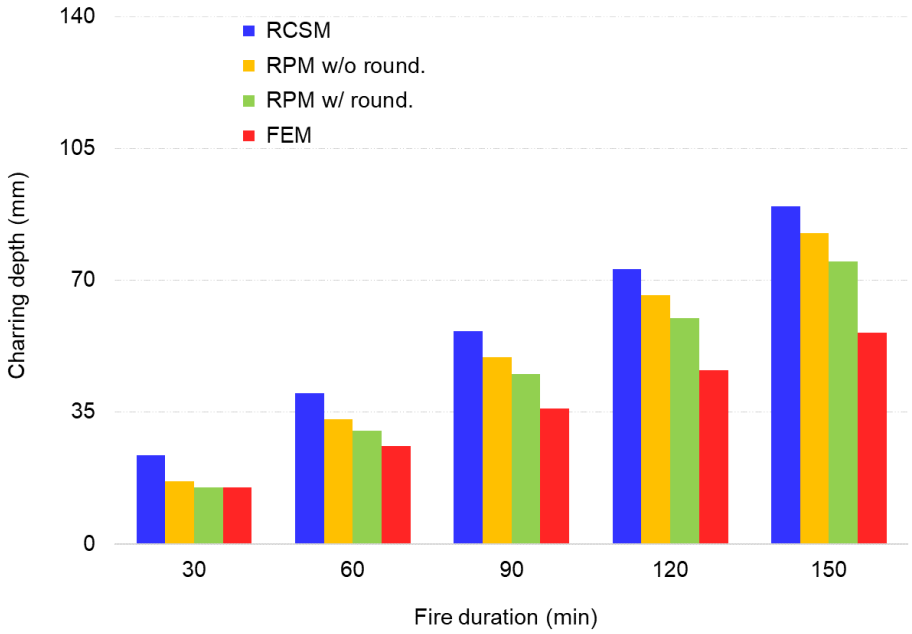


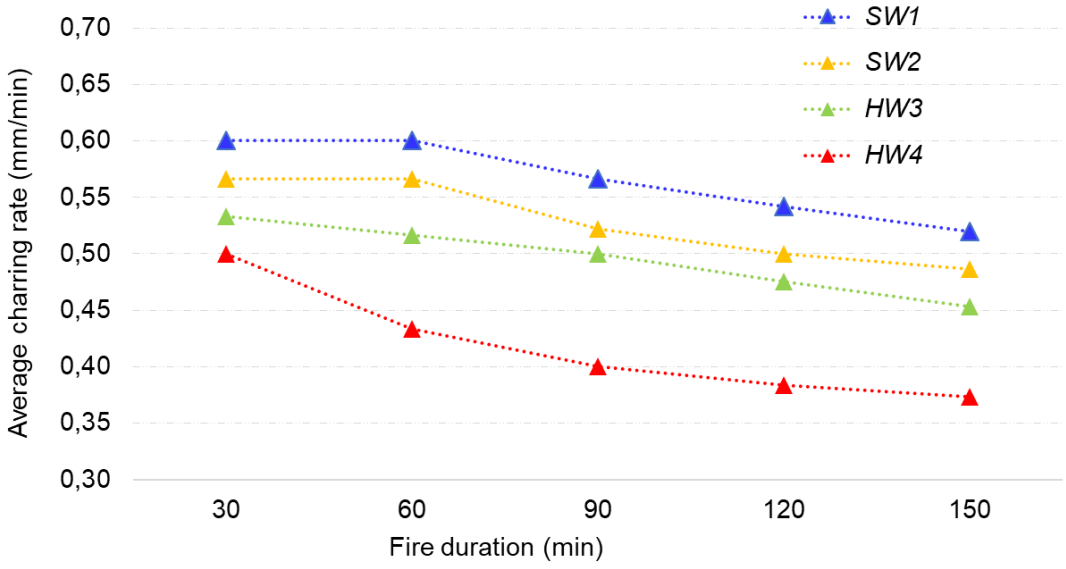
Fig. 7: Charring depth of HW4 for the different methods



It can be seen that the charring depth is higher for lower densities and, except for HW3 with 30 and 60 min, they were inferior for numerical analysis if compared with the use of simplified methods.

Evaluating the average charring rate resulted from the numerical analysis, which is presented by Fig. 7, it can be seen that it decreases as further the fire occurs, due to the thermal conductivity of the char being lower than the conductivity of the wood that originated it, as indicated by EC5 and FRIQUIN [5, 7]. The average charring rate tends to be constant for infinite times of fire exposure, corroborating with [5, 16].

Fig. 8: Average charring rate of the different species studied



DETERMINATION OF BENDING RESISTANCE

With the charring depths defined, the resistance of the elements can be verified. As the established element simulates a beam, usually related to loadings perpendicular to it, verification was made over the bending resistance. Fig. 8, Fig. 9, Fig. 10 and Fig. 11 illustrate the variance of the results for the different species with each method, using the instant of ignition resistance as the relative value.

Fig. 9: Fire duration x bending resistance for SW1

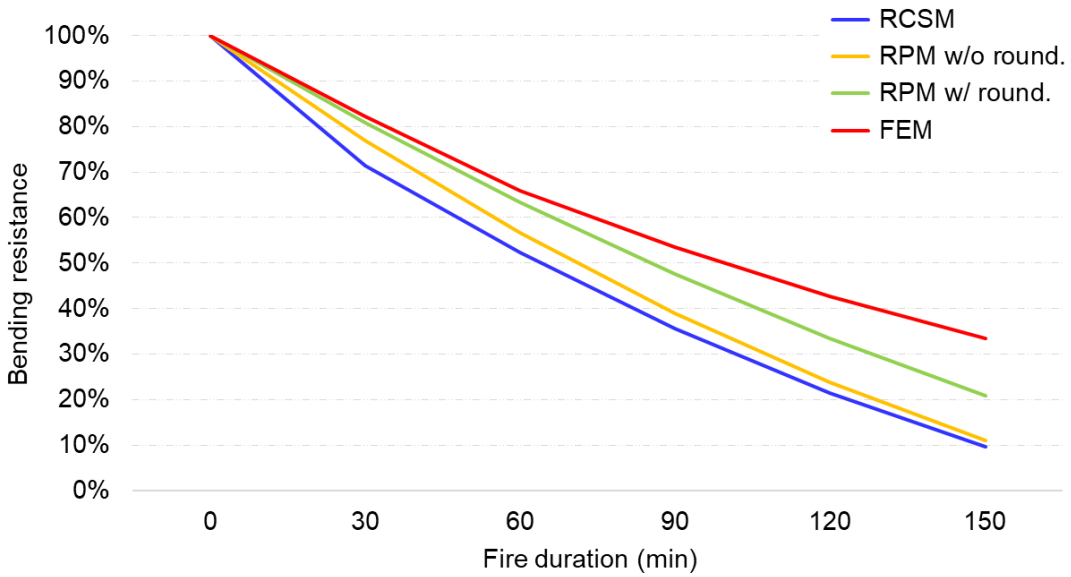


Fig. 10: Fire duration x bending resistance for SW2

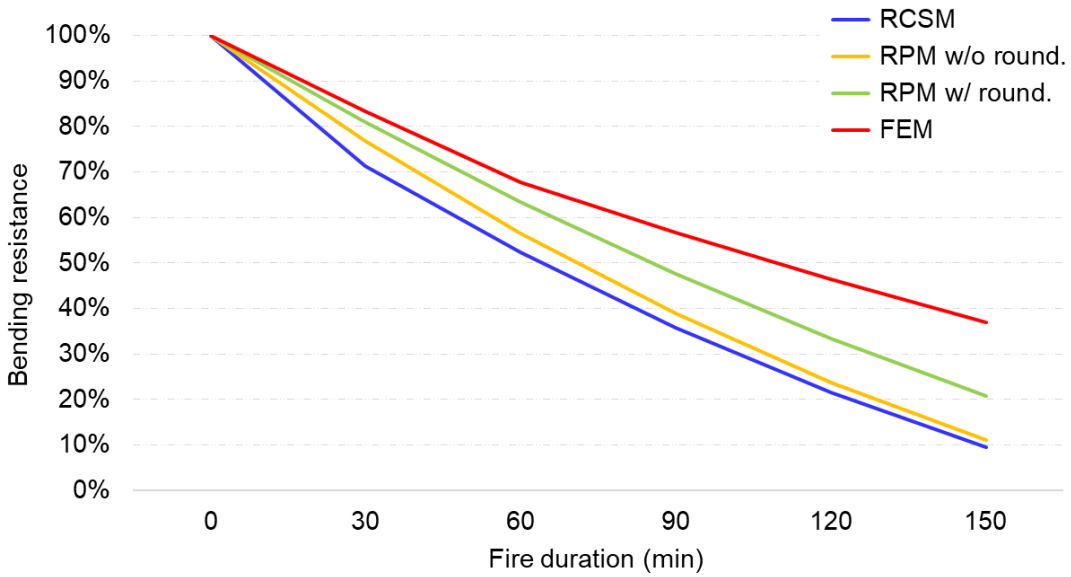


Fig. 11: Fire duration x bending resistance for HW3

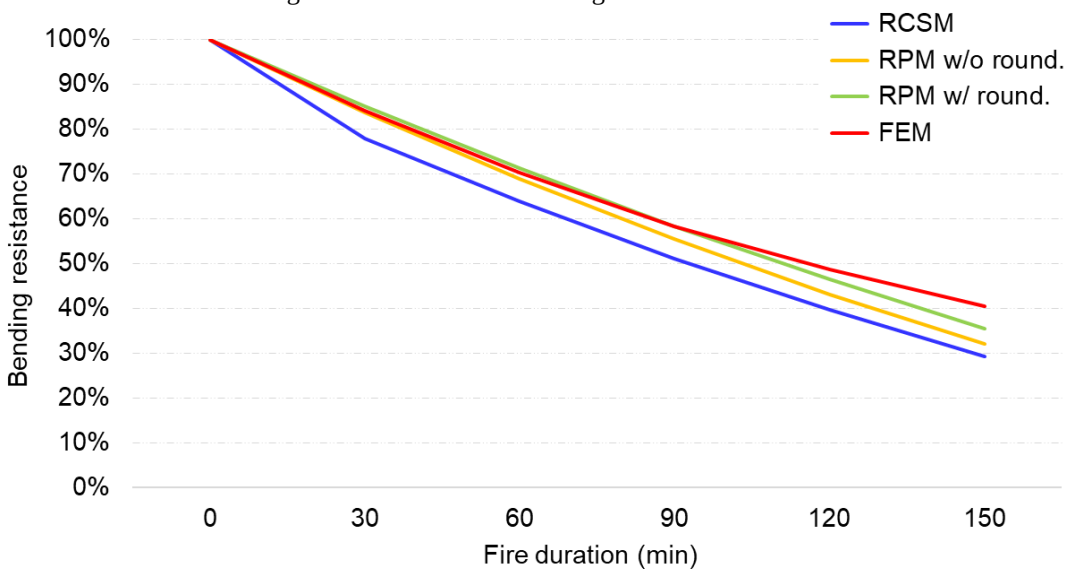
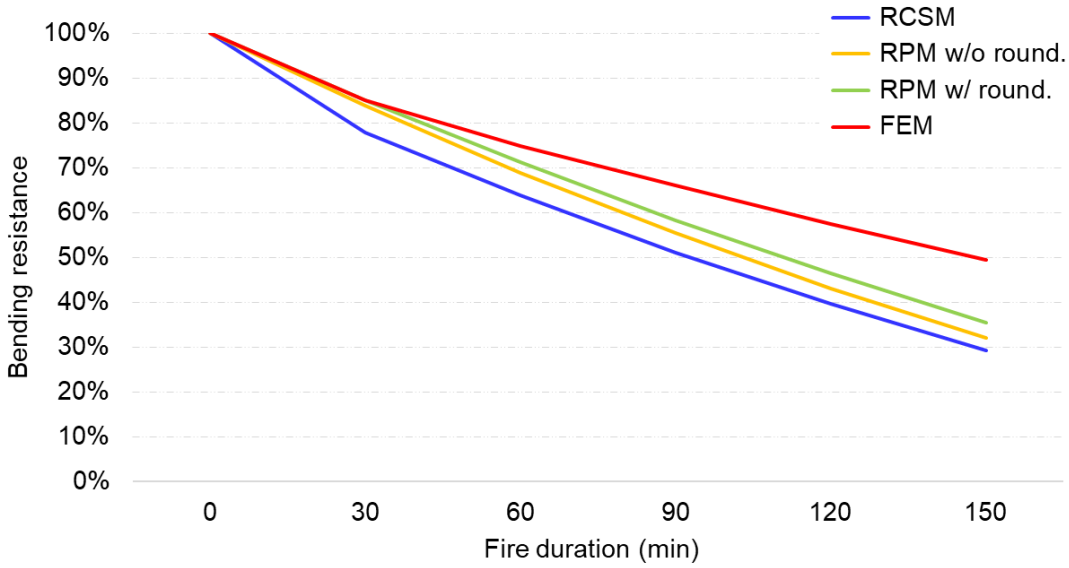


Fig. 12: Fire duration x bending resistance for HW4



As the bending resistance of the elements is directly related to its charring depth during fire occurrence, the results were lower for FEM analysis when compared to RPM considering the rounding effect for the beam HW3. For HW3 at time of 90 min and HW4 for time of 30 min of fire, results were the same. And for all the other comparisons between FEM and simplified methods for different species and different times, the advanced calculation method presented higher values of bending resistance.

Opposing the equality between different species of the same class (softwood or hardwood) brought by EC5, FEM showed difference depending on the wood density: resistance results of SW2 were 10,41% higher than SW1 at minute 150 of fire occurrence, while results of HW4 were 22,36% for the same time. For lower times, difference was smaller, demonstrating that the difference is higher for longer fires.

When compared the different methods for each species, it can be seen that results using FEM analysis were noticeably higher than simplified methods for the longest fire durations analyzed in this study. For the time of 150 min, FEM showed results:

- For SW1:
  - 60,3% higher than RPM with rounding effect;
  - 203,89% higher than RPM without rounding effect;
  - 250,51% higher than RCSM;
- For SW2:
  - 77,14% higher than RPM with rounding effect;
  - 235,53% higher than RPM without rounding effect;
  - 287,1% higher than RCSM;
- For HW3:
  - 14,7% higher than RPM with rounding effect;
  - 2643% higher than RPM without rounding effect;
  - 3,59% higher than RCSM;
- For HW4:
  - 39,57% higher than RPM with rounding effect;
  - 54,70% higher than RPM without rounding effect;
  - 69,58% higher than RCSM.

Again, as for charring rate, results with FEM analysis showed lower bending resistance for 30 and 60 min for HW3 when compared with RPM with rounding effect. The difference was 1,12% and 1,25% for the times mentioned.

DEVELOPMENT OF NEW EQUATION FOR DETERMINING CHARRING RATE

In the FEM analysis carried on in this study, it was verified that the charring rate varies according to the wood density. Also, its values are higher for lower durations of fire, making it become lower as the time of fire occurrence increases. These two behaviors are observed in two different international standards: Australian Stantards approach the charring rate as dependent of the wood density, while the AWC uses the time of fire occurrence to the power of 0,813 in order to insert the peak of charring rate that occurs in the border of the cross-section in the initial instants of fire. As the behavior of each international criteria is close to the behaviors found in the FEM analysis, both equations that guide the standards (Eq. 2 for the Australian, with charring rate in mm/min, and Eq. 3 for the North-American, with charring rate in in/h) were gathered in one (Eq.4).

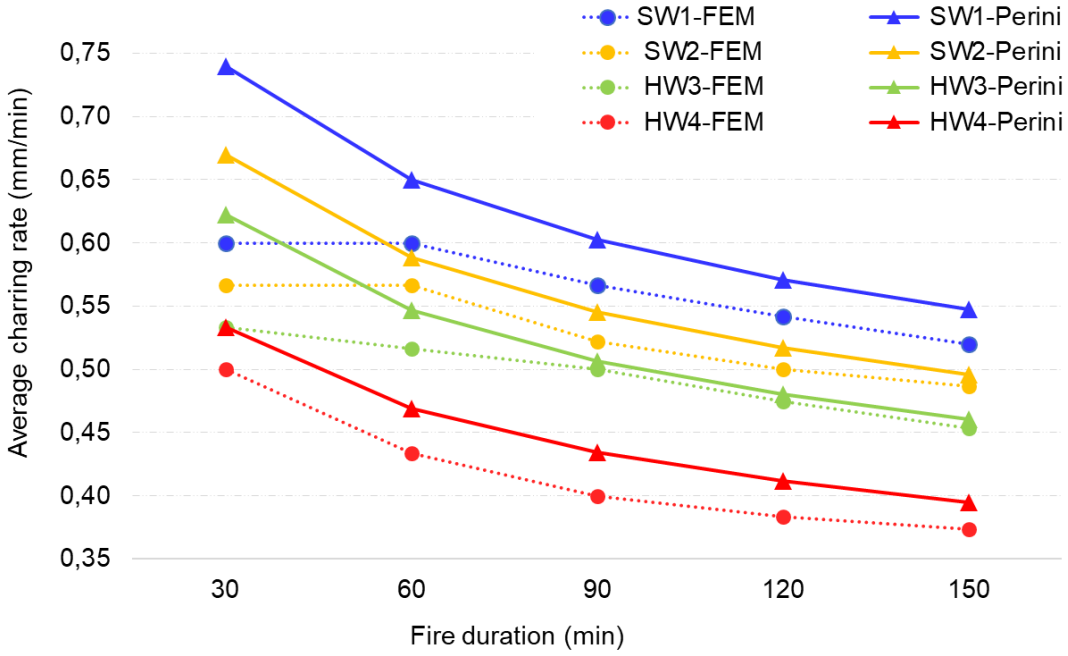
$$\beta = 0{,}4 + (280 \div \rho_{12})^2 \qquad \text{Eq. (2)}$$

$$\beta = d_{char} \div t = (\beta_x \times t^{0,813}) \div t \qquad \text{Eq. (3)}$$

$$\beta = \frac{60^{0,187} \times \left[0,4 + \left(\frac{280}{\rho_{12}}\right)^2\right]}{t^{0,187}} \qquad \text{Eq. (4)}$$

With the new equation, new curves were determined for each species analyzed, being then compared with the results of the FEM analysis. Fig. 13 illustrates the comparison (new equation results are identified as 'Perini').

Fig. 13: Average charring rate for FEM and new equation



It can be seen that the curves of the new equation were closer to the results found in the FEM analysis, if compared the proximity between FEM results and simplified methods results. For the time of 30 min, the highest difference was around 23,3% for SW1. Excluding 30 min results – which diverged from the curve pattern –, difference was close to 8,6%.

When it comes to bending resistance, Fig. 14, Fig. 15, Fig. 16 and Fig. 17 show that results between FEM analysis and results using the new equation adapted to the RPM with rounding effect are very close, having the highest difference verified in around 8,4%, for SW1 at the time 150 min of fire duration.

Fig. 14: Fire duration x bending resistance for SW1

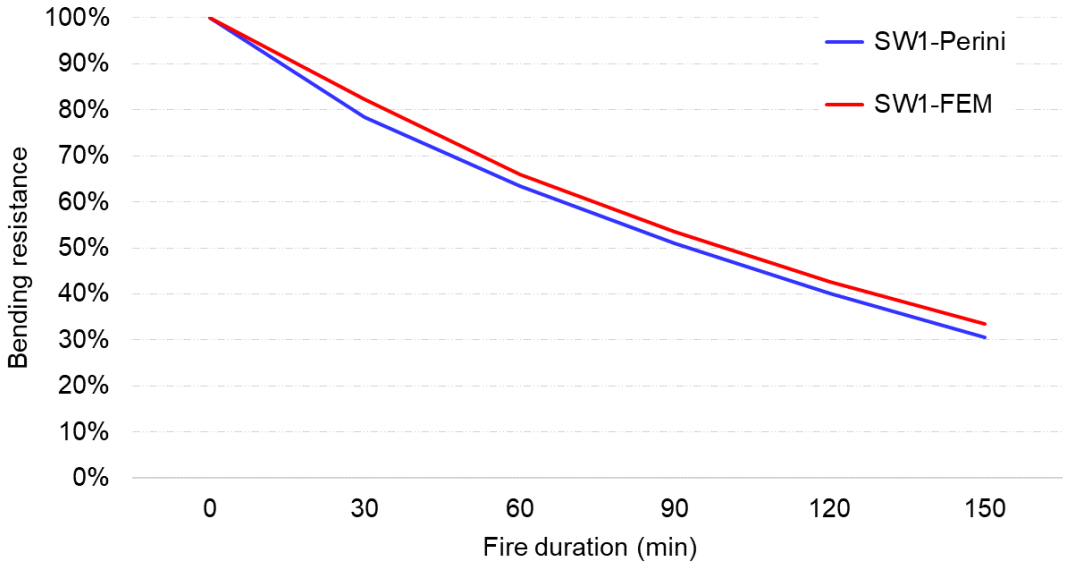


Fig. 15: Fire duration x bending resistance for SW2

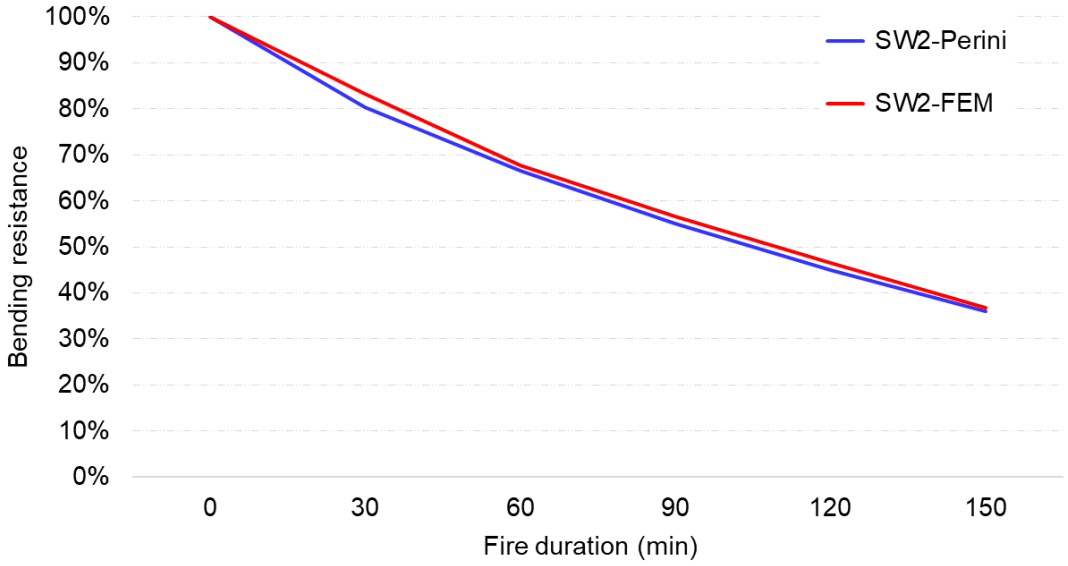


Fig. 16: Fire duration x bending resistance for HW3

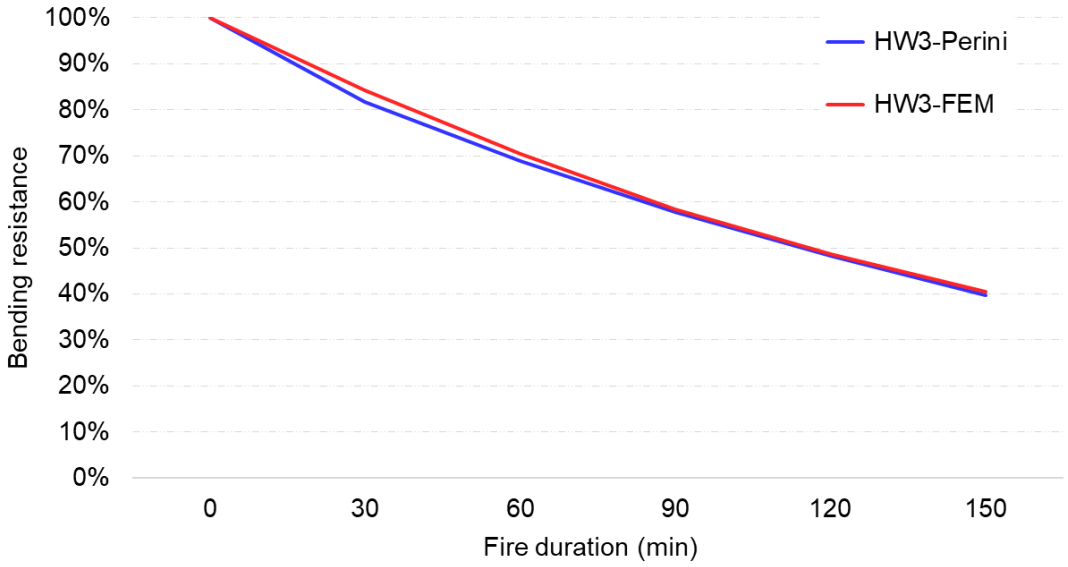
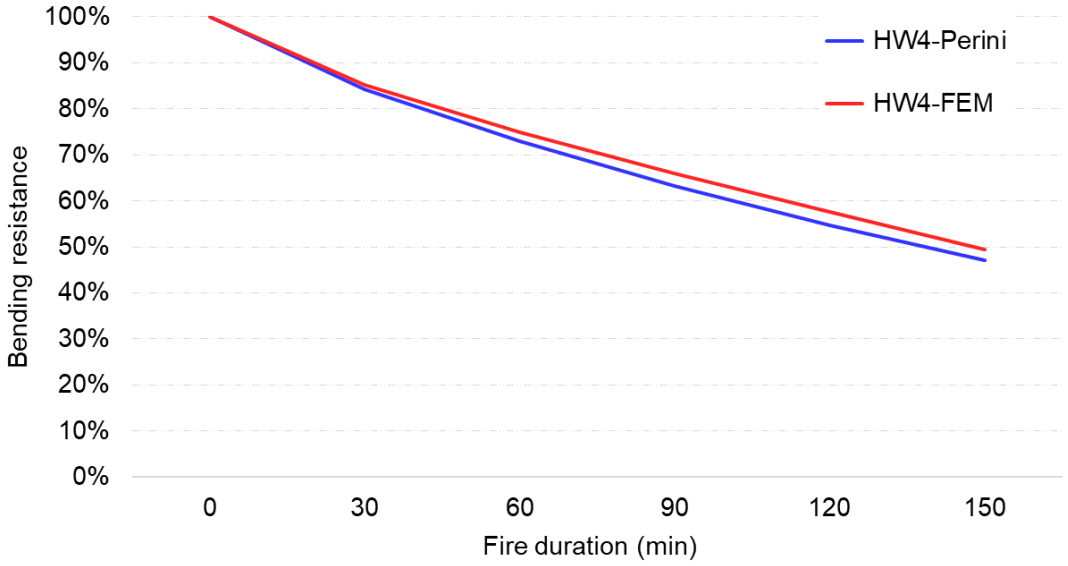


Fig. 17: Fire duration x bending resistance for HW4



CONCLUSION

It was verified that the charring rate depends strong and directly on the density of the wood that is being used in the timber element, being lower for higher densities. That converges to what was mentioned by various authors and is brought by the Australian standards.

The difference between simplified methods and FEM analysis according to the parameters proposed by EC5 are higher than the difference found between the same FEM analysis and the RPM with rounding effect using the results of charring depth originated from the new equation proposed in this study. Moreover, the use of the new equation reached lower bending resistance results than advanced calculation in all times for all species studied, meaning that it respected a certain degree of conservatism in these cases.

Considering that calculation tools used for projecting buildings are no longer limited as they were decades ago, simplified methods as the ones brought by EC5 present little interest economically wise. Solving more complex equations as the one proposed in this study is simple with tools of daily use by professionals who project structures, and its proximity with FEM analysis justify their adoption.

Despite the use of EC5 criteria for FEM analysis being accepted by different authors, it must be enhanced that the results presented in this study are based on theoretical values, being of great interest that similar analysis were run experimentally to check if they corroborate with these results.

REFERENCES

1. Toppinen, A., et al. (2018). The future of wooden multistory construction in the forest bioeconomy: A Delphi study from Finland and Sweden. *Journal of Forest Economics, 31*, 3-10. https://doi.org/10.1016/j.jfe.2017.05.001

2. Zubizarreta, M., et al. (2019). Modeling the environmental sustainability of timber structures: A case study. *Environmental Impact Assessment Review, 78*, 1-11. https://doi.org/10.1016/j.eiar.2019.106286

3. United Nations (UN). (2024). The 17 goals. https://sdgs.un.org/goals#goals

4. Shigue, E. K. (2018). *Difusão da construção em madeira no Brasil: Agentes, ações e produtos* [Thesis, Universidade de São Paulo].

5. Friquin, K. L. (2011). Material properties and external factors influencing the charring rate of solid wood and glue-laminated timber. *Fire and Materials, 35*, 303-327. https://doi.org/10.1002/fam.1055

6. Thi, V. D., et al. (2016). Finite element modelling of the pyrolysis of wet wood subjected to fire. *Fire Safety Journal, 81*, 85-96. http://dx.doi.org/10.1016/j.firesaf.2016.02.001

7. CEN. (2004). *Eurocode 5 – Design of timber structures. Part 1-2: General – Structural fire design* (EN 1995-1-2). Brussels, Belgium: European Committee for Standardization.

8. Quiquero, H., Gales, J., & Abu, A. (2019). Finite element modelling of post-tensioned timber beams at ambient and fire conditions. *Fire Technology*. https://doi.org/10.1007/s10694-019-00901-0

9. Adetayo, O. A., & Dahunsi, B. I. O. (2018). Development of models for charring rate of selected construction timber species in South-Western Nigeria. *FUOYE Journal of Engineering and Technology, 3*, 17-21. https://doi.org/10.46792/fuoyejet.v3i1.115

10. Wen, L., Han, L., & Zhou, H. (2015). Factors influencing the charring rate of Chinese wood by using the cone calorimeter. *BioResources, 10*, 7263-7272.

11. Njankouo, J. M., Dotreppe, J. C., & Franssen, J.-M. (2004). Experimental study of the charring rate of tropical hardwoods. *Fire and Materials, 28*, 15-24. https://doi.org/10.1002/fam.831

12. Cachim, P. B., & Franssen, J.-M. (2008). Comparison between the charring rate model and the conductive model of Eurocode 5. *Fire and Materials, 33*, 129-143. https://doi.org/10.1002/fam.985

13. Associação Brasileira de Normas Técnicas (ABNT). (1997). *NBR 7190 – Projeto de estruturas de madeira*. Rio de Janeiro, Brasil.

14. Fahrni, R., et al. (2017). Fire tests on glue-laminated timber beams with specific local material properties. *Fire Safety Journal*, 1-9. https://doi.org/10.1016/j.firesaf.2017.11.003

15. AS 1720.4. (2019). *Timber structures Part 4: Fire Resistance of Timber Elements*. North Sydney, Australia: Standard Australia.

16. Mikkola, E. (1991). Charring of wood-based materials. *Fire Safety Science, 3*, 547-556. http://dx.doi.org/10.3801/IAFSS.FSS.3-547

The effects of recidivism on criminal enforcement

https://doi.org/10.56238/sevened2024.026-029

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ABSTRACT

The main purpose of the article is to analyze the effects of recidivism in the context of penal execution, when prison task forces are carried out. In order to develop the study, the starting point will be the understanding of the functioning of the task forces and, then, the legal analysis of the issues related to recidivism. The general objective of the study is to analyze what are the effects of recidivism on penal execution and, in order to achieve the desired proposal, the following are the following specific objectives: to understand the functioning of a prison task force; reflect on the importance of the prison task force; understand the position of the STJ with regard to the process of calculating penalties for cases of recidivism. To this end, as a technical procedure, a bibliographic, descriptive research and deductive approach method will be carried out.

Keywords: Task Force, Prison, Recidivism, Resocialization.

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INTRODUCTION

The proposal presented in this study is directly related to the finding of cases of recidivists (people who incur in a new criminal type), when prison task forces are carried out in several prisons in the districts of the State of Paraíba.

In this way, while reading the article, the reader will be able to follow the modus operandi of a prison task force and, in particular, what is the great legal and social function of this process, in the context of penal execution.

In order to be able to carry out the development of the text, it was decided to follow as a general objective to analyze what are the effects of recidivism in the penal execution and, in order to achieve the desired proposal, the following specific objectives are: to understand the functioning of a prison task force; reflect on the importance of the prison task force; understand the position of the SJT with regard to the process of calculating penalties for cases of recidivism. To this end, as a technical procedure, a bibliographic, descriptive research and deductive approach method will be carried out.

SOCIAL AND LEGAL ASPECTS OF PRISON TASK FORCES

After more than 10 (ten) years carrying out prison task forces in several prisons in the Judicial Districts of the State of Paraíba, serving re-educating for various crimes, many of them recidivist, that "etymologically, the term recidivism, from the Latin recidere, means relapse into a new crime", it was observed the need for a deepening of the study of recidivism, whether specific or not, and its effects on penal execution.

The prison task forces are carried out in alphabetical order, with the presence of a Judge, a Prosecutor and a Public Defender, all working in penal execution, and has had a double effect, granting benefits to inmates who have already reached the objective and subjective requirements, and giving the right to listen to those who are incarcerated and often, without proper assistance.

During the task forces, it is a fact that several inmates return, either due to the difficulty of staying out of prison, some after several years incarcerated, which makes it difficult to get a job, mainly due to the use of the electronic anklet, in the face of existing prejudice and many because they are part of factions and generally comply with orders and new crimes are committed.

And if they are already convicted, a final and unappealable sentence, with the practice of a new crime, comes recidivism, which aggravates the situation of the re-educating, and in the face of some understandings, the aggravation is greater, and it is about the effects of recidivism in the penal execution that this article deals with.

Currently, the Penal Code regulates recidivism through arts**.** 61, 63 and 64. See:

> These are circumstances that always aggravate the penalty, when they do not constitute or qualify the crime:
> I – recidivism.
> Recidivism is an aggravating circumstance and at the time of sentencing it must be analyzed at the time of the application of the penalty, as we will see later.
> Article 63 of the same law defines recidivism:
> Recidivism occurs when the agent commits a new crime, after the final and unappealable sentence that, in the country or abroad, convicted him of a previous crime. (BRAZIL, 1940)

And then, article 64 regulates the time in which the effects of recidivism will prevail

> For the purpose of recidivism:
>
> I – The previous conviction does not prevail if between the date of completion or extinction of the sentence and the subsequent offense a period of time greater than five (5) years has elapsed, including the probation period of suspension or conditional release, if there is no revocation. (BRAZIL, 1940)

As can be seen, for recidivism to occur, three factors are necessary: the commission of a previous crime; the final and unappealable judgment of the conviction and the commission of a new crime. And making a brief historical analysis, recidivism has been part of the Penal Code since the time of the Empire. Let's see in Carrazzoni's lesson (2005, online):

> Recidivism in Brazil has been present since the Criminal Code of the Empire of 1830 (article 16, § 3) and in the Penal Code of 1890 (article 40); in both diplomas it was considered an aggravating circumstance, in relation to the "new" crime, as long as it was of the same nature as the antecedent (specific recidivism). It was only in the 1940 Code that the legislator simultaneously adopted generic and specific recidivism (articles 46 and 47), but in perpetuity. In 1977, with the advent of Law 6.416, the Brazilian legislator changed the criterion for applying recidivism, imposing a limit on the time lapse (5 years) and abolishing the specific form of the institute under analysis. (Carrazzoni, 2005 online)

The Penal Code of 1940 made a distinction between specific and generic recidivism, in article 46, which provided as follows:

> Article 46 – Recidivism occurs when the agent commits a new crime, after the sentence has become final, which in the country or abroad, has convicted him of a previous crime.
> Paragraph 1 – Recidivism is said:
> I – Generic, when the crimes are of a different nature;
> II – Specific, when the crimes are of the same nature.
> Paragraph 2 – Crimes of the same nature are considered to be those provided for in the same legal provision, as well as those that, although provided for in different provisions, present common fundamental characteristics due to the facts that constitute them, or for their determining reasons.
>
> Article 47 – Specific recidivism matters:
> I – the application of the custodial sentence above the minimum with the maximum;
> II - the application of the most serious penalty in quality, among those alternatively committed, without prejudice to the provisions of no. I. (BRAZIL, 1940)

With the entry into force of Law No. 6,416, of May 24, 1977, the Penal Code was amended, imposing a limit of 05 years and abolishing the specific form. In the Penal Code of 1940 the effects

of recidivism were perpetual, no matter how long the crime was committed, it would always exist, which was corrected, imposing the limit of 05 years, however, only with the reform of 1984, which took place on July 11, 1984, Law No. 7,209, which completed 40 years this year, recidivism is now dealt with in arts. 63 and 64, of the Penal Code, but maintaining the maximum period of 05 years, counting from the extinction of the punishability.

It is worth mentioning that in that year, 1984, we had a prison population of 258,503 prisoners, for a population of 134 million inhabitants. And according to a report released by the National Secretariat for Penal Policies (SENAPPEN) through the 15th Cycle of Penitentiary Information Survey of the National Penal Information System (SISDEPEN) with data for the second half of 2023, the prison population is 650,822 prisoners in physical cells and 201,188 under house arrest, for 203,080,756 million inhabitants, data updated on 12.22.2023, from the last Census of 2022 (BRASIL, 2022).

The prison population in these 40 years has only grown. And many of those who left, returned, demonstrating, in theory, a greater dangerousness, since the one who is a repeat offender is not always the most dangerous. It may be that the individual is a repeat offender in a crime of bodily injury and a primary offender in a crime of rape, and certainly, the crime of rape demonstrates greater dangerousness. But many have always thought that recidivism was a cause of greater danger and that is why the legislator sought a way to punish more severely those who commit more than one crime. The one who leaves the prison unit and then returns, often leaves serving his sentence in the semi-open regime, commits a new crime and returns. And if the final judgment has already occurred, is not serving a sentence with a provisional collection slip, it will be, in case of a new conviction, configured as recidivism.

The Penal Execution Law, 7.210/84, admits, in its article 2, sole paragraph, that it is possible that a re-educating person is serving a sentence and is not subject, if he commits a new crime, to the effects of recidivism, due to the absence of res judicata.

Recidivism is considered an aggravating circumstance of the penalty, it must be evaluated in the 2nd phase of dosimetry, and cannot be included in the judicial circumstances, under penalty of incurring bis in idem, and thus, the issue was summarized – Precedent 241, of the STJ: "***Criminal recidivism cannot be constituted as an aggravating circumstance and, simultaneously, as a judicial circumstance."*** (emphasis added).

Recidivism can be recognized by the court of criminal executions, regardless of the prosecuting court. And in the beginning, where it was understood that it was not possible to recognize recidivism if it had not been recognized by the sentencing court, we, judges of criminal execution, did not apply it when preparing the calculations for the issuance of the certificate of sentence to be served, and consequently, in the granting of benefits. And this understanding lasted for

a long time, and with the change, it caused a lot of controversy due to the fact that there were scholars who understood that it violated res judicata, however, from the judgment of the Motion for Clarification of Divergences in RESP No. 1.738.968 – MG (2018/0104698 – 0) whose rapporteur was Justice Laurita Vaz, of the Superior Court of Justice, the discussion was resolved and recidivism was recognized even if it had not been recognized in a sentence, in the criminal execution phase.

This decision generated a lot of impact in the scope of Penal Execution. Let's look at the menu:

> 'MOTION FOR CLARIFICATION OF DIVERGENCE IN THE INTERLOCUTORY APPEAL IN THE SPECIAL APPEAL. CRIMINAL EXECUTION. FAILURE TO RECOGNIZE RECIDIVISM BY THE SENTENCING COURT. PROCLAMATION BY THE EXECUTION COURT. POSSIBILITY. INEXISTENCE OF REFORMATIO IN PEJUS. MOTION FOR CLARIFICATION GRANTED. 1. The individualization of the penalty is carried out, essentially, in three moments: in the commination of the penalty in abstract to the legal type, by the Legislator; in the criminal conviction, by the Court of Knowledge; and in criminal execution, by the Court of Executions.2. The intangibility of the final criminal conviction does not remove from the Criminal Execution Court the duty to adapt the fulfillment of the criminal sanction to the personal conditions of the defendant. 3. 'In the case of a criminal conviction, the execution court must stick to the content of the aforementioned *decision*, with regard to the quantum of the penalty, the initial regime, as well as the fact that the custodial sentence has been replaced or not by a sentence that restricts rights. However, the personal conditions of the patient, such as recidivism, must be observed by the execution court for the granting of benefits (regime progression, conditional release, etc)' (AgRg no REsp 1.642.746/ES, Rel. Minister MARIA THEREZA DE ASSIS MOURA, SIXTH PANEL, judged on 08/03/2017, DJe 08/14/2017). 4. Motions for divergence granted in order to upset the embargoed judgment, grant the interlocutory appeal, grant the special appeal and, thus, also annul the judgment under appeal and the decision of the first instance, and the Court of Executions must promote the rectification of the certificate of sentence to record recidivism, with all the resulting consequences."

And several interpretations emerged, and understanding that these are different attributions, Masson (2024 p. 410) discusses the subject well:

> Recidivism may be admitted by the court of criminal executions for analysis of the granting of benefits, even if not recognized by the court that handed down the conviction. The recognition of recidivism in the phases of cognizance and criminal execution produces different effects. It is incumbent upon the court of cognizance to apply the aggravating circumstance of article 61, item I, of the Penal Code, for the purpose of aggravating the reprimand and setting the initial regime for serving the sentence. Secondly, the recognition of this personal condition for the purpose of granting benefits of criminal execution is the responsibility of the Criminal Execution Court under the terms of article 66, item III, of the Criminal Execution Law. Thus, even if not recognized in the conviction, recidivism must be observed by the Execution Court for the granting of benefits, and the allegation of reformatio in pejus or violation of res judicata is unreasonable, as they are distinct attributions. (Masson, 2024 p.410).

And in view of the matter having been much debated, and with the decision of the Superior Court of Justice, cited, when deciding on a benefit to be granted in the context of criminal execution, the judge must observe the issue of recidivism, which can be specific or generic. And this issue of the distinction of recidivism, which had been excluded from the Penal Code of 1940, continued to be observed in the decisions in the application of the penalty and even in the execution of penalties.

With the entry into force of the Anti-Crime Package, Law No. 13,964/2019, the criteria for regime progression were modified, repealing article 2, paragraph 2, of Law No. 8,072/90, which provided for regime progression in heinous or equivalent crimes. And from then on, specific recidivism began to have a connotation of further aggravating the period for obtaining benefits.

Commenting on the subject, Lima (2024 p.97), in his work Manual de Execução Penal, states as follows:

> "Then comes the Anticrime Package, introducing new objective requirements for regime progression, relatively more severe, depending on the specific case. Considering that Law No. 12,964/19 also revoked article 2, paragraph 2, of Law No. 8,072/90, which, at least until then, provided for the progression of the regime for heinous or equivalent crimes, it is necessary to conclude that the new system contained in article 112 of the LEP, with distinct and specific criteria and percentages for each group, it is applicable even for such crimes. Take, for example, the specific recidivist in a heinous crime or equivalent to resulting in death: if, until the entry into force of Law No. 13,964/19, progression was conditional on the fulfillment of 3/5 (three fifths), that is, 60% of the sentence – revoked paragraph 2 of article 2, of Law No. 8,072/90 -, henceforth, read in relation to crimes committed as of the effectiveness of the Anticrime Package (01.23.2020), such convict will have to serve at least 70% (seventy percent) of the sentence. (Lima, 2024 p.97)

Recidivism can be generic or specific. In the generic one, the crimes committed are of different criminal types, and in the specific one, the crime must be of the same criminal type, of the same or similar type. In the case of a heinous or similar crime, without the result of death, if you are convicted of a new crime of this kind, a specific recidivist, the progression will only occur if you serve 60% (sixty percent), which was previously a single threshold, 2/5 or 40%.

Because recidivism is a condition of a personal nature, there are understandings that in a sum of penalties, it should be levied on the total sentence, which has generated a very large increase so that re-educating recidivists can obtain new benefits, which I disagree with this understanding because I understand that it is not a fair criterion, and I accept the understandings that, Although it is a personal condition, it should not be levied on the sum, and each penalty should correspond to the respective percentage. Let's see some judgments:

> "INTERLOCUTORY APPEAL IN HABEAS CORPUS. CRIMINAL EXECUTION. RECIDIVISM. PERSONAL CONDITION THAT AFFECTS THE TOTAL OF THE SENTENCES. IMPOSSIBILITY OF CONSIDERING THE REPRIMANDS INDIVIDUALLY IN ORDER TO APPLY DIFFERENT PERCENTAGES FOR EACH ONE. PRECEDENTS OF THIS COURT. APPEAL DISMISSED. 1. The contested judgment was rendered in line with the understanding of this Superior Court, which was consolidated in the sense that recidivism consists of a personal condition, relating, therefore, to the person of the convicted person and not to his convictions considered individually. As such, recidivism must follow it throughout the penal execution, and there is not even mention of offense to the limits of res judicata, when not found by the Court that handed down the conviction, but recognized by the executing Court. 2. Corroborating this understanding, the Superior Court of Justice understands that "the condition of recidivist, once acquired by the sentenced person, extends over the totality of the sentences combined, and the isolated consideration of each conviction is not justified, nor the application of different percentages for each of the reprimands" (HC 307.180/RS, Rel. Minister FELIX FISCHER, FIFTH PANEL, j. 16/4/2015, DJe 13/5/2015). 3. Regimental appeal not granted." (STJ –

> Regimental Appeal in Habeas Corpus – AgRg no HC 711428 – SC 2021/0393 046 – 1 – Published on 06.14.2022).
>
> "SPECIAL APPEAL. CRIMINAL EXECUTION. UNIFICATION OF PENALTIES. SPECIFIC RECIDIVISM IN A HEINOUS OR EQUIVALENT CRIME. CONDITION OF PERSONAL CHARACTER. EXTENSION OVER ALL SENTENCES. REPERCUSSION ON THE CALCULATION OF ENFORCEABLE BENEFITS. POSSIBILITY. 1. Recidivism is a circumstance of a personal nature that must be considered in the execution phase, when the sentences are unified, extending over the total of the sentences added together, with repercussions on the calculation of the executory benefits. 2. Under the terms of the legislation governing the matter, there is no justification for the isolated consideration of each conviction, nor for the application of a different percentage to each of the reprimands. 3. Special appeal granted." (STJ – Special Appeal – Special Appeal 1957657 MG 2021/0281875-1 – Published on 11.26.2021).

The above-mentioned decisions impose on the convict, in the face of a sum, that until the first conviction, when he was a primary offender, he be considered a repeat offender, aggravating the entire sentence unfairly. Recidivism generates an increase in the penalty due to the practice of a new crime, and if recidivism is applied to a penalty where the convict was primary, including if it is a common crime and the second crime, heinous, the first conviction will be aggravated and the calculations that will follow will be a heinous crime.

In this sense, Giamberadino (2020, p. 230) points out that:

> ″In this case, such a circumstance would be applied to the execution of a sentence that did not even receive such an aggravating factor, because at the time the convict was primary. There is no legal authorization for such a procedure. It is, in effect, a kind of review of the pro societate penalty that is not protected by any legal basis" (Giamberadino, 2020, p.230)

It was a way that the adherents of this understanding found to aggravate the time of imprisonment, and although it is the majority current to affiliate with this line of thought, the STJ – Superior Court of Justice has been changing the understanding, and what is gathered is a fairer criterion, allowing it not to be, recidivism considered in the whole sum. See:

> "HABEAS CORPUS. CRIMINAL EXECUTION. REGIME PROGRESSION. CONVICT WHO IS A REPEAT OFFENDER IN A HEINOUS OR SIMILAR CRIME. PERSONAL CONDITION IN THE EXECUTION OF THE SENTENCE. CHANGES PROMOTED BY THE ANTI-CRIME PACKAGE. SPECIFICATION OF THE NATURE OF THE OFFENSE. IMPOSSIBILITY OF INDISCRIMINATE APPLICATION OF RECIDIVISM. HABEAS PARTIALLY GRANTED. 1. According to the consolidated jurisprudence of the Superior Court of Justice, "the Criminal Execution Court is not restricted to the use given by the Court of knowledge to the criminal records that would give rise to the recidivism of the convict, so that, despite the fact that such annotation has not been recognized in all the convictions of the convict, nothing prevents its use to evaluate the personal conditions of the convicted person with regard to the granting of enforceable benefits such as, for example, conditional release" (AgRg in REsp n.1.721.638/RO, Rel. Minister Rogerio Schietti, 6th T., DJe 10/29/2019). Precedents: AgRg in HC No. 476.422/MG; HC n.378.985/ES; HC No. 379.007/RS; and AgRg in HC No. 511.766/MG.2. Although recidivism is widely recognized, as a personal condition, as an institute proper to the execution of the sentence, its current application requires the observation of recent legislative changes, promoted by Law No. 13,964/2019, regarding the thresholds required for the measurement of regime progression. 3. The Anti-Crime Package implemented a more complex scenario regarding the re-educating person's recidivism, since now it is not just a matter of simply examining the nature of the crime

(whether common or heinous) and the existence of records capable of characterizing the (generic) recidivism of the convict, but rather a more accurate incursion into the examination of the criminal record of the incarcerated individual, it will gain wide relevance whether it is a crime committed with or without violence to a person or serious threat, a heinous or equivalent crime, or even a heinous or equivalent crime resulting in death. 4. In the hypothesis, the convict serves a sentence for circumstantial robbery and two other drug trafficking offenses, that is, it is perceived that the re-educating person is, then, a specific recidivist in the practice of a heinous or equivalent crime, however, a generic recidivist as to crimes committed through violence to a person or serious threat. Consequently, as for drug trafficking crimes, considering the personal nature of recidivism, it is mandatory to comply with 60% of both sentences imposed, since it is recidivism of the same nature – namely, recidivism in a heinous or equivalent crime. However, such logic does not apply to common crime, since the sentenced person is a primary offender in the commission of a crime with violence to the person or serious threat, so that the lapse provided for in article 112, III, of the Penal Execution Law, which requires the fulfillment of only 25% of the sentence in order to investigate progression to a less severe regime, applies to the species. 5. Habeas corpus partially granted to determine the rectification of the calculation of the progression of the sentence related to the conviction of the patient for the common crime, in accordance with the conclusion of the vote." (STJ - HABEAS CORPUS No. 654.870 - MG (2021/0089333-0) RAPPORTEUR: MINISTER ROGÉRIO SCHIETTI CRUZ - Judged on 09.20.2022).

A fair criterion that it is possible to equate legal interests in the context of penal execution is, in fact, to apply the sum of the penalties by performing the calculations, but always taking into account the percentages applicable to each conviction, applying recidivism only in the penalties in which he is actually a repeat offender.

Thus, it is observed that during the prison task forces, many of the inmates assisted are considered recidivists and when moving on to the calculations of the benefits, a recidivism even when it was primary, in the first conviction, is to impose an increase that, depending on the sentence, can be considered as a new sentence, and in no way contributes to rehabilitation.

CONCLUSION

The study included the analysis of issues related to the calculation of benefits in cases of recidivism of re-educating inmates. Thus, it is observed that during the realization of the prison task forces, the re-inmates served, who are considered recidivists when they go through the calculations, must take into account the process of resocialization of the individual and, not only, consider it as a new sentence, without anything contributing to the process of rehabilitation.

It is necessary that, even when it comes to the execution of the sentence, one does not lose sight of the fact committed, its time, especially when the Anti-Crime Package brought several fractions to obtain benefits in the penal execution, otherwise, it would lose meaning in a sum of penalty.

Finally, the STJ must move towards consolidating the understanding that for each crime, the respective fraction corresponds, with the recidivism applied in the convictions that it really is and not in an interpretation of personal condition, aggravating the entire sum of the penalty.

REFERENCES

1. BRASIL. STJ. RESP n. 1.738.968 – MG (2018/0104698). Disponível em: ATC (stj.jus.br). Acesso em 15 de agosto de 2024.

2. BRASIL. STJ. AgRg no RECURSO ESPECIAL Nº 1986299 - MG (2022/0046680-0). Disponível em: ATC (stj.jus.br). Acesso em 15 de agosto de 2024.

3. BRASIL. STJ. HABEAS CORPUS Nº 307.180 - RS (2014/0270387-0). Disponível em: ATC (stj.jus.br). Acesso em 15 de agosto de 2024.

4. BRASIL. STJ. HABEAS CORPUS Nº 654.870 - MG (2021/0089333-0). Disponível em: HC 654.870-MG - STJ (trilhante.com.br). Acesso em 15 de agosto de 2024.

5. BRASIL. (2022). Censo demográfico 2022. Portal do IBGE – Instituto Brasileiro de Geografia e Estatística.

6. BRASIL. (2024). *Código Penal Comentado* (12ª ed.). Editora Método.

7. Carrazzoni Jr., J. (2005). Aspectos da reincidência sob a perspectiva do garantismo. *Boletim Jurídico, 3*(114). Disponível em: https://www.boletimjuridico.com.br/doutrina/artigo/518/aspectos-reincidencia-sob-perspectiva-garanti. Acesso em: 18 mar. 2020.

8. Giamberardino, A. R. (2020). *Comentário à Lei de Execução Penal* (2ª ed.). Belo Horizonte.

9. Lima, R. B. de. (2024). *Manual de Execução Penal* (Vol. único). Editora Jus PODIVM.

10. Masson, C. (2024). *Código Penal Comentado* (12ª ed.). Editora Método.

11. Mossin, H. A. (2012). *Comentários ao Código Penal*. Editora JH Mizuno.

12. Pontes, R. (1942). *Código Penal Brasileiro – Comentários* (3ª ed.). Editora Freitas Bastos.

Complete gravimetry of urban solid waste in the city of Manaus – AM

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ABSTRACT

82 million tons of municipal solid waste (MSW) are generated per year in Brazil, which are destined for landfills and dumps. In the city of Manaus alone, one million tons of garbage are generated per year, which results in many public health problems, soil and river pollution, emission of gases into the air, etc. Factors such as progressive population increase combined with consumption and waste behavior, lack of awareness, low percentage of other possible treatments, such as recycling and composting have contributed to this. This work aims to describe the activities developed to characterize urban solid waste destined to the landfill of the city of Manaus-AM through gravimetric analysis, composed of three steps, required by NBR 10.007/2004: quartering, identification and weighing of waste categories. It was also possible to determine the apparent specific weight of these residuals. The studies were carried out in eighteen neighborhoods, between the years 2022 and 2023. With these data, it was found a large amount of material with the capacity to be recycled (60% + 2% on dry days and 50.0% + 1.6% on rainy days) and an average apparent specific weight of 74 Kg/m³. Thus, it is concluded that selective collection and sorting are of paramount importance, as alternatives for the reduction of waste destined to the city's landfill, enabling its useful life and the reuse of recyclable materials, bringing economic, social and environmental benefits to the city and its inhabitants.

Keywords: Urban solid waste, Gravimetrics, Physical characterization of waste, NBR 10.007/2004, Recycling.

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INTRODUCTION

Federal Law No. 12,305/10, which instituted the National Solid Waste Policy (PNRS), gave a period of 10 years for the problems arising from MSW to be extinguished. After the deadline, approximately 60% of the country's cities had not yet reached this goal. Dumps and controlled landfills currently occupy large areas in large urban centers, contaminating soils and groundwater, attracting animals and insects, increasing the risks to the health of the population and increasing the emission of greenhouse gases. A considerable portion of this MSW ends up in the beds of rivers and streams, obstructing rainwater systems and causing flooding.

Between 2012 and 2022, MSW generation in Brazil increased by 11%, from 62.7 million tons to 81.8 million tons. In turn, per capita generation increased from 348 kg/year to 380 kg per year, on average, which is equivalent to 1.04 kilograms of urban waste per day for each inhabitant (ABRELPE/IBGE, 2022).

In the city of Manaus, capital of the state of Amazonas, the largest state in Brazil, with its ecological and environmental riches, approximately 1,000,000 (one million) tons of MSW are landfilled every year, in an area of 660,000 m² whose capacity is completed in 2024. In addition, the Brazilian Institute of Geography and Statistics (IBGE) classified Manaus as being the fourth worst city in Brazil with accumulation of garbage in public places. Approximately 6.2% of the surroundings of the households have the presence of accumulated garbage. Only near the streams are 108,000 residents affected with unpleasant odors, diseases and a lot of dirt. A total of 345,000 families are affected by the dirt in the streams of Manaus (IBGE, 2020).

The study area of this work focuses on the urban area of the city, on the 06 (six) administrative regions that the city of Manaus divides the city and on the urban solid waste landfill of Manaus, located at Km 19 of the AM-010 Highway – Manaus - Itacoatiara road. The objective is to describe the activities developed to characterize the urban solid waste destined to the landfill of this city through gravimetric analysis, composed of three steps, required by NBR 10.007/2004: quartering, identification and weighing of the waste categories, as well as determining the apparent specific weight of these wastes. To achieve the proposed objectives, selective collections of MSW were carried out in eighteen neighborhoods, between 2022 and 2023, in the six administrative regions of the city, namely: North, South, East, West, Center-South and Midwest. Approximately 3200 liters of MSW were collected in the neighborhoods that are part of these regions, using the labor of experienced collectors and a vehicle with a body. For each collection site, gravimetry tests

were performed: quartering, identification, volume and mass measurement, and calculation of percentages, as well as calculation of apparent specific weight.

DEVELOPMENT

ENVIRONMENTAL IMPACTS

Rapid urbanization and the absence of effective waste management systems have turned landfills into one of the world's biggest problems. About 40% of the planet's solid waste goes to these areas, harming the lives of about 4 billion people. One of the solutions is the creation of sanitary landfills, a strategy taken by the Brazilian government since 2010 to deactivate dumps and promote better management of what is discarded (MMA. 2019).

A study carried out by the World Wide Fund for Nature (WWF) shows that Brazil is the fourth country in the world that produces the most garbage. There are more than 11 million tons per year. Our country is behind only the United States (1st place), China (2nd) and India (3rd). The Abrelpe study (2019) shows that the impact of landfills here in Brazil entails a cost of more than R$ 3 billion per year for the health system (MMA. 2019).

Latin America and the Caribbean region has one of the highest urbanization rates in the world, with an estimated 500 million people living in cities, which translates to about 80% of the population. Among the various problems caused, those related to mobility, safety, health, well-being, sanitation and adequate management of USW stand out. About 354,000 tons are produced daily, through inhabitants with the most diverse consumption habits, cultural characteristics and purchasing power. Of this fraction, it is estimated that 50% (or more) of the MSW generated are from food waste and materials of organic origin. Despite this great potential for recovery through different technological options that exist today, the portion of organic waste from MSW is discarded and deposited in landfills or dumps, bringing severe impacts to the environment, with the generation of Greenhouse Gases (GHG) in the face of the emission of methane gas (CH4), which is 25 times more harmful than carbon dioxide (CO2). and currently accounts for 3% of total GHG emissions in the atmosphere (ABREN, 2019).

In addition, there is the risk of contamination of water resources by leachate or leachate, that is, a reduction in the drinking water available on the planet. Because of its enormous volume (approximately half of MSW in developing countries), municipal organic waste deserves proper and specialized management. In addition to minimizing costs and severe environmental impacts, it is

possible to produce important by-products such as energy (electricity and thermal), fertilizers, and fuels (ABREN, 2019).

PUBLIC HEALTH

Dumps are a global emergency for health and the environment. Landfills receive about 40% of the world's waste and serve 3 to 4 billion people. The 50 largest dumps affect the daily lives of 64 million people, a population the size of France. As urbanization and population growth continue, several hundred million people will be served by dumps, particularly in low-income countries. If the situation follows the usual scenario, landfills will generate 8 to 10% of man-made greenhouse gases by 2025 (ISWA, 2019).

More than 750 people died due to poor waste management in dumps in the first half of 2016 alone (ISWA, 2019). Abrelpe (2020) reports that dumps cost health systems one billion dollars a year. Even in times of pandemic, dumps continue to operate in Brazil and affect the health of more than 77 million people.

In addition to being a source of diseases such as dengue, yellow fever, zika and chikungunya, parasitosis and many others, combined with the deficient structure and scarcity of resources of the Unified Health System (SUS), there are also high social and economic costs in public spending by the municipality, state and federal government. In addition, zoonoses – infectious diseases capable of being naturally transmitted between animals and humans – represent 60% of all infectious diseases in humans and are on the rise due to the destruction of wild habitats resulting from the most diverse economic activities. These diseases certainly affect the tripod of sustainability – the economy, society, and the environment, in addition to the negative impacts on community life (SANEAMENTO BÁSICO, 2020).

Basic sanitation portal (2020) suggests that proposals for the environmentally correct disposal and treatment of garbage, in all its classifications, first involve massive investments, in a planned and responsible way, in sustainable alternatives and with substantial gains for health, the economy and the environment with all the complexities that affect it. He cites what governments have done during the Covid-19 pandemic, concerned with protecting populations, with even emergency and reserve investments, in two consecutive years so far.

The garbage that human beings produce and throw on the planet every day is a very serious risk to the health of all living beings and the planet itself. Here are some of the problems that garbage can cause: Diseases: Garbage that goes to open dumps or vacant lots produces bacteria and fungi. It also attracts cockroaches, rats, flies, mosquitoes, etc. These animals can transmit serious diseases, such as dengue, typhoid, cholera, dysentery, bubonic plague and leishmaniasis (RETEC, 2015).

Air accidents: garbage accumulated near airports causes accidents, because the plane collides with a vulture or other large bird, for example. It can cause the death of people, in addition, of course, to the death of the bird, which could have been avoided (RETEC, 2015).

Air pollution: garbage – burned or not, produces gases that are harmful to the health of living beings and the planet, such as methane gas and hydrogen sulfide gas. These gases pollute the air and can cause respiratory diseases. The burned garbage produces carbon dioxide, a gas that is toxic if it is in large quantities. And if you remember that the planet's air is already full of carbon dioxide because of cars and factories (RETEC, 2015).

Floods: PET bottles, plastic bags and other garbage are washed away in a heavy rain. They end up clogging storm drains and even preventing rivers from flowing through their beds. This causes terrible flooding. Dirty water from floods spoils people's homes, kills domestic animals and causes more diseases in the population (RETEC, 2015).

The problem of the disposal of USW is great and affects the entire country, but it can be reduced if each one of those involved does their part, the governments, the institutions, the companies and each inhabitant of the nation. An example was studied by Ferreira (2018) in Brasília – DF. Due to the type and amount of waste that was received at the controlled landfill of Jóquei, in the 1990s, when approximately 100 waste collectors moved to the region. When the landfill was deactivated, approximately three thousand people lived in the place and made their living from the region, under very harsh conditions. The landfill did not have the minimum conditions for survival, such as lack of drinking water, lighting, violence, sub-human working conditions, health risks, child labor and proliferation of diseases, exposed to extreme pollution, with the possibility of suffering attacks by wild birds and rodents. The lack of structure and inadequate conditions of The work of the waste pickers resulted in several accidents. From 2009 to 2017, at least 47 accidents were recorded, ranging from burns and falls, to more serious cases, such as truck overturning and loss of fingertips, severed arm, being run over, and death (FERREIRA, 2018).

SORTING AND RECYCLING

The sorting process is the separation of materials that will be sent for recycling, according to their physical and chemical characteristics. This is an essential step in the recycling process, being considered the initial step for the production of new products. The Ministry of Cities defines a shed or sorting unit as the set of buildings and facilities intended for the handling of materials from the selective collection of dry waste from household waste or similar to them (paper, plastics, metals, among others), by workers with recyclable materials, formally linked to organizations of this category, according to the logistics of implementation and operation (MINISTRY OF CITIES,

2010). In Manaus, these activities are not carried out. The MSW collected by the transport trucks unload the waste and are then scattered and landfilled in the city's landfill.

In a sorting plant, the material from mixed collection and selective collection is received and then separated into materials of equal characteristics, at least in 03 (three) fractions: recyclable, organic and waste. Depending on the population, which generates a lot of waste, it would need a large place and many people to separate all the MSW that arrives every day. The PNRS (2010) requires that organic material be destined for biodigesters or composting. Pyrolysis and incineration lose in economic viability. Composting is best applied when there is waste with many vegetables and tree remains (PRS, 2021).

Recyclable materials account for around 45% of all waste. A recycling facility is required for any material (plastic, paper, glass, electronics, plaster, etc.). The process of separating materials is a very simple service and Brazilian legislation requires that selective collection personnel and low-income people be classified in this process. Anyone who receives 15 to 30 minutes of training can join the team. The separated material must go to the industry to be reused in the production line. The recyclable materials market emerges, which seeks the right buyer for the material to be evaluated, packages and delivers it to the industry (PRS, 2021).

Screening can be done manually, automatically or semi-automatically. The first type involves the separation of household waste and the activity of waste pickers. This is a type of sorting that requires little investment, but has low production capacity and, therefore, is inefficient (FRAGMAQ, 2015).

Automatic sorting can receive a much larger volume of garbage, executing the sorting process with agility and without interruption for rest. In addition, the separation of garbage is done with more quality and in a more reliable way. On the other hand, automatic garbage sorting requires high investment in equipment and space rental. It is a method more suitable for large cities. There is also semi-automatic sorting, which combines the work of garbage collectors with the installation of modern machinery (PRS. 2021).

CHARACTERIZATION OF MSW

The characterization of MSW is important to obtain data on their behavior under certain conditions, also allowing the study of ways to control or minimize their impacts on the environment. From these qualitative and quantitative data, and with the application of statistical methods and analysis, it is possible to propose selective collection and recycling actions, verify if the recyclable materials have marketing value and if the organic matter is appropriate for composting or biodigestion, or, establish the appropriate treatment or destination, determine the necessary adaptations for the development of solutions for reduction, or even elimination, of the MSW from

that community. In order to carry out a reliable characterization of waste, it is necessary to carry out a reliable sampling, according to NBR 10007 – Solid waste sampling (ABNT, 2004).

Preparation for sampling

This subsection establishes the basic lines that must be observed before taking any sample in order to define the sampling plan (sampling objective, number and type of samples, samplers, sampling location, vials and sample preservation).

Purpose of sampling

The objective of sampling is to collect a representative amount of waste, in order to determine its characteristics in terms of classification, treatment methods, etc.

Pre-characterization of a residue

The pre-characterization of a waste is done through a survey of the processes that gave rise to it. The information thus obtained (approximate volume, physical state, main constituents, temperature, etc.) allows the definition of the most appropriate type of sampler, the parameters to be studied or analysed, the number of samples and their volume, the type of collection bottle and the preservation method(s) that should be used.

Sampling plan

The sampling plan shall be established prior to the collection of any sample, be consistent with the purpose of sampling and with the pre-characterization of the residue, and shall include: evaluation of the site, form of storage, sampling points, types of samplers, number of samples to be collected, their volumes, their types (plain or compound), number and type of collection bottles, preservation methods and storage time, as well as the types of protective equipment to be used during collection. This plan should also establish the date and time of arrival of the samples at the laboratory. In NBR 10007 (2004) there are tables that present the methods of preservation and storage of solid and liquid samples.

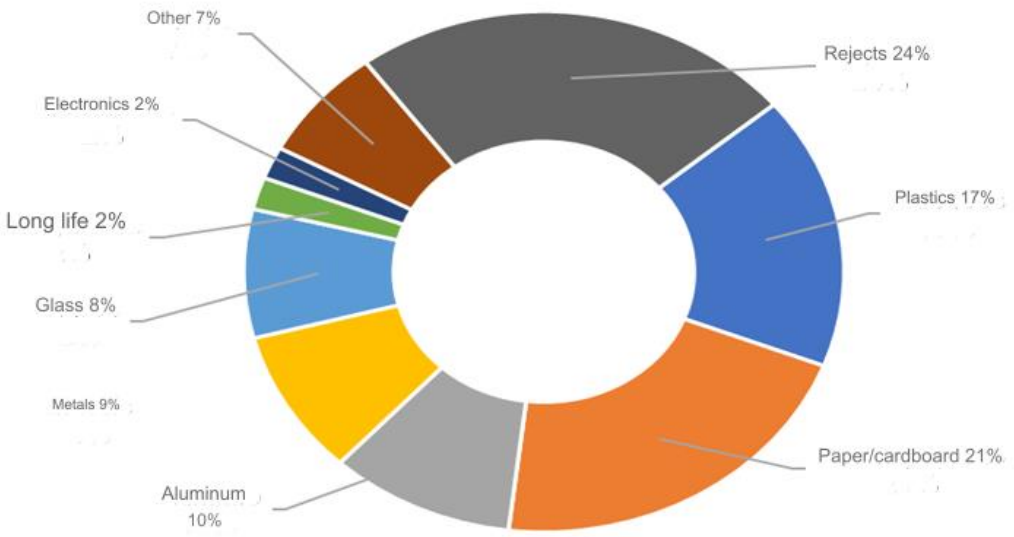
Physical characteristics

Gravimetry

Gravimetric composition of USW is the percentage survey of the materials that make up the USW deposited in a given location. This is accomplished by measuring the mass of each material and calculating the percentage of that mass. For example, the gravimetric composition of USW in Brazil is represented in Figure 1. Waste that is composed of residential garbage, remains from fairs,

various packaging (long life, aluminum cans, glass) is equivalent to half. There is a large amount of organic matter that is thrown into the dumpsters mixed with other types of waste. As in other studies, paper/cardboard shavings continue to be the most collected types of materials (by weight), followed by plastics in general. The percentage of tailings is still high (about 24%), demonstrating the need for investments in raising awareness among the population to carry out the correct separation of waste (CEMPRE, 2019).

Figure 1. Percentage composition of the residuals. Source: CEMPRE, 2019.



It is estimated that in the years 2020 and 2021 the situation tends to worsen as a result of the pandemic. According to Abrelpe (2020), solid waste generation increased by approximately 25% during the pandemic. Due to the protective quarantine measures, with home office work and children at home, there was an increase in consumption, delivery orders and a greater number of meals at home, and as a consequence a growth in the generation of MSW.

Apparent specific gravity

It is the weight of the loose waste by the volume freely occupied, without any compaction, given in kg/m³. The determination of the apparent specific weight is extremely important for the design of equipment and facilities. In the absence of more precise data, the following values can be used: 231 kg/m³ for the specific weight of household garbage (average); 280 kg/m³ for the specific weight of waste and health services; 1,300 kg/m3 for the specific weight of construction debris. Some other examples: 1213 Kg/m³ for organic matter; 338 kg/m³ for paper/cardboard; 240 kg/m³ for others (sand, rubble, among others); 224 kg/m³ for plastic film; 135 kg/m³ for rigid plastic; 119

kg/m³ for rags; 73 kg/m³ for rubber; 60 kg/m³ for Treta Pak; 53 kg/m³ for metal; 50 kg/m³ for glass; 41 kg/m³ for wood (DIAS, 2016).

INFORMATION ABOUT THE CITY OF MANAUS-AM

Manaus, the capital of the state of Amazonas, is in seventh place in the ranking of capitals with a population of 2,116,254 people, being the largest and most populous city in the state of Amazonas, located right in the center of the Amazon rainforest, as shown in Figure 2. In territorial extension it is the second largest in the country with an area of 11,401.092 km² (the largest is Porto Velho – RO, with 34,090.952 m²), so extensive that if you add all sixteen capitals of the south, southeast and northeast regions (9,023 km²) Manaus alone still exceeds all in area.

In urban areas, the city of Manaus has the fourth largest in the country, with 427 square kilometers, according to IBGE data (2020). The area of the Metropolitan Region of Manaus, on the other hand, has an area of 127,287.789 square kilometers. It is the largest Brazilian metropolitan area, larger than the area of some Brazilian states such as Pernambuco, Santa Catarina and Rio de Janeiro (being more than twice as large as this one) and has approximately the same dimensions as some nations such as Iceland (103,000 km²) and South Korea (99,538 km²), and larger than countries such as Hungary (93,032 km²) and Portugal (92,391 km²) (IBGE, 2020).

NEIGHBORHOODS OF THE CITY OF MANAUS.

Since 2010, the city of Manaus has recognized 63 official neighborhoods (IBGE, 2010). Neighborhoods that are not recognized by the administrative body are considered to be part of other neighborhoods. The rural area is not divided into neighborhoods and is therefore not represented on the list. Among all the administrative regions of the city, the South Zone is the largest in number of neighborhoods, with a total of 18 neighborhoods, and is also the most densely populated. However, the most populous neighborhoods are found in the North and East zones, such as Cidade Nova and Jorge Teixeira, which each have more than 100,000 inhabitants. The last territorial division occurred in the municipality on January 14, 2010, through Municipal Law No. 1,401/10.1 By this measure, the neighborhoods of Cidade de Deus Distrito Industrial II, Gilberto Mestrinho, Lago Azul, Nova Cidade, Novo Aleixo and Tarumã-Açu were approved.

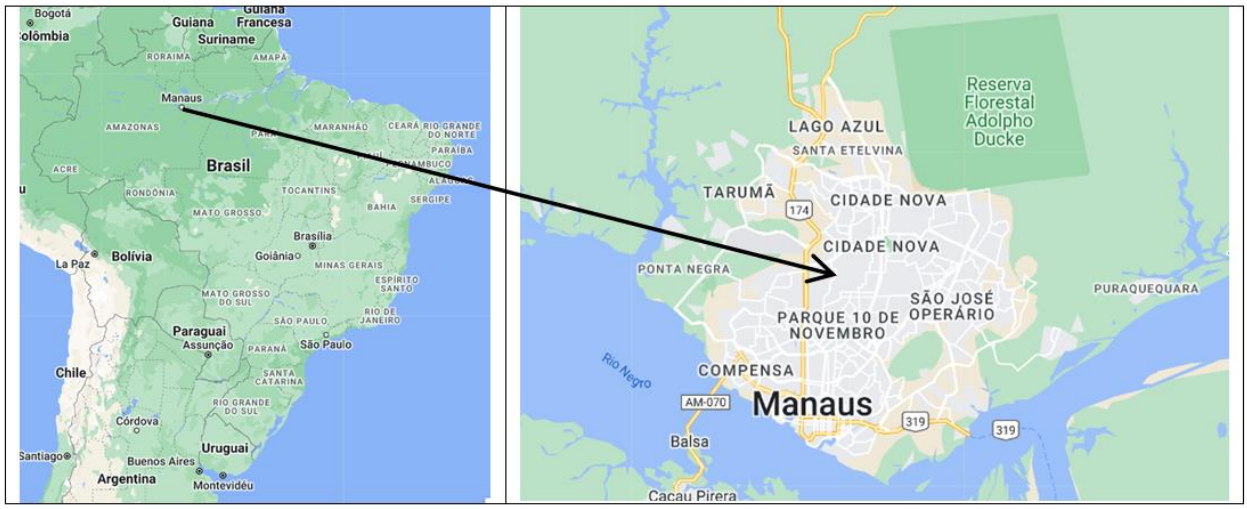
According to the IBGE (2020), the neighborhood in Manaus with the best quality of life and Human Development Index is Nossa Senhora das Graças, which has an HDI of 0.943, a quality of life similar to that of Norway, for example. However, there are also places in Manaus with poverty rates similar to those of poor countries, such as the community of Greater Vitória, which has an HDI of 0.658, similar to that of Bolivia, or the community of Parque São Pedro, which has an HDI of 0.688, which allows it to be compared to Vietnam. In total, thirteen communities and neighborhoods

in Manaus were classified as in a state of "poverty" and another two as in "extreme poverty". The region of the city considered to have the best quality of life is the Center-South, in addition to other locations such as Ponta Negra and some parts of the Cidade Nova neighborhood. The region with the highest incidence of poverty is found in the communities of Nova Vitória, Grande Vitória and in the neighborhoods of Cidade de Deus and parts of Jorge Teixeira and Tarumã. Table 1 summarizes the population of the city's administrative areas.

Table 1. Population of the administrative zones of the city of Manaus-AM. Source: IBGE, 2020.

Zona Administ	Population	Area (m²)
NORTH	592.325	9.876,84
EAST	529.543	15.568,39
SOUTH	338.674	4.707,97
WEST	299.782	12.829,44
CENTER-SOUTH	180.577	3.556,97
CENTRAL-WEST	175.353	1.799,31
Total	2.116.254	48.338,92

Figure 2. Location of the city of Manaus- AM. Source: GOOGLEMAPS, 2022.



METHODOLOGY

GRAVIMETRY

A team consisting of a driver, three waste pickers and four assistants properly equipped with their PPE traveled to the neighborhoods of the city of Manaus, state of Amazonas, and collected approximately 3200 liters of MSW from each of the neighborhoods, in a car with a body, as illustrated in Figure 3. This amount was taken to a covered shed where another team of recyclers and helpers unloaded the MSW that were removed from the plastic bags, disaggregated and homogenized on plastic sheeting that covered the floor of the shed, until forming a single pile. Soon after, a block was made and two of the diametrically opposite parts were discarded and the other two were used to fill plastic buckets of 100 liters each until a volume of 1,000 liters of waste was obtained. Each of the

containers containing waste was properly placed on a Filizola scale, type 34, with a capacity of 150 kg, and its mass was measured and noted, shown in Figure 4. After weighing the total sample, the waste was sorted on the plastic tarpaulin as follows: Paper/cardboard, wood, metals, glass, hard plastic (HDPE), soft plastic (LDPE), PET plastic, PP plastic, Styrofoam, tailings and organic material. Again, each container with each type of material was properly weighed, separately, to obtain the representativeness by weight of each type of material. With these data, the percentages of each type of material existing in that 1000-liter sample were determined, according to Equation 1, by dividing the percentage of the mass of each material by the total mass of the sample, as well as the calculation of the specific weight of the MSW, by directly dividing the total mass of the sample by the total volume.

Equation 1. Percentage of each type of material after sorting.

$$\text{Percentual de cada categoria (\%)} = 100 * \frac{\text{peso de cada fração (kg)}}{(\text{peso total da amostra (Kg)})} \qquad \text{(Equation 1)}$$

Source: Basic physics.

Where:

Percentage of each category = percentage of each class/type of waste present in the sample;

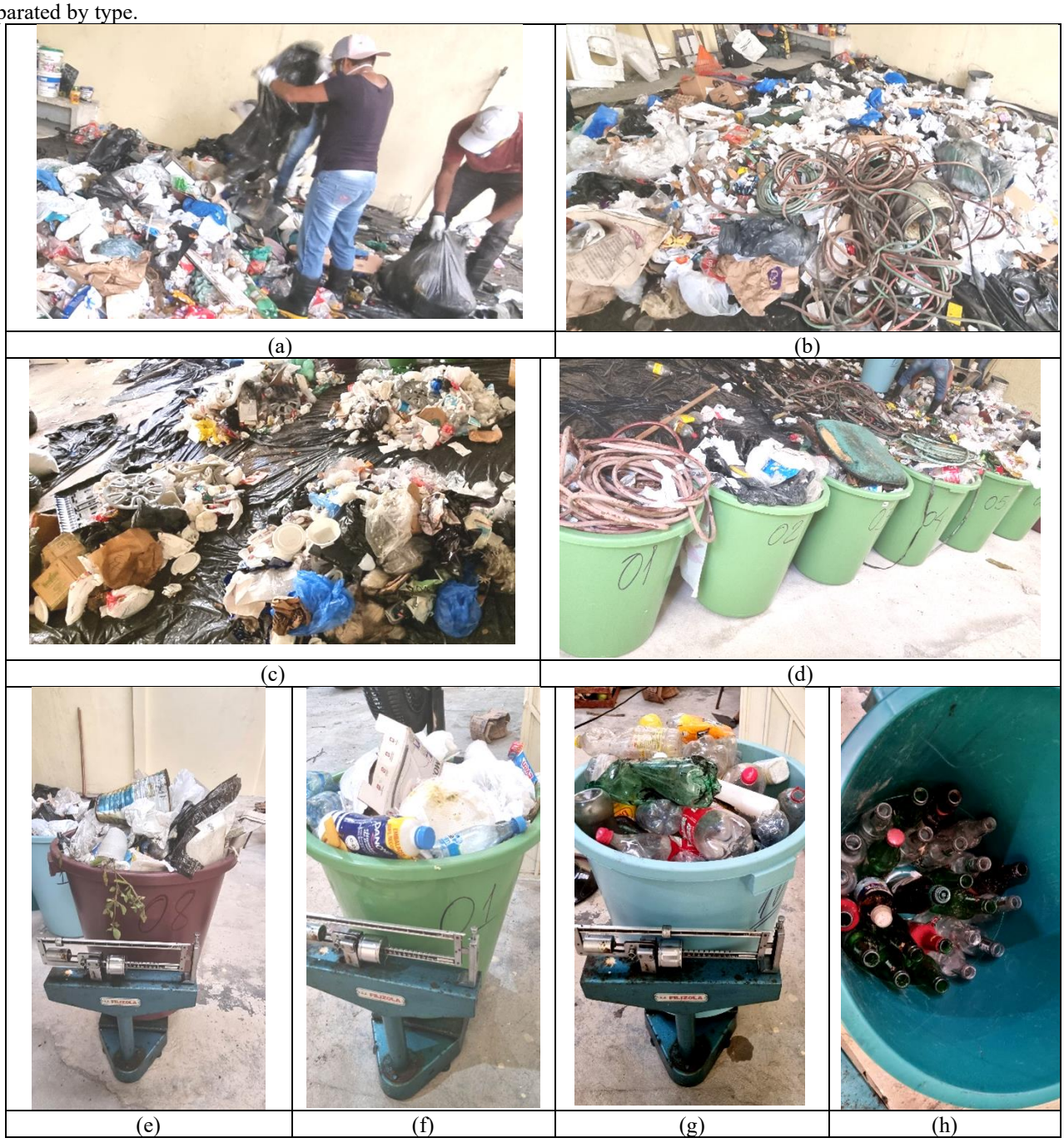
Weight of each fraction = weight of each class/type of waste after sorting.

Figure 3. Selective collection. (a) On the streets; (b) In community dumps; (c) vehicle used.

(a) (b) (c)

Source: The authors.

Figure 4. Gravimetry: (a) Removal of waste from plastic bags; (b) mixing of waste; (c) quartering; (d) separation of 1m³ of waste; (e) weighing of waste; (f) weighing of mixed waste; (g) weighing of separated waste; (h) weighing of waste separated by type.



Source: The authors.

APPARENT SPECIFIC GRAVITY

From the volume of MSW collected from the clays, mixed and quarteated and placed in 100-liter bucket containers, in a total of 1000 liters for each of the neighborhoods, the mass of each of the buckets was placed on the scale and measured, obtaining the total mass of the volume of 1000 liters, as shown in Figure 5. The arithmetic division of this mass by the volume is called the apparent specific weight of the material, according to Equation 2. This parameter is of paramount importance for selective collection companies. Because it is quantitative in nature, it reflects the density of MSW

and varies greatly according to its composition. Its knowledge results in an adequate sizing of routes, number of collection trucks and compaction machinery.

Figure 5. Weighing of the volume of 1m³ of MSW: (a) Measurement of the volume; (b) Mass measurement.

(a) (b)

Source: The authors.

Equation 2. Apparent specific weight.

$$Specific\ weight\ (\frac{Kg}{m^3}) = \frac{residue\ mass\ (Kg)}{residue\ volume\ (m^3)} \qquad \text{(Equation 2)}$$

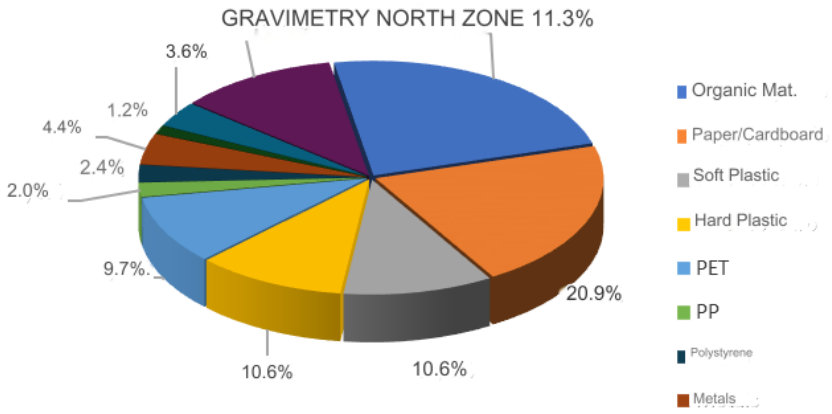
Source: Basic physics.

CONCLUSION

GRAVIMETRY

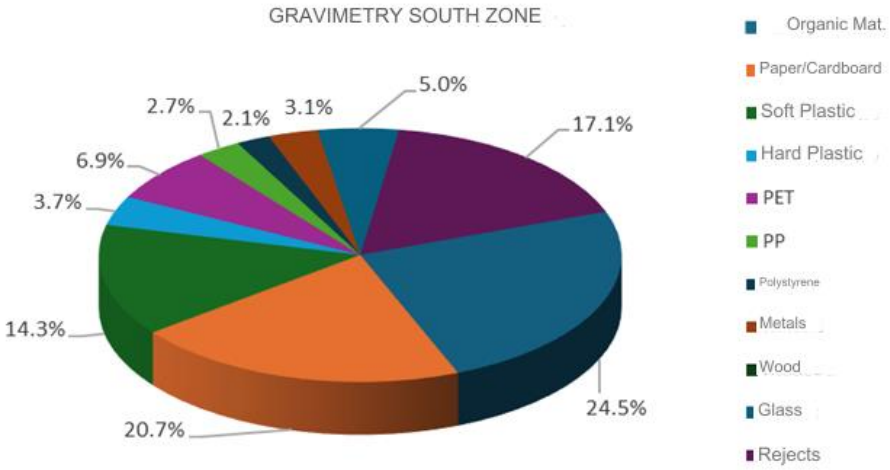
The objective is to describe the activities developed to characterize the urban solid waste of the city of Manaus-AM through the gravimetric analysis, composed of three stages, required by NBR 10.007/2004: quartering, identification and weighing of the categories of waste and their apparent specific weight, detailed sampling of the gravimetric profile of the urban solid waste of each of the administrative regions worked resulted in the data and percentage proportions shown in Figures: 6, 7, 8, 9, 10 and 11, referring to dry days. It is possible to perceive the quantities and percentages of each material constituting the waste collected and worked. The mean of the neighborhoods was extracted as well as the standard deviation of the sample.

Figure 6. Gravimetria da Zona Norte. Average values - dry days.



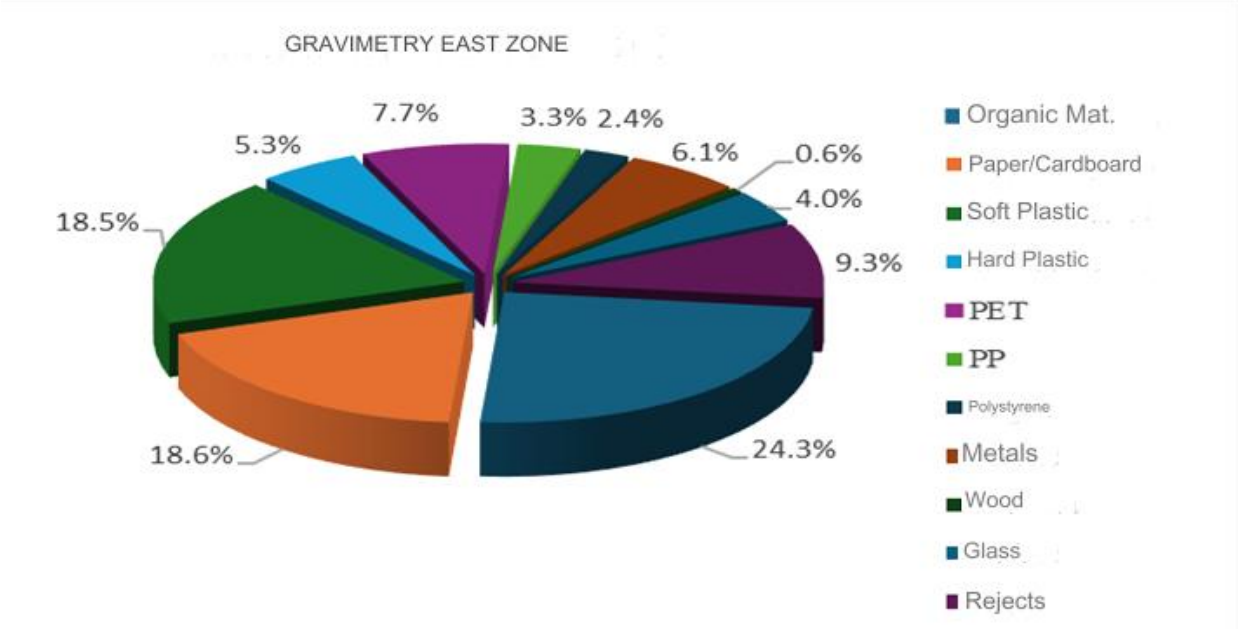
Source: The authors.

Figure 7. Gravimetria da Zona Sul. Average values - dry days.



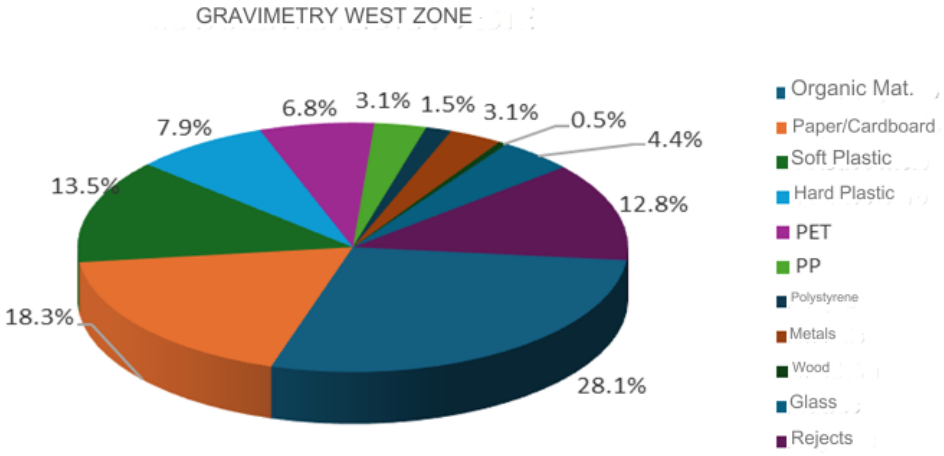
Source: The authors.

Figure 8. Gravimetria da Zona Leste. Average values - dry days.



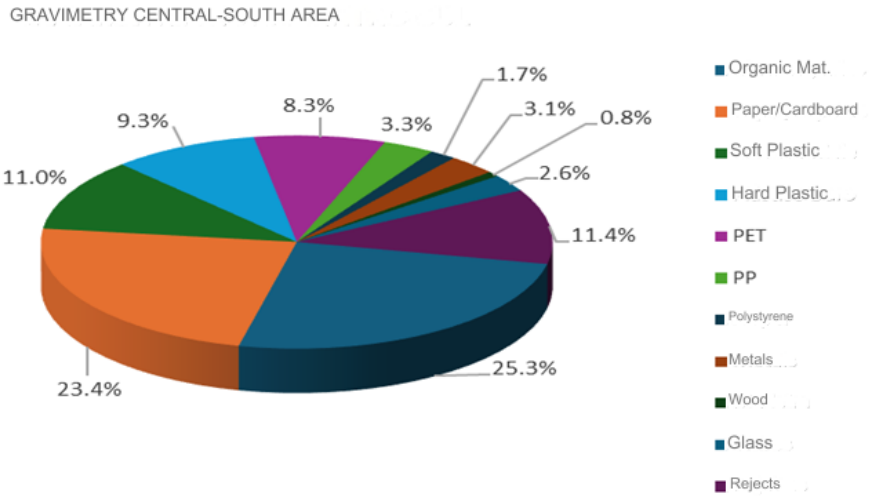
Source: The authors.

Figure 9. Gravimetria da Zona Oeste. Average values - dry days.



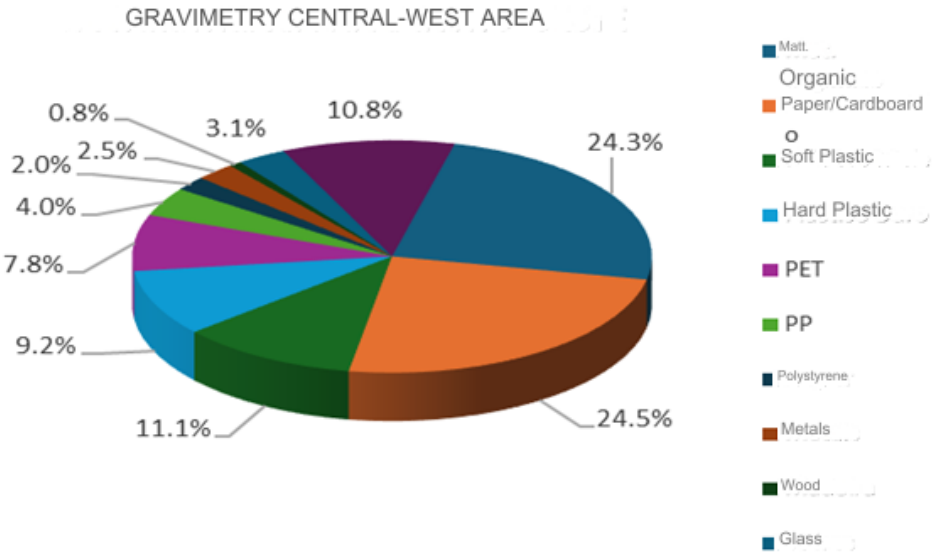
Source: The authors.

Figure 10. Gravimetry of the Center-South Zone. Average values - dry days.



Source: The authors.

Figure 11. Gravimetry of the Midwest Zone. Average values - dry days.



Source: The authors.

The results indicated a partial variation in certain materials compared to the national average. The profile of waste differs because it presents a greater amount of recyclable materials such as paper, cardboard and plastics, in relation to the national average, while organic waste is in a higher percentage. This is due to the separation carried out in this work between tailings and organic material whose destination can easily be biodigestion or composting, as summarized in Table 2 for data referring to dry days and in Table 3 for rainy days.

Table 2. Percentage fractions by administrative area and weighted average of each material that make up the MSW.

COMPONENTS	PERCENTAGE FRACTION						AVERAGE	WEIGHTED AVERAGE
	NORTH	SOUTH	EAST	WEST	CENTER-SOUTH	CENTRAL-WEST		
Mat. Organic	23,25%	24,5%	24,5%	28,1%	25,3%	28,5%	25,68%	25,04%
Recyclable	64,24%	58,47%	58,47%	58,61%	62,55%	61,23%	60,60%	60,68%
Paper/Cardboard	20,92%	20,7%	20,7%	18,3%	23,4%	22,9%	21,13%	20,81%
Mole-LDPE Plastic	10,61%	14,3%	14,3%	13,5%	11,0%	10,9%	12,42%	12,58%
Hard Plastic-HDPE	10,60%	3,7%	3,7%	7,9%	9,3%	5,5%	6,81%	6,88%
PET	9,70%	6,9%	6,9%	6,8%	8,3%	7,8%	7,74%	7,87%
PP	2,00%	2,7%	2,7%	3,1%	3,3%	4,0%	2,97%	2,73%
Styrofoam	2,44%	2,1%	2,1%	1,5%	1,7%	0,8%	1,77%	1,96%
Year	4,36%	3,1%	3,1%	3,1%	3,1%	2,5%	3,19%	3,39%
Glasses	3,60%	5,0%	5,0%	4,4%	2,6%	6,8%	4,57%	4,47%
Wood	1,20%	0,0%	0,0%	0,5%	0,8%	0,3%	0,46%	0,50%
Rejects	11,31%	17,1%	17,1%	12,8%	11,4%	10,0%	13,27%	13,78%
TOTAL	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
Weighting factor	0,2799	0,1600	0,2502	0,1417	0,0853	0,0829		

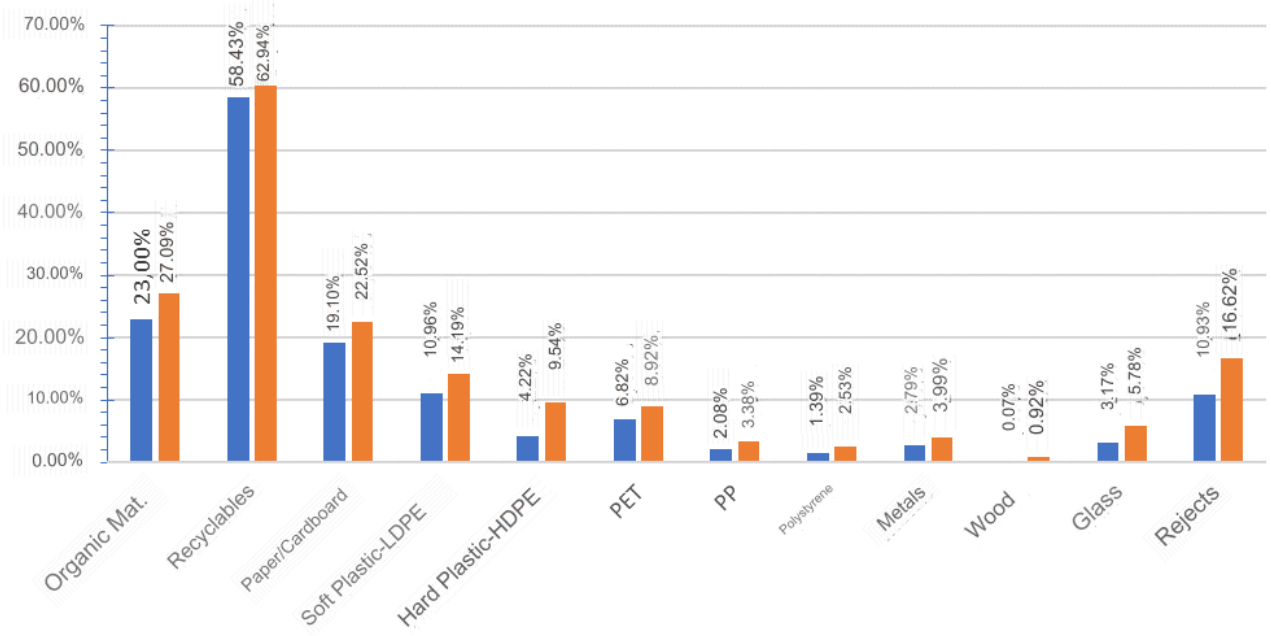
Source: The authors.

Table 3. Percentage fractions by administrative area and weighted average of each material that make up the MSW. On rainy days.

Component	NORTH	SOUTH	EAST	WEST	CENTER-SOUTH	CENTRAL-WEST	AVERAGE	D.P.	WEIGHTED AVERAGE
Mat. Organic	25,8%	27,1%	26,7%	27,6%	19,3%	21,7%	24,7%	3,4%	25,6%
Paper/Cardboard	10,1%	13,1%	17,0%	20,4%	11,2%	17,1%	14,8%	4,0%	14,4%
Plastic Mole	7,1%	9,6%	8,2%	12,0%	11,0%	7,9%	9,3%	1,9%	8,9%
Hard Plastic	6,8%	5,9%	6,9%	4,7%	4,3%	4,9%	5,6%	1,1%	6,0%
PET	8,1%	8,6%	7,5%	5,4%	7,5%	9,7%	7,8%	1,4%	7,7%
PP	5,5%	4,6%	3,5%	2,2%	3,0%	2,0%	3,5%	1,4%	3,9%
Styrofoam	1,5%	1,4%	2,4%	1,5%	0,6%	2,1%	1,6%	0,6%	1,7%
Year	2,1%	2,1%	2,7%	2,7%	1,2%	0,5%	1,9%	0,9%	2,1%
Wood	1,8%	2,4%	2,6%	0,6%	2,1%	0,3%	1,6%	0,9%	1,8%
Glasses	4,9%	4,0%	1,9%	0,5%	8,9%	5,1%	4,2%	2,9%	3,8%
Clothing/Fabrics	5,8%	0	0	0	11,6%	5,6%	3,8%	4,7%	3,1%
Rejects	20,4%	21,2%	20,6%	22,3%	19,4%	23,1%	21,2%	1,3%	21,0%
TOTAL	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	1,4%	100,0%
Recyclable	48,8%	47,7%	50,7%	49,6%	52,4%	50,1%	49,9%	1,6%	49,7%
Weighting factor	0,279893	0,160035	0,250227	0,141657	0,085329	0,082860			

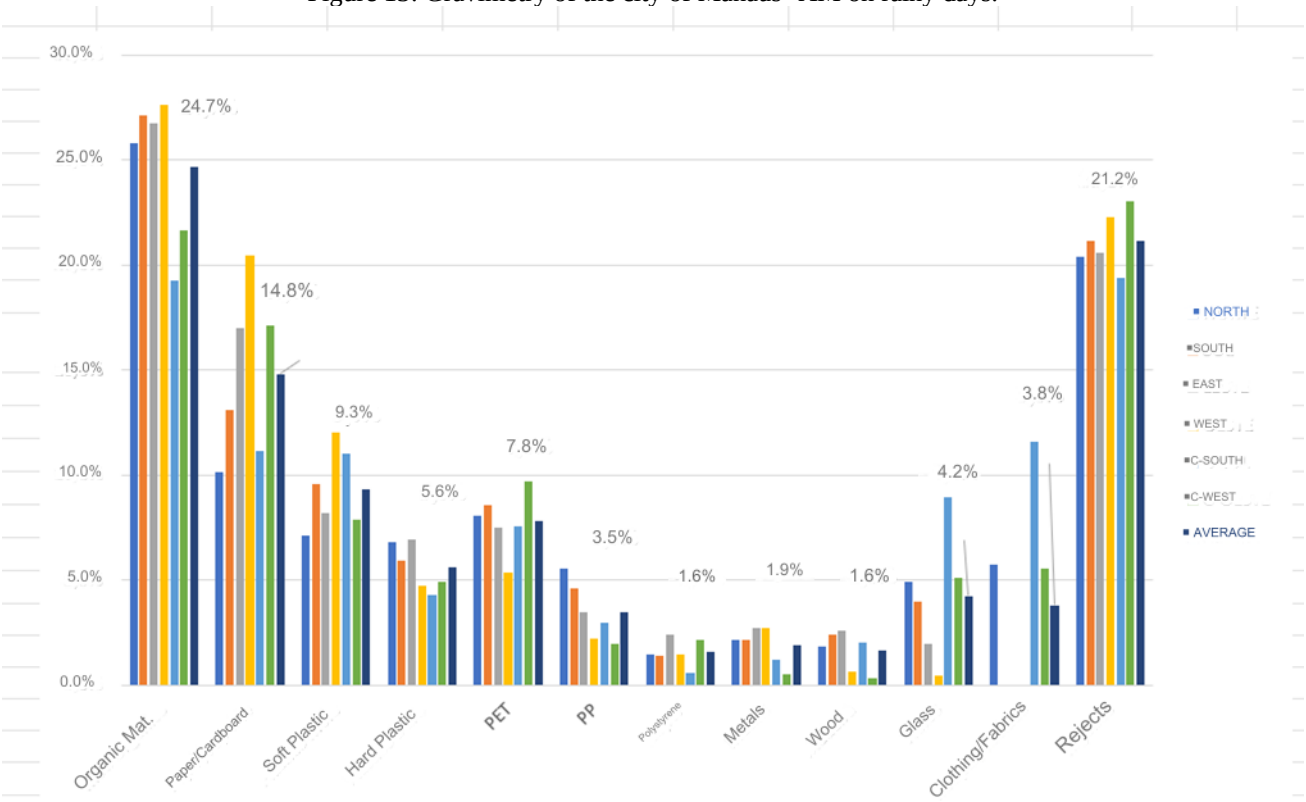
Source: The authors.

Figure 12. Final gravimetry of the city of Manaus -AM on dry days.



Source: The authors.

Figure 13: Gravimetry of the city of Manaus -AM on rainy days.



Source: The authors.

For a better understanding, Figure 12 and Figure 13 above seek to show the final values taking into account the weighting according to the population of each of the administrative areas, as shown in Table 4.

Table 4. Population and weighting coefficient by administrative area of the city Manaus – AM.

ZONE	Population (inhab)	Weighting (w)
NORTH	592.325	0,2799
SOUTH	338.674	0,1600
EAST	529.543	0,2502
WEST	299.782	0,1417
CENTER-SOUTH	180.577	0,0853
CENTRAL-WEST	175.353	0,0829
TOTAL	2.116.254	1,0000

Source: The authors.

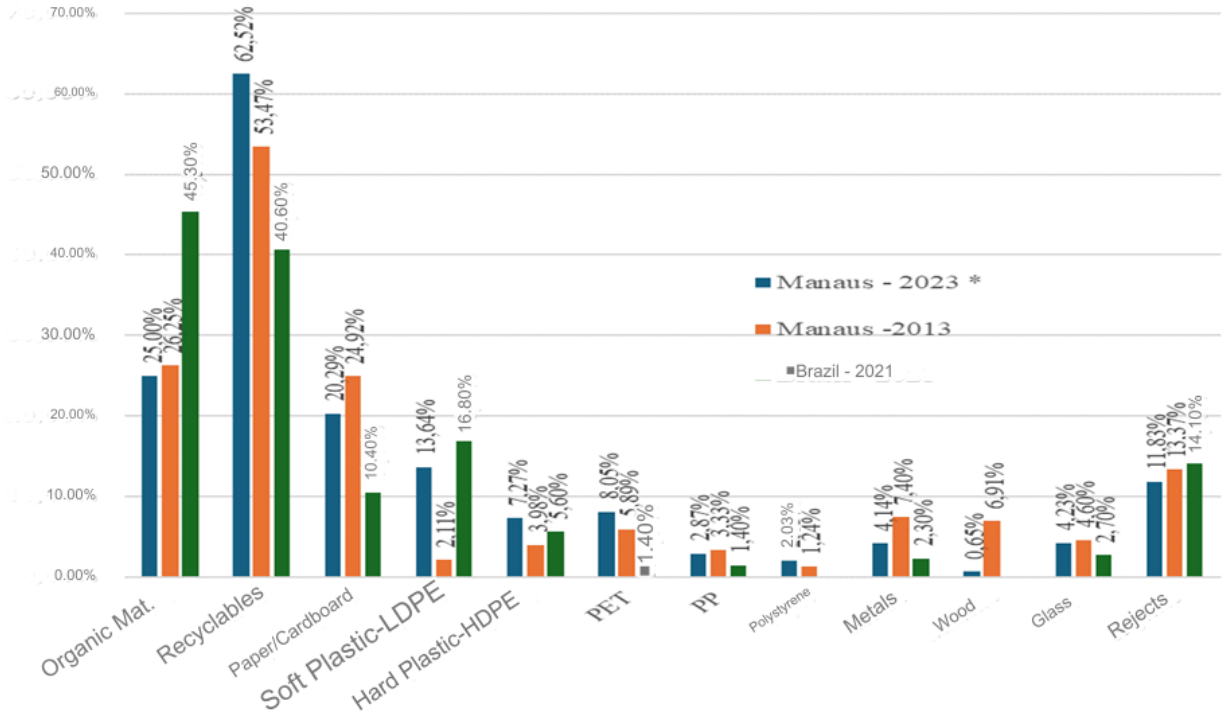
Comparing with the national average and with the values obtained from a study carried out by the city's municipal cleaning department in 2013, described in Semulsp, 2013, Table 5 and Figure 14 were prepared below.

Table 5. Percentage fractions by administrative area and weighted average of each material that make up the MSW. Carried out in 20223 (by the author), in 2013 (SEMULSP, 2013) and in Brazil (ABRELPE, 2022).

COMPONENTS	PERCENTAGE FRACTION. * Weighted average.									
	NORTH	SOUTH	EAST	WEST	CENTER-SOUTH	CENTRAL-WEST	AVERAGE	Manaus - 2023 *	Manaus -2013	Brazil - 2021
Mat. Organic	23,25%	24,50%	24,30%	28,10%	25,30%	28,50%	25,65%	25,00%	26,25%	45,30%
Recyclable	64,24%	58,47%	65,81%	58,61%	62,55%	61,23%	61,82%	62,52%	53,47%	40,60%
Paper/Cardboard	20,92%	20,70%	18,60%	18,30%	23,40%	22,90%	20,78%	20,29%	24,92%	10,40%
Mole-LDPE Plastic	10,61%	14,30%	18,50%	13,50%	11,00%	10,90%	13,13%	13,64%	2,11%	16,80%
Hard Plastic-HDPE	10,60%	3,70%	5,30%	7,90%	9,30%	5,50%	7,07%	7,27%	3,98%	5,60%
PET	9,70%	6,90%	7,70%	6,80%	8,30%	7,80%	7,86%	8,05%	5,89%	1,40%
PP	2,00%	2,70%	3,30%	3,10%	3,30%	4,00%	3,06%	2,87%	3,33%	1,40%
Styrofoam	2,44%	2,10%	2,40%	1,50%	1,70%	0,80%	1,81%	2,03%	1,24%	
Year	4,36%	3,10%	6,10%	3,10%	3,10%	2,50%	3,69%	4,14%	7,40%	2,30%
Wood	1,20%	0,00%	0,60%	0,50%	0,80%	0,30%	0,56%	0,65%	6,91%	
Glasses	3,60%	5,00%	4,00%	4,40%	2,60%	6,80%	4,41%	4,23%	4,60%	2,70%
Rejects	11,31%	17,10%	9,30%	12,80%	11,40%	10,00%	11,97%	11,83%	13,37%	14,10%
TOTAL	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
Weighting factor	0,2799	0,16	0,2502	0,1417	0,0853	0,0829				

Source: The authors.

Figure 14. Gravimetrias of the city of Manaus -AM, carried out in 2023 (by the author, on dry days), in 2013 (SEMULSP, 2013) and in Brazil (ABRELPE, 2022).



Source: The authors.

In the survey, it was evidenced that the greater representativeness of recyclable waste (62% on dry days and 50% on rainy days) and the small proportional reduction of organics (25%) and

waste (12% on dry days and 21% on rainy days), while the national average these values are 45%, 40% and 14% respectively, are possibly consequences of the excessive use of packaging, due to the number of people who start to live in the vicinity of the Manaus Industrial Pole and the commercial and service area in the urban area of the city. In the field analysis, it was found that at least 50% of this plastic material comes from recyclable packaging (or easily found commercial value in the market), evidencing the possibility of selective collection if a sorting plant is installed before the waste is landfilled. Such characteristics may be a consequence of the growing increase in the use of packaging, evidencing the need for local public policies for post-consumption responsibility, product life cycle analysis and priority marketing of products with sustainable packaging.

There is a slight increase in recyclable materials, when compared to data from the Manaus report of 2013 and the national average of 2021, apparently motivated by the period of contingency of the population with the pandemic that made it possible for some habits of the daily routine to return, such as eating at home, which can be suggested by the increase in the amount of disposable packaging, such as tetra packs and milk for breakfast, styrofoam lunchboxes and bottles of soft drinks and juices, boxes of cream and condensed milk for desserts. There was also an increase in soap and toilet paper packaging. The paper that surrounds the soap, the boxes, the toilet paper tubes, as well as the toilet paper used are items of the paper/cardboard component. The increase in the percentage of plastics is due to food deliveries to homes where plastic bags are used as food delivery packaging, showing that the population's consumption pattern has really changed since the pandemic years.

APPARENT SPECIFIC GRAVITY

The volumes and masses of the samples of each of the neighborhoods of the six administrative regions are shown in Table 6, as well as the results of the apparent specific weights after the application of equation 2.

Table 6. Apparent specific weight of MSW in the administrative regions of the city of Manaus. Source: The authors.

LOCAL	VOLUME:	BRUTE:	NET:	SPECIFIC WEIGHT:
	Litres	Medical history	Medical history	Kg/m³
New Israel	988,0	105,10	82,30	83,30
New town	988,0	99,70	76,90	77,83
Learners	988,0	88,60	65,80	66,60
Square 14	988,0	102,10	79,30	80,26
Armando Mendes	988,0	98,60	75,80	76,72
Tancredo Neves	988,0	95,60	72,80	73,68
Compensates	988,0	90,90	68,10	68,93
Tarumã	988,0	133,40	110,60	111,94
Flowers	988,0	84,60	61,80	62,55
Park Ten	988,0	93,20	70,40	71,26
Dawn	988,0	87,80	65,00	65,79
AVERAGE	**988,0**	**95,60**	**72,80**	**73,68**

One of the consequences of the presence of a high percentage of recyclable packaging and materials is the average value of apparent specific weight, 73.68 Kg/m³, approximately one third of the national average, confirming the large amount of light materials containing air inside, such as packaging and enabling a high degree of compaction when dimensioning the route and the number of waste compactor collection trucks.

The studies carried out in these neighborhoods were fundamental for the collection of initial and updated data, which enabled the gravimetric characterization of solid waste in the city of Manaus, state of Amazonas, and will enable other studies that will benefit the population and enrich the data academy of this city, data that are scarce in the literature. For the time being, it has been found that there is a large amount of material capable of being recycled (62% ± 2%) and (50% ± 1.6%), respectively on dry days and rainy days, despite the publicity's advertising campaigns, with low apparent specific weight, confirming little organic matter and a lot of light material that can be recycled, leading to the idea of installing a sorting plant as an alternative to reduce waste destined to the landfill of the city, increasing its useful life and the reuse of recyclable materials, bringing economic, social and environmental benefits to the city and its inhabitants.

RECOMMENDATIONS FOR FUTURE WORK

The proposed management plan for the city of Manaus-AM aims at adequate treatment and final disposal of MSW to reduce dependence on landfill and electricity generation. A thermal characterization study with laboratory tests, such as specific heat, thermogravimetry tests (TGA), immediate analysis, elemental analysis, higher calorific value (PCS) and lower calorific value (PCI), as well as an economic analysis should be presented in the future taking into account some scenarios

of recycling percentages, the amount and cost of fuel spent in incineration, the energy consumed in the process, as well as the gas emissions and financial impacts that may be caused. Finally, the calculation of the actual mass to be deposited in landfill, which includes the solid ash from incineration and the possible use of this in the composition of cementitious material to be used in civil construction.

REFERENCES

1. ABNT. (2004). *NBR 10007/2004 - Amostragem de resíduos sólidos*. Rio de Janeiro, RJ.

2. ABNT – Associação Brasileira de Normas Técnicas. (1992). *NBR 8419: Apresentação de Projetos para Aterros Sanitários de RSU*. Rio de Janeiro, RJ.

3. ABNT – Associação Brasileira de Normas Técnicas. (2004). *NBR 10.004: Resíduos sólidos - Classificação*. Rio de Janeiro, RJ.

4. ABRELPE: Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais. (2022). *Panorama dos resíduos sólidos no Brasil 2020/2021*. Brasília, DF.

5. ABRELPE: Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais. (2020). *Panorama dos resíduos sólidos no Brasil 2018/2019*. Brasília, DF.

6. ABREN: Associação Brasileira de Recuperação Energética de Resíduos. (2019). *Regulação Nacional e Internacional de Waste-to-Energy*. Waste Expo Brasil, São Paulo, SP.

7. CEMPRE: Compromisso Empresarial para a Reciclagem. (2019). Preço dos materiais recicláveis. *Revista Cempre Review*, 159. Disponível em <http://cempre.org.br/cempre-informa/id/115/preco-dos-materiais-reciclaveis>. Acesso em 12 nov. 2020.

8. Dias, J. O. V. (2016). *Estudo para a implementação de um sistema integrado de gestão de resíduos sólidos urbanos na Escola Superior de Tecnologia* (Monografia). Universidade do Estado do Amazonas - UEA, Manaus, AM.

9. Ferreira, R. S. (2018). *Desativação do aterro controlado do Jóquei X transferência para o aterro sanitário de Brasília: Análises dos principais aspectos sociais e ambientais* (Monografia). UNICEUB, DF.

10. GoogleMaps. (2022). Mapa de Manaus-AM. Disponível em <https://www.google.com.br/maps/place/Manaus,+AM/@-3.0443066,-60.1319187,11z/data=!3m1!4b1!4m6!3m5!1s0x926c1bc8b37647b7:0x2b485c9ff765a9cc!8m2!3d-3.1190275!4d-60.0217314!16zL20vMDJia2sz?entry=ttu>. Acesso em 12 dez. 2022.

11. IBGE. (2020). Conheça cidades e estados do Brasil. *Instituto Brasileiro de Geografia e Estatísticas*. Disponível em <https://cidades.ibge.gov.br/brasil/am/panorama>. Acesso em 29 set. 2020.

12. ISWA – International Solid Waste Association. (2019). Dumpsites: A global waste emergency. Disponível em <https://closingdumpsites.iswa.org/why/why-close-dumpsites/>. Acesso em 12 dez. 2020.

13. Lei nº 12.305, de 2 de agosto de 2010. Política Nacional de Resíduos Sólidos. Diário Oficial da União, 2010.

14. MCIDADES: Ministério das Cidades. Secretaria Nacional de Saneamento Ambiental. (2010). Termo de referência técnico: elaboração do projeto básico e executivo completo de galpão / unidade de triagem para coleta seletiva. Disponível em <https://antigo.mdr.gov.br/images/stories/ArquivosSNSA/Arquivos_PDF/16_TRProjRSUGalpao_triagem%202010_2011.pdf>. Acesso em 14 abr. 2021.

15. MMA – Ministério do Meio Ambiente. (2020). MMA abre consulta pública para alavancar a cadeia de reciclagem e reutilização de embalagens. Disponível em <https://mma.gov.br/component/k2/item/15752-mma-abre-consulta-p%C3%BAblica-para-alavancar-a-cadeia-de-reciclagem-e-reutiliza%C3%A7%C3%A3o-de-embalagens.html>. Acesso em 25 out. 2020.

16. PRS: Portal dos Resíduos Sólidos. (2021). Como montar uma usina de triagem de resíduos sólidos. Disponível em <https://www.youtube.com/watch?v=XqI-J7pRYbM>. Acesso em 11 abr. 2021.

17. RETEC: Tecnologias em Resíduos. (2015). Problemas que o lixo causa. Disponível em <https://www.retecresiduos.com.br/problemas-que-o-lixo-causa/#:~:text=Doen%C3%A7as%3A%20O%20lixo%20que%20vai,disenteria%2C%20peste%20bub%C3%B4nica%20e%20leishmaniose.>. Acesso em: 24 mai. 2020.

18. Saneamento Básico. (2020). Lixões a céu aberto são tão graves quanto uma pandemia. Disponível em <https://www.saneamentobasico.com.br/lixoes-ceu-aberto-pandemia/>. Acesso em: 25 nov. 2020.

Use of essential oils for ADHD treatment

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ABSTRACT

Attention Deficit Hyperactivity Disorder (ADHD) is a neurobehavioral condition that affects both children and adults, with a significant prevalence. Traditionally, treatment involves behavioral therapy and medications, such as stimulants. However, research has explored the use of essential oils as an alternative approach. This review analyzes recent studies on the effects, applications, and mechanisms of essential oils in the treatment of ADHD, considering their efficacy, limitations, and safety issues. Essential oils show potential due to their soothing properties. This review contributes to the understanding of essential oils in the management of ADHD and their impact on the quality of life of those affected.

Keywords: ADHD, Attention Deficit Hyperactivity Disorder, Essential oils, Alternative treatment, Mechanisms of action, Efficacy, Safety.

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INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is a widely recognized neurobehavioral condition that affects both children and adults, characterized by inattention, hyperactivity, and impulsivity (ABDA, 2021). Its prevalence is significant, with studies indicating that it affects approximately 5% of children worldwide (SILVA, 2017). The complexity of ADHD and its variety of symptoms make treatment an issue of great clinical and social importance.

Traditionally, the treatment of ADHD has involved the combination of behavioral therapy and the use of medications, such as central nervous system stimulants (SMITH et al., 2019). However, a growing search for alternative therapeutic approaches has led to the investigation of essential oils as a possible treatment option.

This review article aims to analyze the existing research on the use of essential oils as a therapeutic approach in the treatment of ADHD. We will explore the most recent studies that have investigated the effects of essential oils, their applications, and the proposed mechanisms by which these natural compounds may affect ADHD symptoms. In addition, we will consider the effectiveness, limitations, and safety issues associated with this approach.

As highlighted by Johnson et al. (2020), essential oils are a promising area of research in the field of ADHD, due to their potential calming and anxiety-reducing properties. As we seek to better understand the role of essential oils in the treatment of ADHD, it is crucial not only to enhance the therapeutic options available but also to foster in-depth discussions about the clinical implications and quality of life for individuals affected by this condition.

DISCUSSION

The discussion about the use of essential oils in the treatment of Attention Deficit Hyperactivity Disorder (ADHD) involves a critical analysis of existing studies and research, considering their relevance in the therapeutic context. In this section, we will address the main topics, including proposed mechanisms of action, efficacy, limitations, and safety issues, based on a theoretical framework.

MECHANISMS OF ACTION OF ESSENTIAL OILS:

Studies suggest that essential oils can positively influence ADHD symptoms due to their bioactive components. The potential action of essential oils is based on the presence of compounds, such as monoterpenes and sesquiterpenes, which have calming and anxiolytic properties (PERRY et al., 2016). These compounds act on the central nervous system, possibly modulating neurotransmission and the activity of GABA (gamma-aminobutyric acid) receptors (KELLY, 2019). Further research is needed to fully clarify these mechanisms.

EFFECTIVENESS AND LIMITATIONS OF USING ESSENTIAL OILS

Several studies have reported promising results in reducing ADHD symptoms with the use of essential oils. For example, in a placebo-controlled case study, SANTOS et al. (2021) observed a significant improvement in attention and impulsivity levels in children with ADHD undergoing lavender oil aromatherapy. However, the effectiveness of essential oils can vary between individuals and is not uniform across studies.

In addition, notable limitations include the lack of standardization in essential oil preparations, the variability in individual response, and the paucity of long-term studies evaluating long-term effects (JOHNSON et al., 2020).

SAFETY AND ETHICS ISSUES

The safety of essential oils is an important consideration. While they are generally considered safe, they can cause dermal irritation, allergies, and adverse reactions in some people (TADROS, 2021). Additionally, inappropriate use of essential oils, such as ingestion without proper supervision, can be harmful.

From an ethical point of view, it is essential to ensure that the use of essential oils in the treatment of ADHD is based on well-founded practices and supervised by qualified health professionals (PERRY, 2012). It is important to consider informed consent, especially when treating children, and to monitor for possible adverse effects.

In summary, while there is growing interest in the use of essential oils as a therapeutic approach for ADHD, it is critical to recognize that research is at an early stage and that more studies are needed to determine the efficacy, safety, and specific mechanisms of action. The incorporation of essential oils in the treatment of ADHD should be carried out with caution and under proper supervision, keeping ethical integrity and patient safety in mind.

REFERENCES

1. ABDA (Associação Brasileira do Déficit de Atenção). (n.d.). *TDAH - Transtorno do Déficit de Atenção e Hiperatividade*. Retrieved October 5, 2023, from https://tdah.org.br/tdah/

2. Johnson, R. L., Foster, J., & Soutar, D. (2020). Attention-deficit/hyperactivity disorder: A review of the essential facts. *Primary Care Companion for CNS Disorders, 22*(2).

3. Kelly, D. S. (2019). Omega-3 fatty acids and cognitive decline: A review of clinical and preclinical studies. *Nutrients, 11*(7), 1786.

4. Perry, N. S., Bollen, C., & Perry, E. K. (2016). New insights into the properties of essential oils as a result of research on their neural effects. *International Journal of Aromatherapy, 16*(3-4), 121-126.

5. Santos, P. J., Oliveira, A. L., & Matsuo, T. (2021). Aromatherapy with *Lavandula angustifolia* may alleviate symptoms of attention deficit hyperactivity disorder. *Pharmacognosy Magazine, 17*(73), 295-299.

6. Tadros, L. (2021). Essential oils and their constituents as anticonvulsants: A review. *Natural Product Communications, 16*(10), 1934578X211049178.

The connection (everything is interconnected) between being and knowing in Gregory Bateson: Epistemological contributions to the environmental sciences

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ABSTRACT

Gregory Bateson is the author of a vast body of work, elaborating a series of concepts, reflections and deep and inspiring interdisciplinary approaches to a systemic way of knowing the world. Bateson dedicated himself to an interdisciplinary posture in his work, seeking to identify principles and elaborate concepts that could encompass different areas of knowledge and levels of existence. However, the fact is that Gregory Bateson's work is still not widespread in the Brazilian academic environment. Thus, the objective of this study is to present some fundamental concepts present in his writings, their influence on different areas of knowledge and his integrative perspective of mind and environment, Nature and culture. Bateson contributed to Anthropology, changing paradigms and integrating the cultural and biological aspects, traditionally seen through a disciplinary prism. He also contributed to the development of Cybernetics, Psychology and Psychiatry. One of Bateson's main concepts is that of the *ecology of the mind* and the *pattern that connects* all things.

Keywords: Ecological epistemology, Ecology of the mind, Pattern that binds.

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INTRODUCTION

This study is the result of a provocation to reflection and writing with the Graduate Program in Environmental Sciences in the moments of study of Environmental Epistemology. We explain this situation with the didactic purpose and the intention of contextualizing the components of the system such as the authors, the moment of this philosophical study, the institution with its professors and researchers and with its curricular propositions, thus expressing ideas that are in tune with what Gregory Bateson proposed that everything is interconnected.

In this sense, one of Bateson's main ideas is that the relationships between living beings take place in a *context*, where the flow of information occurs and where learning takes place (the system and the parts of the system exist, are and learn). It is in the context in which events are endowed with meanings (Bateson, 1986).

However, this production was not written to meet a specifically disciplinary demand, but proposes to highlight the importance of Bateson for current ecological and environmental reflections, always proposing the interdisciplinary character of analysis and construction of knowledge going beyond the disciplinary walls so strong in the world of modern science.

Gregory Bateson is the author of a vast body of work, elaborating a series of concepts, reflections and deep and useful interdisciplinary approaches for various areas of knowledge. To be more fair to his work, we must say that it has enormous relevance to merge, relate and connect (reconnect) the disciplined and fragmented knowledge present in universities, books and academic research. In addition, it proposes another look at the world and life. Scholars of Bateson and his analyzed work corroborate this understanding.

Bateson dedicated himself to an interdisciplinary posture in his work, seeking to identify principles and elaborate concepts, beyond the closed world of disciplines, which could encompass different areas of knowledge and levels of existence. The fact is that, even building great advances in analysis and leaving a relevant legacy, the work of Gregory Bateson is still little known in the Brazilian academic environment.

In this way, the objective is to present some main concepts present in Bateson, his influence on different areas of knowledge and his integrative perspective of mind and environment that can be updated in academia and in the diverse knowledge of society. In this way, it also seeks to contribute to the dissemination of this important legacy of Bateson.

SHORT BIOGRAPHY

The biographical information comes from Centeno (2009). Bateson's father, William Bateson, was a scholar of genetics and was interested in the effects of the environment on species variations. Gregory Bateson was born in Grantchester, a village near Cambridge, England, on May 9, 1904. The

name Gregory Bateson was a tribute to Gregor Mendel. In 1924 he came to work with his father, at his invitation. On the island of Chatham, New Zealand, on his way to a scientific expedition to the Galapagos Islands, Bateson has contact with indigenous people and meets and observes them for the first time. On another stop on the trip, he joined ornithologists, but zoology was not his priority field at that time. Humans and the relationship with the environment seemed to him to be an object of greater interest to study.

A.C. Haddon, an English anthropologist and ethnologist in Cambridge, was interested in the observations that Bateson had made about the natives. He then asked Bateson to present a paper on the subject. Bateson began to study anthropology. He envisioned clarifying the relationship between the Natural Sciences and the Human Sciences. His knowledge of the natural sciences contributed to the study of cultural differences. Around 1932 he became involved with studies related to Psychology, Psychoanalysis and Learning Theories.

Gregory Bateson married Margaret Mead in 1936 and they had a daughter, Mary Catherine Bateson, who also became a renowned anthropologist and writer. In 1939, Bateson moved to the United States. Some time later he became a naturalized American. Between 1942 and 1948, Bateson delved into the studies of Psychiatry and also became increasingly interested in the development of Cybernetics and Information Theory. In 1948 he was invited to participate in a study on Communication and Psychiatry.

Gregory and Mead divorced in 1950, but the period of their union was intellectually fruitful, as both were influential in the field of anthropology and contributed to the development of studies on culture and human behavior. They have collaborated on a number of researches, including the study of cultures in New Guinea.

Bateson had two other daughters, Nora Bateson (born 1969), daughter of Gregory Bateson by his third wife, Lois Cammack. Nora Bateson has served as a filmmaker, writer, and educator, involved with the continuation of her father's work in cybernetics and ecology. She directs the *International Bateson Institute* in Sweden and works on systems concepts and complexity. Gregory Bateson also had a third daughter with Lois Cammack, Laura Bateson.

Between 1952 and 1954 Bateson developed a study of animals at the San Francisco Zoo, California, involving communication between them. Later on, Bateson would become involved in studies involving aspects of communication and schizophrenia. The hypothesis resulting from these studies was presented in 1956, generating a great impact in the field of Psychiatry, as the disease was seen, innovatively, from an interactive and systemic perspective.

Subsequently, Bateson leaves the research group and continues his work towards the identification of the fundamental principles of communication in general. In 1965, Bateson developed a study related to animal communication.

In 1972, Bateson released the work *Steps to an Ecology of Mind*. The work resulted in invitations to several lectures throughout the United States. In 1979, the book *Mind and Nature: a Necessary Unity* was released. The works synthesize the ideas of his work developed throughout his life. Bateson died in 1980.

AN INTER/TRANSDISCIPLINARY WORK: CONTRIBUTIONS TO AN INTEGRAL VISION OF HUMAN KNOWLEDGE AND THE RELATIONSHIP WITH THE WORLD OF LIFE

Bateson produced a work that permeates different areas of knowledge. In fact, his work can be characterized not only as interdisciplinary, but transdisciplinary. Bateson's thought contributed and can still contribute a lot to the different areas of knowledge, or to knowledge in general. Being more Batesian in our statement, because for the thinker there seemed to be no boundaries or disciplines, only knowledge, or perhaps we could affirm, the world and knowledge about it, as a metaphor.

Regarding Anthropology, Velho (2001) reports the problem of the scientific nature of the Social Sciences. At the end of the nineteenth century, Dilthey and, later, Weber, "solved" this problem, distinguishing the "sciences of the spirit" from the "sciences of nature". However, according to the author, such a solution was framed in the opposition between Nature and culture, further distancing these fields as distinct. The author also reports a historical process, of an interpretationist stance of the Social Sciences, against imperialism arising from the natural sciences, permeated by reductionism.

Thus, the Social Sciences have adopted a defensive posture, influencing very little in contemporary scientific debates because they close in on themselves. Also according to Harries-Jones (1995), Gregory Bateson adopted a different posture from the one exposed, more proactive, with the search for a paradigm shift.

Currently his writings arouse interest in anthropologists, who had suffered a rupture between their sociocultural and biological aspects. Bateson tries to integrate these two aspects. For Velho (2001), a recent sign towards an interdisciplinary "ecological paradigm" related to Anthropology was the launch of the book *The Perception of the Environment* (Ingold, 2000), taking up many of Bateson's questions. Despite the differences, the work was heavily influenced by Bateson's ideas.

Chiesa (2017) shows the importance of Bateson in the development of *Cybernetics*. According to the author, the *Macy's Conferences* were a series of interdisciplinary meetings held between 1946 and 1953, promoted by the Josiah Macy Jr. Foundation, in the United States. Organized by mathematicians and neurologists, the conferences brought together a diverse group of scientists, including biologists, psychologists, engineers, mathematicians, anthropologists, among others, to discuss cybernetics and topics related to communication and control of biological and

mechanical systems. The conferences were held in various locations in the United States, but those held in New York and on the East Coast stand out.

The central objectives were: 1. The creation of a unified theory about complex systems, both natural and artificial, proposing to establish the foundations of a new general science about the human mind; 2. Studies on feedback, homeostasis and communication in different types of systems; 3. The exploration of concepts such as automation, artificial intelligence (AI) and the relationship between machines and living beings. 4. The investigation of the social and ethical implications of the technological advances of the nineteenth and twentieth centuries.

Chiesa (2017) reports that the set of events resulted in the emergence of Cybernetics or "science of regulation and communication in the animal and in the machine", with Bateson as one of its influencers.

Quoting Capra (1996), Chiesa (2017) points out that it caught Bateson's attention:

> ... the centrality of the conceptions of *feedback*, *self-regulation* and *self-organization* for the full understanding of the dynamics of life. The key idea that there is a *general pattern* of organization of life – applicable both to organisms and to social configurations, which is connected and perpetuated in different layers of reality – also seems to have enthused him, as well as the eminently interdisciplinary character of those propositions (p. 411).

Later, cyberneticists themselves criticized the theory, due to the comparison that was made between the functioning of the human brain and computers, as they are different structures. But the interdisciplinary principle and the systemic interpretation of Cybernetics remain, and it evolves into a broader view.

> This look at the connections, interactions and transformations, at the system in its totality, at the *pattern that connects*, would help, in Bateson's view, to produce a more interesting understanding of the environment, the mind and life itself. Thus, based on cybernetic principles, he will try to overcome certain long-established worldviews (and divisions) and propose another reading, another *epistemology*, another way of seeing, of doing science and of relating to ourselves and to everything that surrounds us. A science of relationships, paths, movements, improvisations, processes, which helps us to see and think about the world in a different way, less dichotomous, more fluid, or, if we want, less binary, more chromatic (Chiesa, 2017, p. 413) (emphasis added).

In fact, Cybernetics influences the systemic way in which one seeks to see the environmental problem today, as we can see in the work of Krüger (2001). In a systemic approach to the environmental problem, the author makes reference to Cybernetics using its principles to highlight the complexity, interdependence and self-regulating nature of environmental systems, while also pointing out how human action is interfering too much in these vital mechanisms, not allowing self-regulation, which results in the environmental crisis.

Now, the environmental problem is not only a multi-faceted approach, but also an inter- and transdisciplinary one, as it is multifactorial and multidimensional, which is a characteristic of

Environmental Sciences, which was consolidated as an area of knowledge in Brazil in 2011, according to Capes (2019), "*based on the need to address environmental challenges, considering the interaction between anthropic and natural* systems". This interdisciplinary approach is related to Bateson, as it is influenced by Cybernetics and systems thinking.

An interdisciplinary scientific approach requires the development of appropriate language. Brügger (2006) points out that Western knowledge, the modern science of instrumental reason, is based on disciplinarity. Thus, as the basis is the monodiscipline as a foundation, for the development of interdisciplinarity to happen, language must be reviewed, as it reflects a dichotomous "structure of thought", based on disciplinary oppositions and fragments of knowledge that do not encompass the totality. "Words do nothing but translate a thought." Thus, "our *language is inadequate*" for an interdisciplinary knowledge construction, because "All theoretical knowledge starts from a world already shaped by language" according to Cassirer (1992) *apud* Brügger (2006).

Also in the considerations of Brügger (2006) it is possible to perceive the influence of the systemic thinking introduced by Cybernetics, with regard to the concept of feedback, which was influenced by Bateson, as already reported, when the author mentions that "language and thought (and culture) feed each other".

In addition to Cybernetics and Anthropology, Bateson also exerted influence on Communication Theory. According to Lana (2008), the orchestral communication model came from Cybernetics and systems theory. According to the author, one of Bateson's contributions is the concept of *double bind*, developed in conjunction with other researchers. According to Winkin (1998), the double embarrassment consists in "seeing the origin of childhood schizophrenia in a network of contradictory relationships between mother and child".

> The theory, related to schizophrenia, postulates that the symptoms of the disease would be an expression of the anguish caused by situations of double embarrassment, which refers to a paradox in communication" (LANA, 2008, p. 238).

However, we perceive the inter and transdisciplinary character of Bateson when Lana (2008) cites Winkin (1998), stating that Bateson does not limit his work to Psychiatry. Lana (2008) highlights Winkin's (1998) statement:

> While his colleagues continue their work within Psychiatry, Bateson resumes his vast interrogation about communication. He returns to animal communication, which had fascinated him so much when he discovered the game between otters. He is interested in the modes of interaction between octopuses, and then between dolphins (WINKIN, 1998, p. 50-51).

We see here, therefore, a search for a general theory of communication, based on diverse data, derived from observations of schizophrenic behaviors, games between otters and dialogues between a ventriloquist and his dummy (Winkin, 1998).

It can be seen that Bateson did not have a gaze focused on a single aspect of life, on a single object, but sought a broader vision, a vision of the whole, in search of patterns, or the *pattern of patterns*, of what would connect all things, of the relationships, of the connections between living beings mainly, but also between living and non-living beings. That would be the *pattern that binds*.

Bateson's influence on psychology is also reported. Carvalho and Steil (2013), commenting on Bateson's focus on the search for understanding relationships, mentions that Lewin makes perception paramount for Social Psychology in the understanding of the reciprocal relationships between the person, behavior and the environment from its deepening in the notions of Ecological Psychology, vital space and psychological field, making an interaction with Bateson's thoughts.

It is discussed by Carvalho and Steil (2013) that the forms of interactions that Bateson questions have positively influenced the area of Psychology with their contributions to Environmental Psychology. The same authors also report on Gibson's position in relation to Environmental Psychology being direct and that the information is not in the mind of the perceiver but in the environment and the discussion of the direct relationship between the perceptive subject and the environment, leaving aside the processing of sensory stimuli.

Bateson's contribution to the emergence of a look, of a thought that is more integrated with things, with the world, with phenomena, with the environment, with life itself, can be observed in Steil and Carvalho (2014), who propose the term *ecological epistemologies*, rereading several contemporary authors from this "interpretative key". This group of authors, cited by Steil and Carvalho (2014), such as Haraway (2003), Latour (2004), Stengers (2002), Leff (2006) and Gibson (1979), are situated in a "heterogeneous field of *ecological epistemologies*" by identifying their convergences and continuities (despite the differences between them).

> The term ecological epistemologies as we propose it delimits a region of the contemporary theoretical-philosophical debate, which comprises authors from disciplinary backgrounds and different theoretical options, whose common point is the effort to overcome modern dualities, such as nature and culture, subject and society, body and mind, artifice and nature, subject and object (STEIL; CARVALHO, 2014, p. 164).

In this analysis, it is also possible to observe Bateson's influence. Steil and Carvalho (2014) point out that the term ecology was already mentioned by Gregory Bateson between 1960 and 1970, in his work in the areas of Anthropology and Psychology. Citing Bateson (2000), the authors also point out that, through the concept of *ecology of mind* , Bateson pointed "to the continuities that exist not only between nature and culture, but also between mind and environment".

For Steil and Carvalho (2014), Bateson criticizes "the externality of the observer in relation to the researched object and of the mind in relation to the environment", as a criterion used to validate knowledge, the old Cartesian practice fed by the positivism of the knowing subject dissociated from the object to be studied. This puts Bateson's thought in coincidence with other thinkers with regard to the criticism "of the researcher's externality in relation to what he observes in the investigation process".

Regarding the ecology of the mind, Marques (2012), citing Canevacci (2001), points out that this concept demonstrates an attempt to radically overcome the archaic dualisms of matter and spirit, proposing the fusion between Nature and culture.

> Thus, he supports the thesis that "the mind rightfully belongs not only to the human being, but also to each immanent unit in the great biological system: the ecosystem." This translates into what Bateson calls "the pattern that connects". (MARQUES, 2012, p. 18)

LEARNING TO LEARN AND CONNECTING THINGS: FATHER-TO-DAUGHTER TEACHINGS FOR A THINKING POSTURE

Learning to learn is a learning of contexts (Bateson, 1993 *apud* Martins, 2002). One of the ideas, among many, present in Gregory Bateson, is to learn how to learn. And in this way, or in this spirit, he apparently developed his work and himself.

His daughter, Nora Bateson, reports this relationship in the education she received from her father and also observed this posture (mentality) in the daily behavior of Gregory Bateson. The concept of *systems thinking* also comes from Bateson. However, it is interesting to note what Nora Bateson reports in an interview with Demarchi et. al., in 2013, making a severe criticism of disciplinary thinking:

> First of all, it is important to recognize that there was no such thing, a systems thinking. There was no systemic way of looking. You have to remember that this was before these words were even used, that is, pre-cybernetics, pre-systems thinking, pre-complexity, pre-chaos, before all these thoughts. In this context, there was no field of thought in which he could apply these concepts. He created the rules as he went along. He was really venturing into conceptual territory. In his academic career, I can only say that he used the tools of academia to serve the purposes of his research: to put the puzzle of the world back together. He did not serve the academy. He has never held a position for more than ten years in any place where he taught. He never wrote a dissertation. He thought that disciplines and the separation of disciplines were something monstrously brutal, for the whole notion of how life works and how things are organized, whether it was a family, or a lake, or a political system, or a forest, or a cultural structure. The disciplines are built to be separate. If you ask a university to build a jungle, you'll end up with a reptile department, (laughs) a bird department, a tree department, and a water department. I think that this is a really good example, because this forest would not work in a dynamic and integrated way. However, there is real value in studying the parties. We have to study the parts. There's no doubt that in our body's system, we don't want the heart to do the work of the lungs, right? We don't want reptiles to be birds in our forests. We want each of them to be themselves. So, there are these individual roles, of the parties, which are very important for the integration and interdependence of the whole system. They are not important in and of themselves, separately. So what we do with our scientific method is we take things out of their contexts, but we never put them back. Therefore, in terms of relations between the disciplines, we have

> a long way to go, perhaps not so long, but undoubtedly a radical step to be taken. Because just thinking about this, about what it means to look at our whole complex system, the first thing we do is separate another category of systems thinking, as if it were something different. I have always been concerned about why Ecology is separate from Family Therapy and Economics? Why is it in a separate field of study? It shouldn't be. It should be the Ecology of Family Therapy, the Ecology of Communication, the Ecology of the Economy, the Ecology of..., right? However, somehow this has also become a different discipline and systems have the ability to do this as well. It's like a trap. We should really be careful not to fall into the seductive idea that this is something different. (DEMARCHI et al., 2013, p. 280) (emphasis added).
>
> For Gregory, this did not exist. There was nothing of *systems thinking* or *systemic theory*. It never existed. It was just what it was. It is very difficult to perceive this at this moment in history, in the present. ... we thought: *well, Bateson was using systems thinking*. No. Bateson was just being Bateson. Systems thinking was the name we ended up giving to this activity, later in time" (DEMARCHI et al., 2013, p. 280).

Although Centeno (2009) states that Bateson wrote his dissertation in 1935 (the work *Naven*) and in 1936 published his thesis, unlike Demarchi et al. (2013) report that Bateson never wrote a thesis. He received the title of Doctor *Honoris Causa* from the academy. In fact, in the words of Nora Bateson, Gregory Bateson "thought it was an absolute waste to try to get a PhD! He thought the best thing to do was simply to pursue what interested him." Gregory Bateson was also not limited to the knowledge disciplined in the universities.

Also according to the authors Demarchi et. at (2013), Nora Bateson comments that Gregory Bateson:

> ... He worried about what was being broken, disconnected. What worried him was a very delicate interdependence and the delicate relationships that created them. (Demarchi et al., 2013, p. 280).

This concern with the relationship, connection or interdependence between things can be perceived in the following sentence by Bateson:

> You've probably been taught that you have five fingers. This is totally incorrect. This is the way in which language subdivides things into things. The biological truth is probably that in the growth of this thing in your embryology, which you barely remember, what was important was not the five, but the four relationships between pairs of fingers (DEMARCHI *et. al, 2013, p. 275).*

Not only the concern with the connections and relationships between things (parts of one or the system), but the concern with the mind, with the way people think and that results in the rupture of such relationships, was also the object of deep concern for Bateson, according to his statements in the film *An Ecology of Mind* (Bateson, 2011):

> What is it about our way of perceiving that makes us miss the delicate interdependencies in an ecological system that give it its integrity? We don't see them, and for that reason we break them. (emphasis added).
> The main problems in the world are the result of differences between how Nature works and the way people think. (emphasis added).

THE PATTERN THAT BINDS: HISTORY, CONTEXT, AND MEANING

From here, we focus on some ideas and concepts present in Bateson, specifically from his book *Mind and Nature: The Necessary Unity* (1986).

According to Barbosa (2011), Bateson appropriates Jung's concepts of *pleroma* and *creature* , from the work *Septem Sermones ad Mortuos* (Seven Exhortations to the Dead). According to Bateson (1986), Jung presents two worlds, called *creatura* (the living) and *pleroma* (the non-living, the world of "things"). Bateson makes this "separation" between non-living "things" (pleroma) and living things (*creatura*) in his book *Mind and Nature: The Necessary Unity* (1986) and states that the content of this work is about living things and that, throughout his life, he had left the *pleroma* "in peace". Regarding this apparent separation, Centeno (2009) observes that:

> The observation that the Pleroma and the Creatura form two distinct worlds could lead us to think that Bateson defended Cartesian dualism. However, the unifying perspective of the world is safeguarded when it affirms the interrelation of the determinisms resulting from each world. ... The two worlds are separable simply as levels of description (Centeno, 2009, p. 3).

In this sense, according to Centeno (2009, p. 3)

> Cartesian dualism introduced a break between the ability to apprehend the mental process and the attitude to reflect on the natural world. The rejection of the Cartesian position oriented Bateson in the direction of a monistic perspective of reality and to consider spirit and matter as an inseparably united whole. The environment is inside us and not outside us. The others are part of us, we are the ones who transport them.

From the above, Bateson asks, "What is the *standard that binds* all living things?" Bateson sought to understand what he called the pattern that binds. This concept, present in his work *Mind and Nature: the necessary unity* (Bateson, 1986), is initially presented from morphological observations of a crab. In the initial demonstration of the presence of patterns, Bateson notes the following:

> The anatomy of the crab is repetitive and rhythmic. Like music, it is repetitive with modulation. In fact, the path from the head towards the tail corresponds to a sequence in time: in embryology, the head is older than the tail. A flow of information is possible, from front to back (p. 94).

Being more specific, Bateson (1986) reports that:

> The parts of a crab are linked by various patterns of bilateral symmetry, serial homology, and so on. Let's call these *internal* patterns of individual crab development *first-order connections*. Let's now look at a crab and a lobster, and again we find a link by default. Let's call this *a second-order connection*, or phylogenetic homology (p. 93).

Thus, it is observed that, starting from macroscopic anatomy, Bateson (1986) seeks to detail the levels of connections existing in the world. Three levels of connections are presented: first,

second, and third order. *First-order connections* are inherent in the (pattern) relationships between the parts that make up an individual (a crab or a lobster, for example). On the other hand, relationships (similar to relationships between the parts of the same individual) between two distinct individuals (between a crab and a lobster) are *second-order connections*. *Third-order connections* arise from the comparison between crab and lobsters and the comparison between horse and rider, for example.

From this exposition, Bateson (1986) exposes his concept of the pattern that connects: "The *pattern that connects is a metapattern*. It is a pattern of patterns. It is that *meta-pattern* that defines the vast generalization, which, by the way, are *patterns that connect*."

At this point in the study, we return to the issue of *context* and *meaning*, which we began to address in the introduction, as a didactic presentation proposal.

The idea of *history, context and meaning* presented by Bateson (1986) helps us to better understand what the connecting pattern is. "A story is a small group or complex of this kind of connection that we call *belonging*." To exemplify, Bateson assumes that "any A is pertinent to any B if A and B are both parts or components of the same *story*". Bateson says that we think in terms of stories and that this would not isolate the human being "as something separate from the stars and sea anemones, the coconut trees" or any other living being. In fact, since the whole world is connected, " *thinking in terms of stories* must be shared by all minds or minds, whether ours or those of the redwood forests and sea anemones."

In this way, context and pertinence are characteristic of the "behaviors (those stories projected in *action*)" and also of the "internal stories, the sequences of formation of the sea anemone. Its embryology must be somehow made of the same material as the stories", as well as the evolutionary process itself, prior to the embryology of the anemone and all other living beings. This brings us to the idea of *context* and the *pattern that connects through time (BATESON, 1986).*

Continuing his exemplification, Bateson (1986) exposes that when a person goes to a psychoanalyst, he creates a *context*. It presents "stories built inside" the being. "The patterns and sequences of childhood experience are built within" the person. The learning took place in the "experimental sequence of what those *important others* ", aunt, father and mother, did. In this context, for the psychoanalyst, the father may be an anti-father, because things only have meaning in some context. In this way:

> Or *context* is linked to another undefined notion called *meaning*." Without context, words and actions have no meaning. This is true not only of human communication through words, but also of all kinds of communication, of every mental process, of every mind, including the one that tells the sea anemone how to grow and the amoeba what to do and what to do (p.

FINAL CONSIDERATIONS

When starting to read by and about Gregory Bateson, depending on the starting point, the reader may initially have the impression that he is reading about ecology pure and simple. Then he sees himself in the world of Cybernetics. Advancing in the reading, the reader realizes that it is about Psychiatry. Then he finds himself immersed in the context of Anthropology, Biology, and the Theory of Communication. During this journey, he sees himself provoked, curious, instigated, questioning and questioned.

One can see, then, thinking about thought, when one comes across Gregory Bateson dealing with human thought and the divergence between the human way of thinking and the way Nature works. The work, or thought, of Gregory Bateson is not restricted to certain areas of knowledge or to some disciplines. Bateson proposes to understand issues that apply to the whole of life, to universal principles and not just optional and punctual.

Bateson's influence is diffuse. Bateson had a hand in the development of Cybernetics. This is perhaps one of Bateson's great contributions and form of influence in several areas of knowledge. Cybernetics has contributed to the development of profound forms of analysis of diversified types of systems, whether anthropic or natural, from computers to natural ecosystems.

His works also influenced Psychiatry and Communication Theory, which in turn is related to Psychiatry and Psychology.

Bateson's interdisciplinary character and his systems thinking are also important for the understanding and solution of environmental problems, which must be evaluated and solved in an inter/transdisciplinary and systemic way. In this sense, Bateson's epistemology is directly related to the Environmental Sciences by showing the ecological and sociocultural interconnection.

Finally, we highlight the concept of ecology of the mind and the pattern that connects, developed by this important thinker. Both concepts are similar and interactive that lead us to the idea of integration, of the unity of the mind with the environment (ecology of the mind) and, in addition, the idea of something that connects (connects) all things, that is present in all living beings and among all living beings (pattern that connects), present in and between all systems at their different levels of existence, as a kind of mind.

It is also worth asking: What would be the reflections of Bateson today, whose work deals with the mind and ecology, in the face of the acceleration of the environmental crisis (which is always socio-environmental) manifested by global warming and climate change, intense degradation of ecosystems that break the subtle relationships between lives, leading to the erosion of biodiversity and destruction of habitats? What would you say about the pollution of water, air and soil, the overexploitation of natural commons that cause deforestation, desertification, water scarcity and annihilation of life forms and putting the human species itself at risk? What would be your

perception of the socio-environmental inequality of access to resources and the configuration of environmental vulnerabilities? How would you look at the unsustainable form of production and consumption? How would you observe hyperurbanization? What look would you have at technological advances and artificial intelligence? How would you evaluate the ways of knowing that we use?

If we are taking great strides towards a world of machines endowed with "artificial intelligence", computers that learn and are being taught to learn with increasingly complex algorithms, how will the interaction with the human way of being and knowing be? How will the interaction with the environment take place?

Machines integrated into a network, a system, allow the exchange of data (information/kind of 'experiences') with each other in a feedback system that enhances the learning of the machines themselves, which already in our time have begun to replace and assist the human being in some activities and have the potential to interact with the natural environment and with the human mind and culture.

Can machines also be useful for understanding and solving complex environmental problems, or are they also part of the ecological problem that we face? From a systemic and interdisciplinary approach, with artificial intelligences developed and trained for this, it is possible that there is a need for new ways of thinking that deepen the understanding of relationships, as well as, it is possible, on the other hand, the emergence of forms of "instrumental artificial intelligences" that further deepen the exploitation and degradation of Nature, by the dismantling of ecological systems that are all interconnected, also interfering in the human world.

Another element to be questioned is what refers to the energy consumption by these Artificial Intelligence machines, which can cause great impacts on vital systems, adding degrees to the already intense environmental crisis, which is also a crisis of knowledge, as Leff (2006) postulates.

Returning to the aforementioned statement by Bateson (2011), that "the main problems in the world are the result of the differences between how Nature works and the way people think", one more question is worth asking here: Would we be reproducing in our time a "way of thinking" based on the opposition of culture and Nature, in disparity with the way the material basis of life works, the natural commons and forms of life and their ecological principles? How can we calibrate our thinking and knowledge to other more sustainable ways of existing in the world without breaking the relationship - the pattern that connects - with life in all its diversity? In what sense can the inter/transdisciplinarity of knowledge provide us with new directions?

It is true that Bateson is no longer with us, so it is up to the existing ones to reflect on the possible answers. Bateson's thought, present in his work, can be a light on the path of this great

challenge to free himself from the trap of fragmented knowledge and the social practices (cultural, political and economic) that arise from it and that increasingly weaken life on Earth.

REFERENCES

1. Barbosa, G. B. (2011). Do um e do todo: o anti-dualismo de Gregory Bateson e Marilyn Strathern. *Campos Revista de Antropologia, Universidade Federal do Paraná, 12*(1).

2. Bateson, G. (2000). *Steps to an ecology of mind*. Chicago and London: The University of Chicago Press.

3. Bateson, G. (1986). *Mente e natureza: a unidade necessária*. Rio de Janeiro: Francisco Alves.

4. Bateson, N. (Direção). (2011). *An ecology of mind* [Documentário, 60 min., son., color. Legendado]. S.I: The Impact Media Group. Disponível em: https://www.youtube.com/watch?v=nW3ovmBjQ9I&t=638s. Acesso em: 21 jun. 2021.

5. Brügger, P. (2006). O vôo da águia: reflexões sobre método, interdisciplinaridade e meio ambiente. *Educar em Revista, 27*, 75-91.

6. Canevacci, M. (2001). *Antropologia da comunicação visual*. Rio de Janeiro: DP&A.

7. CAPES. (2019). *Documento de área: Área 49 - Ciências Ambientais*. Coordenação de Aperfeiçoamento de Pessoal de Nível Superior.

8. Capra, F. (1996). *A teia da vida*. São Paulo: Cultrix.

9. Carvalho, I., & Steil, C. (2013). Percepção e ambiente: aportes para uma epistemologia ecológica. *Revista Eletrônica do Mestrado em Educação Ambiental*, Special issue, 59-79.

10. Cassirer, E. (1992). *Linguagem e mito* (3. ed., Trad. J. Guinsburg & M. Schnaiderman). São Paulo: Perspectiva.

11. Centeno, M. J. (2009). *O conceito de comunicação na obra de Bateson: interação e regulação*. Covilhã: Labcom.

12. Chiesa, G. R. (2017). À procura da vida: pensando com Gregory Bateson e Tim Ingold a respeito de uma percepção sagrada do ambiente. *Revista de Antropologia, 60*(2), 410-435.

13. Demarchi, A., Lima, M. R. P., Morim, A. G., & Omim, S. (2013). Uma conversa sobre ecologia da mente: entrevista com Nora Bateson. *Enfoques - Revista dos Alunos do PPGSA-UFRJ, 12*(1), 266-283.

14. Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

15. Haraway, D. J. (2003). *The companion species manifesto: dogs, people, and significant otherness*. Chicago: Prickly Paradigm Press.

16. Harries-Jones, P. (1995). *A recursive vision: ecological understanding and Gregory Bateson*. Toronto: University of Toronto Press.

17. Ingold, T. (2000). *The perception of the environment: essays in livelihood, dwelling and skill*. Londres: Routledge.

18. Krüger, E. L. (2001). Uma abordagem sistêmica da atual crise ambiental. *Revista Desenvolvimento e Meio Ambiente*, Editora da UFPR, (4), 37-43.

19. Lana, L. C. de. (2008). Gregory Bateson e o processo comunicativo. *Em Questão*, Porto Alegre, *14*(2), 235-245.

20. Latour, B. (2004). *Politics of nature: how to bring the sciences into democracy*. Cambridge: Harvard University Press.

21. Leff, E. (2006). *Aventuras de la epistemología ambiental: de la articulación de las ciencias al diálogo de saberes*. México, D. F.: Siglo XXI.

22. Marques, J. (2012). *Ecologia da alma*. Petrolina: Franciscana.

23. Martins, M. de L. (2002). *A linguagem, a verdade e o poder*. Lisboa: Fundação Calouste Gulbenkian e Fundação para a Ciência e a Tecnologia.

24. Steil, C. A., & Carvalho, I. C. de M. (2014). Epistemologias ecológicas: delimitando um conceito. *Mana*, Rio de Janeiro, *20*(1), 163-183.

25. Stengers, I. (2002). *Penser avec Whitehead: une libre et sauvage création de concepts*. Paris: Seuil.

26. Velho, O. (2001). De Bateson a Ingold: passos na constituição de um paradigma ecológico. *Mana*, *7*(2), 133-140.

27. Wiener, N. (1948). *Cybernetics: or control and communication in the animal and the machine*. Cambridge: The MIT Press.

28. Winkin, Y. (1998). *A nova comunicação: da teoria ao trabalho de campo*. São Paulo: Papirus.

Investigation of islands of resistance in complete genomes of *Brucella abortus*

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ABSTRACT

The current evolution of sequencing platforms has increased the amount of information generated and drastically reduced prices. The use of these technologies enabled the development of several omics sciences. Thus, conducting in *silico experiments* through bioinformatics provides basic information for various omics analyses, such as genomics, transcriptomics, metabolomics, among others.

These analyses are especially important when the target of the study is a microorganism of biotechnological, agricultural or environmental interest, as is the case of *Brucella abortus*, a Gram-negative, immobile bacterium with absence of flagella, non-capsulated, non-spore-forming, aerobic, considered a facultative intracellular pathogen and whose cultivation is considered complex.

Thus, the objective of this project is to analyze the complete genomes of *Brucella abortus* available in databases, through bioinformatics approaches, to characterize the resistance profile, evolution and mechanisms of virulence and pathogenicity.

Keywords: *Brucella abortus*, Bioinformatics, Genomics, NGS, Prokaryotes.

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INTRODUCTION

The set of antibiotic resistance genes of microorganisms is called the resistome, proposed by Gerard D. Wright (Wright, 2007). The resistome encompasses the resistance genes of pathogenic and non-pathogenic bacteria, which include antibiotic-producing genes and genes that encode proteins with modest resistance or with binding capacity to antibiotic molecules, inhibiting their action (Caumo et al., 2010).

The incorrect disposal and indiscriminate use of antibiotics are factors that have contributed to the increase in bacteria resistant to various classes of antibiotics. In the past, antibiotic resistance was restricted to hospital settings, but more recent studies have demonstrated the presence of these resistant bacteria in various environments, such as water and soil (Alves et al., 2020). Contamination of the environment by antibiotics can occur through waste from hospital units, agriculture, livestock and/or the disposal of human waste in inappropriate places. The presence of these antibiotics in these environments acts by naturally selecting resistant bacteria, and these in turn can transmit resistance genes through plasmids, integrons, and transposons, altering the balance of the microbial environment (Andersson et al., 2016).

Horizontal gene transfer plays an important role in the development and dissemination of antibiotic-resistant bacteria through the acquisition of resistance genes, conferring new metabolic capacities to the microorganism that receives exogenous DNA, allowing its survival and proliferation in antibiotic-present environments (Alonso et al., 2001).

According to Baba et al (2002), genomic islands (GIs) that are resistant to antibiotics are called islands of resistance (REIs). According to Yoon et al (2015), REIs are a class of GIs linked to pathogenesis, conferring simultaneous resistance to multiple antibiotics and facilitating the emergence of multidrug-resistant pathogens.

Thus, the investigation of resistance genes in organisms of biotechnological and medical-veterinary interest are extremely important, such as the microorganism with which brucellosis is caused in cattle. *Brucella abortus* is a gram-negative bacterium that can cause brucellosis in cattle, leading to miscarriage in pregnant cows, and infertility in male cattle (Neta et al., 2010). Bovine brucellosis is a disease responsible for causing major economic impacts in the agricultural sector of cattle production, mainly causing abortions in the final stretch of pregnancy and the birth of weakened calves, which can cause the early disposal of the animal, losses that justify efforts in the search for effective control solutions, which has vaccination as its most important strategy (Souza, 2009).

METHODOLOGY

DATA COLLECTION

Twenty-three (23) complete genomes of *Brucella abortus* (Table 1) and one of *Escherichia coli* str. K-12 substr. MG1655 deposited in the National Center for Biotechnology Information (NCBI) public database.

Table 1. Complete strains of Brucella abortus available at NCBI.

STRAINS	BioSample	BioProject	Identification	SUBMISSION	REGISTRATION DATE
CIIMS-NV-4	SAMN02604294	PRJNA18999	NC_010742.1	Dr. GM Taori, Central India Institute of Medical Sciences	January 22, 2018
A19	SAMN02604220	PRJNA9619	NC_006932.1	Inner Mongolia Agricultural University	July 8, 2018
NCTC 10505	SAMN02603577	PRJNA74681	NC_016795.1	Los Alamos National Laboratory	August 15, 2014
19BA	SAMN08295219	PRJNA428582	NZ_CP025743.1	RARI and FSBI SCEEMP	June 18, 2018
clpP	SAMN09499628	PRJNA478292	NZ_CP030751.1	China Animal Disease Control Center	October 1, 2019
BAB8416	SAMN02769901	PRJNA244264	NZ_CP007700.1	Shanghai Jiao Tong University School of Medicine	June 30, 2015
BD	SAMN09405586	PRJNA475940	NZ_CP077765.1	China Agricultural University	August 22, 2017
MC	SAMN12827000	PRJNA573837	NZ_CP044338.1	China Agricultural University	August 22, 2017
BJ1	SAMN02712083	PRJNA243017	NZ_CP008774.1	China Institute of Veterinary Drug Control	October 23, 2018
68	SAMN07508059	PRJNA398311	NZ_CP022877.1	University of Alaska Fairbanks	December 17, 2020
BDW	SAMN07508100	PRJNA398313	1:NZ_CP022879.1	Los Alamos National Laboratory	August 15, 2014
ABOUT	SAMN10238131	PRJNA496294	1:NZ_CP033079.1	Los Alamos National Laboratory	August 15, 2014
BFY	SAMN12837785	PRJNA573988	I:NZ_CP046720.1	Los Alamos National Laboratory	August 15, 2014
63 75	SAMN02769911	PRJNA243877	1:NZ_CP007705.1	Los Alamos National Laboratory	August 15, 2014
104M	SAMN02770262	PRJNA244260	1:NZ_CP007709.1	Beijing Institute of Biotechnology	September 22, 2015
2308	SAMN02770266	PRJNA243881	1:NZ_CP007765.1	Oak Ridge National Laboratory	November 28, 2005
A13334	SAMN03108762	PRJNA263969	1:NZ_CP009625.1	Macrogen	15 December 2011
RB51	SAMN02767917	PRJNA243872	1:NZ_CP007681.1	U.S. Department of Agriculture	March 31, 2020

S19	SAMN02767934	PRJNA243875	1:NZ_CP007682.1	Virginia Bioinformatics Institute	May 22nd, 2008
9-941	SAMN02786918	PRJNA244261	1:NZ_CP007738.1	University of Minnesota	April 5, 2005
86/8/59	SAMN02767544	PRJNA243873	1:NZ_CP007663.1	Los Alamos National Laboratory	August 15, 2014
870	SAMN17078505	PRJNA685163	1:CP066175.1	Los Alamos National Laboratory	August 15, 2014
C68	SAMEA3138256	PRJNA16203	I:NC_007618.1	Los Alamos National Laboratory	August 15, 2014

Source: NCBI (2022).

PHYLOGENETIC ANALYSIS

The phylogenetic tree will be performed from the *rpoB gene*, and the multiple alignment will be performed by the BioEdit program (Alzohairy, 2011), through the ClustalW program, and the construction of the tree by the MEGAX program (Kumar et al., 2018), using the Maximum Parsimony method with 1000 bootstrap replicates. As an external group, the genome used will be that of the *Escherichia coli* str strain . K-12 substr. MG1655 available in the NCBI database under access number NC_000913.3.

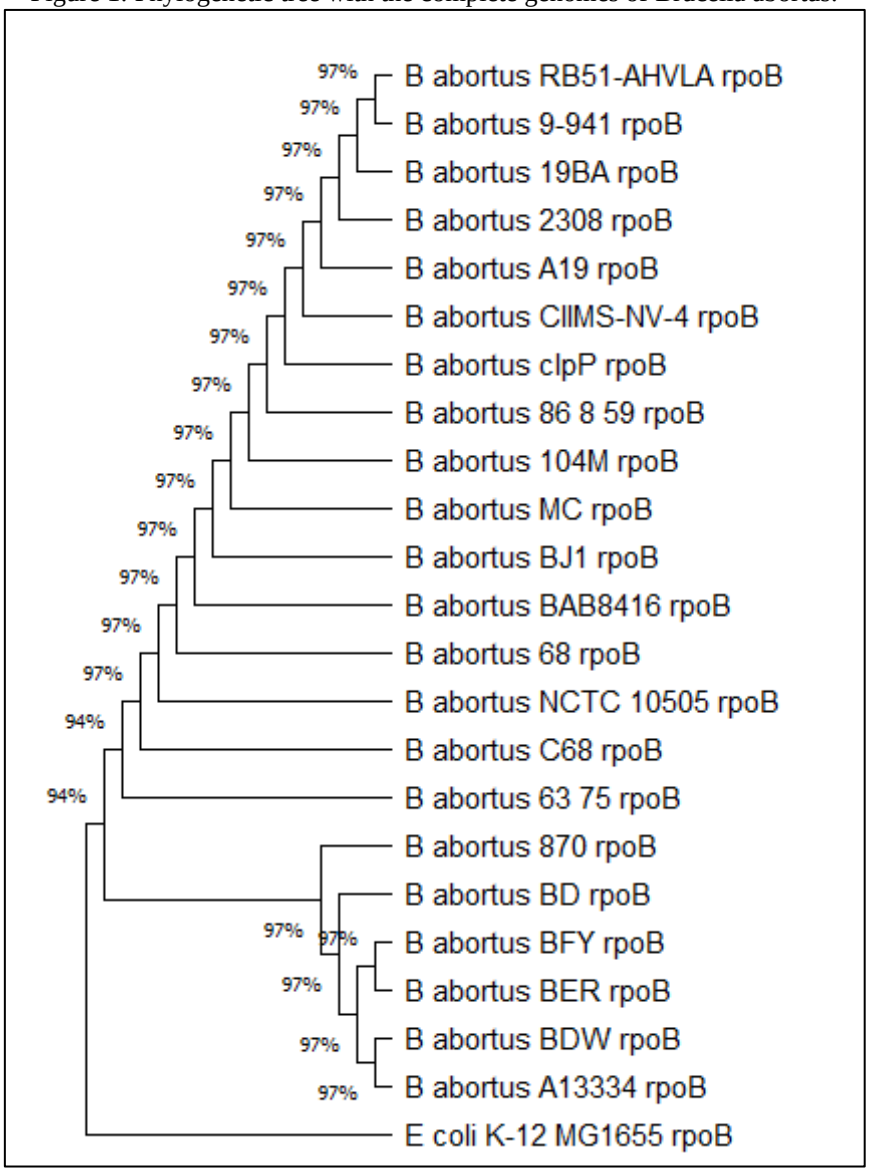
ISLANDS OF RESISTANCE

The identification of resistance islands will be carried out by the Gipsy program (Soares et al., 2016), and this tool is responsible for predicting genomic characteristics shared between a pathogenic and a non-pathogenic species. The standard parameters of the program will be adopted for GA prediction: GC 1.5 content deviation, codon 0.95 use deviation, transposase genes 1E-04, search for specific factors 1E-06, tRNA genes 1E-04 and absence in other organisms 1E-06.

RESULTS

The phylogenetic tree was performed with 23 strains of *B. abortus*, represented by figure 1, in which bootstrap values of at least 94% can be observed, evidencing a high rate of proximity between the strains.

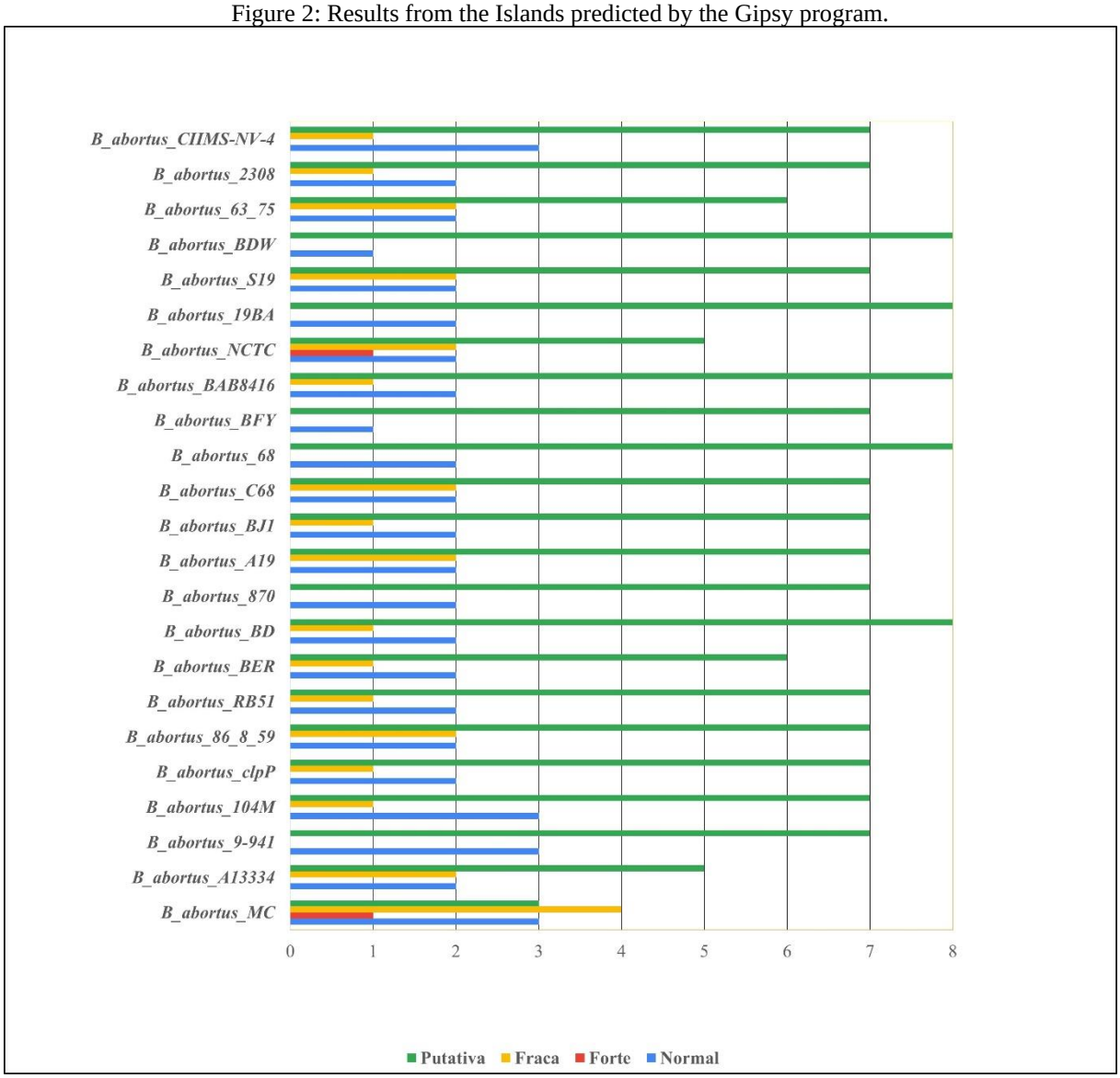
Figure 1: Phylogenetic tree with the complete genomes of Brucella abortus.



After the creation of the phylogenetic tree, the identification of the resistance islands of the Gipsy program was carried out.

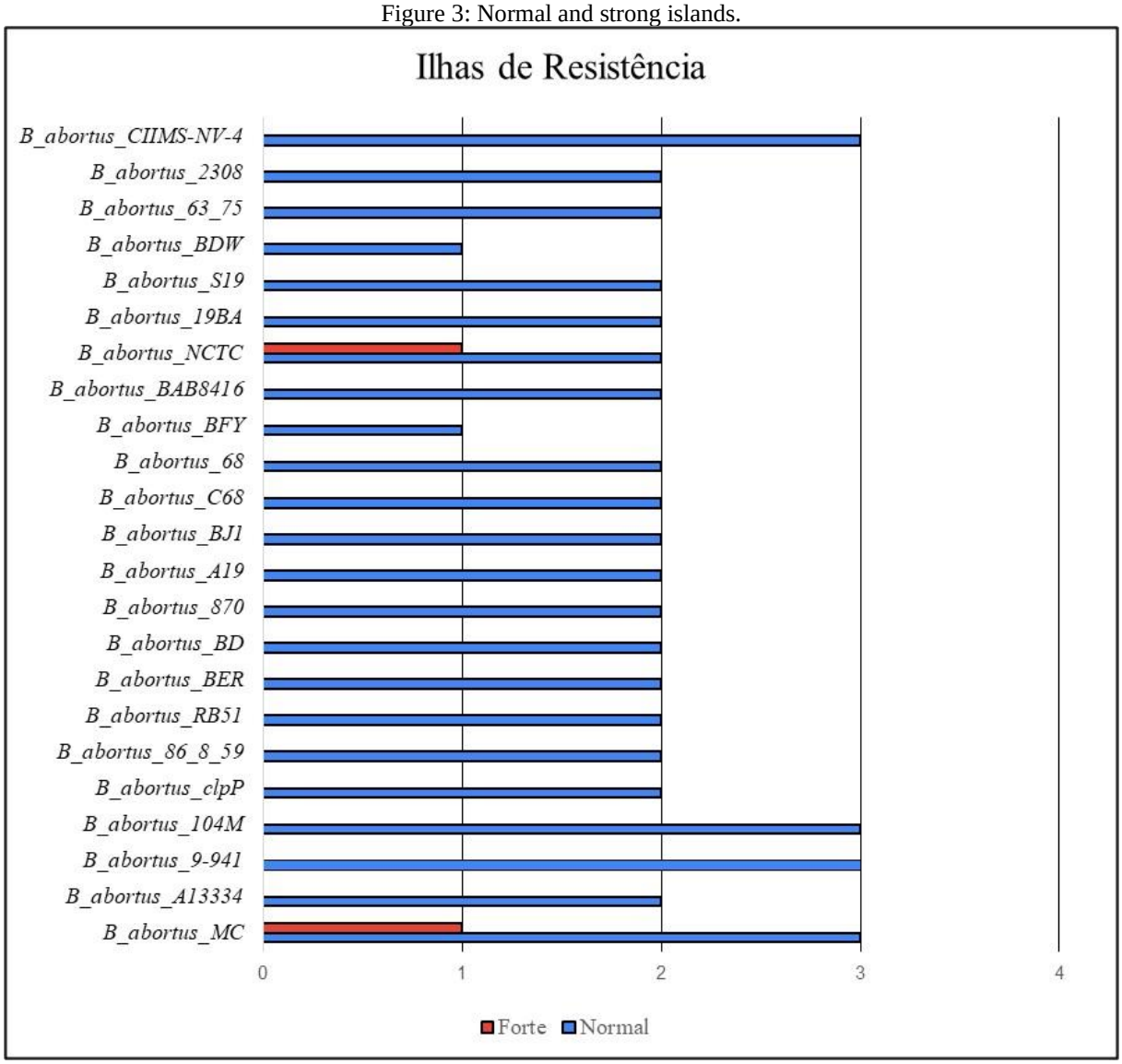
Figure 2 shows the number of REIs found in B. *abortus* strains, which are classified as putative (156), weak (27), strong (2) and normal (48). The number of REIs found is 233.

Figure 2: Results from the Islands predicted by the Gipsy program.



The results of interests are normal and strong presented in figure 3. Strains with the highest numbers of identified islands B . *abortus MC* (4), *B. abortus 9-941* (3), *B. abortus 104M* (3), *B. abortus CIIMS-NV-4* (3).

Figure 3: Normal and strong islands.



DISCUSSION

According to Moreira et al (2015), the phylogenetic tree is a graphic representation, presenting the evolutionary relationships between various species, genes, proteins or any other elements that may have a common ancestor.

The high value of similarity found between the strains in the phylogenetic tree (figure 1) was already expected, as they are strains of the same species and *the rpoB* analysis was performed. The *rpoB* gene (RNA polymerase beta subunit) is a highly conserved molecular marker, also used to identify bacteria and to study their evolutionary relationships (Pulingam, 2022).

Through the bootstrap method, which consists of a number associated with a certain clade in the tree present in the different databases (Efron, 1992). The phylogenetic tree (figure 1) showed high similarity between *B. abortus strains*.

According to Soares et al (2016), genomic islands receive a prediction score of "Weak", "Normal" or "Strong" according to the following rules:

I - Strong, these are regions that have very high concentrations of the specific factor chosen and all other characteristics when compared to the entire genome sequence;
II - Strong, also for regions that manifest low and normal concentration of one genomic signature trait, high concentration of the other and very high concentration of the specific factor chosen;
III - regions that have a low concentration of a
genomic signature trait and high concentration of the other, with a high concentration of the specific factor chosen.
IV - As well as the classification of normal, it is also used to classify regions with normal to high concentration of the specific factor chosen and also high concentrations of 36 hypothetical proteins and deviation of genomic signature; and, (V) otherwise weak (Soares et al., 2016).

The predictions of the islands of interest through GIPSy resulted in a total of 50 REIs identified. Among the results, only two strains showed strong REIs, the *B. abortus NCTC strain and B. abortus MC*, which indicates that these results have a high probability of being true IGEs, as they contain known resistance or pathogenicity genes (Soares et al., 2016).

CONCLUSION

In this study, it was found that the 23 strains analyzed have a great phylogenetic similarity. Using GIPSy to do some analysis and you notice some interesting changes. For example, the "G+C shift", which is basically a change in the percentage of Guanine and Cytosine in the genome. There is also a "codon use deviation", which refers to how often different combinations of nucleotides form an amino acid in protein synthesis.

Therefore, the results show that REIs may be related to pathogenic traits that may lead to the development of new antibiotic-resistant strains or that may cause new diseases. The study of genomic islands is important to understand the evolution of bacteria and the development of antibiotic resistance and the development of resistance islands to develop more efficient treatments against bacteria with pathogenic characteristics.

REFERENCES

1. Alonso, A., Sanchez, P., & Martinez, J. L. (2001). Environmental selection of antibiotic resistance genes. *Environmental Microbiology, 3*(1), 1-9.

2. Alves, J., Dias, L., Mateus, J., Marques, J., Graças, D., Ramos, R., Seldin, L., Henriques, I., Silva, A., & Folador, A. (2020). Resistome in Lake Bolonha, Brazilian Amazon: Identification of genes related to resistance to broad-spectrum antibiotics. *Frontiers in Microbiology, 11*, 67. https://doi.org/10.3389/fmicb.2020.00067

3. Alzohairy, A. (2011). BioEdit: An important software for molecular biology. *GERF Bulletin of Biosciences*.

4. Andersson, D. I., Hughes, D., & Kubicek-Sutherland, Uppsala, J. Z. (2016). Mechanisms and consequences of bacterial resistance to antimicrobial peptides. *Drug Resistance Updates, 26*, 43-57. Elsevier Ltd.

5. Baba, T., Takeuchi, F., Kuroda, M., Yuzawa, H., Aoki, K., Oguchi, A., Nagai, Y., Iwama, N., Asano, K., Naimi, T., Kuroda, H., Cui, L., Yamamoto, K., & Hiramatsu, K. (2002). Genome and virulence determinants of high virulence community-acquired MRSA. *The Lancet, 359*(1819-1827).

6. Caumo, K., Duarte, M., Cargnin, S. T., Ribeiro, V. B., Tasca, T., & Macedo, A. J. (2010). Resistência bacteriana no meio ambiente e implicações na clínica hospitalar. *Revista Liberato, 11*(16), 89-188.

7. Efron, B. (1992). Bootstrap methods: Another look at the jackknife. In *Breakthroughs in statistics: Methodology and distribution* (pp. 569-593). New York, NY: Springer New York.

8. Kumar, S., Glen, S., Michael, L., Christina, K., & Koichiro, T. (2018). MEGA X: Molecular evolutionary genetics analysis across computing platforms. *Molecular Biology and Evolution*.

9. Moreira, L. M., & Varani, A. M. (2015). *Plasticidade e fluxo genômico*. Ribeirão Preto: Sociedade Brasileira de Genética.

10. Neta, A. V. M., de Souza, G. O., do Nascimento, M., & Monteiro, M. A. O. (2010). Brucelose bovina: Uma revisão. *Revista Eletrônica de Veterinária, 11*(12), 1-14.

11. Pulingam, T., et al. (2022). Antimicrobial resistance: Prevalence, economic burden, mechanisms of resistance and strategies to overcome. *European Journal of Pharmaceutical Sciences*.

12. Soares, S. C., et al. (2016). GIPSy: Genomic island prediction software. *Journal of Biotechnology*.

13. Souza, F. G. de. (2009). *Desenvolvimento e avaliação da virulência residual de uma cepa mutante de Brucella abortus* (Tese de Doutorado). Universidade Federal de Mato Grosso do Sul.

14. Wright, G. D. (2007). The antibiotic resistome: The nexus of chemical and genetic diversity. *Nature Reviews Microbiology, 5*(3), 175-186.

15. Yoon, S. H., Park, Y.-K., & Kim, J. F. (2015). PAIDB v2.0: Exploration and analysis of pathogenicity and resistance islands. *Nucleic Acids Research*.

Neurosciences and mental health: New frontiers of clinical research

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ABSTRACT

This chapter explores the new frontiers of clinical research in neuroscience applied to mental health, highlighting recent advances and their implications for psychiatric practice. The integration between neuroscience and mental health has allowed a deeper understanding of mental disorders, with the identification of biomarkers that help in the diagnosis and personalization of treatment. Therapeutic interventions based on neuroplasticity, such as Transcranial Magnetic Stimulation (TMS) and neurofeedback, have been shown to be effective in modulating brain activity and improving symptoms in patients resistant to conventional treatment. Emerging technologies such as artificial intelligence, virtual reality, and brain-computer interfaces are reshaping the future of psychiatry, enabling a more precise and personalized approach. However, these advances bring ethical and practical challenges, including privacy issues, equity in access, and the need for regulation. The chapter concludes that the integration of these innovations into clinical practice must be accompanied by a commitment to ethics, accessibility, and humanization of care.

Keywords: Neuroscience, Mental Health, Neuroplasticity, Biomarkers, Emerging Technologies, Ethics.

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INTRODUCTION

Mental disorders are one of the main public health challenges in the contemporary scenario, affecting millions of people and imposing a substantial impact on the personal, social, and professional lives of individuals. According to the World Health Organization (WHO), disorders such as depression, anxiety, and schizophrenia are responsible for a significant part of the global burden of disease, being among the main causes of disability (WORLD HEALTH ORGANIZATION, 2022). In addition to individual suffering, these conditions entail a heavy economic burden for health systems and society, highlighting the urgent need for scientific innovations capable of improving diagnosis, treatment, and prevention.

The advancement of neuroscience in recent decades has been fundamental in transforming the understanding of mental disorders, allowing for a more integrated and evidence-based approach. Technologies such as functional neuroimaging and genetics have made it possible to identify the neurobiological alterations associated with various psychiatric conditions, revealing new biomarkers and paving the way for more personalized treatments (PIZZAGALLI et al., 2019). This integration between neuroscience and mental health has the potential to revolutionize clinical practice by offering therapeutic interventions that not only treat symptoms, but also aim to modify the functional and structural bases of the brain.

This chapter explores the new frontiers of clinical research in neuroscience applied to mental health, focusing on recent advances that are reshaping the field. First, scientific progress related to the brain mechanisms of mental disorders will be addressed, including discoveries obtained through advanced technologies such as functional magnetic resonance imaging (fMRI) and positron emission tomography (PET). These techniques have been essential for mapping neurobiological dysfunctions in conditions such as depression, anxiety, and schizophrenia, contributing to a more detailed understanding of psychiatric illnesses.

Next, the concept of neuroplasticity will be explored as an important therapeutic axis. The brain's ability to reorganize itself in response to new experiences opens doors to innovative interventions, such as Transcranial Magnetic Stimulation (TMS) and neurofeedback, which show promising applications in the management of disorders resistant to conventional treatment. These therapies, by promoting the modulation of brain activity, have the potential to restore compromised functions and improve patients' clinical outcomes.

In addition, the chapter will discuss the role of biomarkers in the diagnosis and treatment of mental disorders, highlighting how these biological indicators are being used to personalize interventions and identify psychiatric conditions early. From genetic markers to detectable alterations in neuroimaging exams, biomarkers represent a powerful tool to improve diagnostic accuracy and guide therapeutic choice, contributing to a more individualized medicine.

Next, emerging technologies that are shaping the future of psychiatry, such as artificial intelligence (AI) and virtual reality (VR), will be analyzed. AI, for example, has proven useful in analyzing large volumes of neuropsychiatric data, helping to predict treatment responses and identify complex patterns of brain functioning. VR, with its therapeutic applications, offers new possibilities for treating phobias, post-traumatic stress disorders, and cognitive rehabilitation.

Although promising, these innovations bring with them ethical and practical challenges, which will also be addressed in this chapter. The privacy of brain data, unequal access to new technologies, and the risk of excessive medicalization are issues that need to be carefully considered to ensure that advances in neuroscience are applied equitably and responsibly. The discussion of these ethical aspects is essential for the construction of a clinical practice that respects the autonomy of patients and promotes social justice.

Finally, the conclusion will summarize the main advances discussed throughout the chapter, emphasizing the importance of interdisciplinary research for the development of more effective strategies in the prevention, diagnosis, and treatment of mental disorders. The ongoing integration between neuroscience and mental health points to a promising future in which patients will be able to benefit from more accurate and evidence-based approaches, improving quality of life and reducing the impact of mental disorders on society.

RECENT ADVANCES IN NEUROSCIENCES RELATED TO MENTAL HEALTH

In recent decades, neuroscience has provided a deeper understanding of the brain mechanisms involved in mental disorders, allowing significant advances in the identification, diagnosis, and treatment of these conditions. Neuroimaging techniques such as functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) have been widely used to map the neurobiological dysfunctions associated with disorders such as depression, anxiety, and schizophrenia, revealing patterns of brain activity that differ significantly from healthy brains (MARSH et al., 2020).

These technological advances have allowed researchers to identify functional and structural changes in the brains of patients with mental disorders, such as increased activity in the amygdala in people with anxiety disorders or decreased hippocampal volume in individuals with chronic depression. The identification of such patterns not only reinforces the biological nature of mental disorders, but also contributes to the development of new therapeutic approaches that aim to normalize these dysfunctions (MEHTA et al., 2019).

Genetics and epigenetics also play a crucial role in modern neuroscience, providing insights into how heritable and environmental factors influence predisposition to mental disorders. Whole-genome association studies (GWAS) have identified genetic variations linked to conditions such as

schizophrenia and bipolar disorder, suggesting that these disorders have a significant genetic basis (SCHIZOPHRENIA WORKING GROUP OF THE PSYCHIATRIC GENOMICS CONSORTIUM, 2018). In addition, epigenetics, which studies modifications in gene expression without altering the DNA sequence, has revealed how stress, diet, and other environmental factors can modify gene expression, contributing to the development of mental disorders.

Another area of emphasis is the study of brain circuits and their relationship with behaviors associated with mental disorders. Recent research focuses on functional connectivity between different brain regions, showing, for example, the dysfunction of cognitive control networks in individuals with obsessive-compulsive disorder (OCD) and hyperconnectivity in reward circuits in patients with substance dependence (RIDDERINKHOF et al., 2019). These findings reinforce the idea that mental disorders result from complex interactions between multiple brain systems, rather than localized abnormalities in a single region.

In addition, the development of new data analysis methodologies, such as the use of artificial intelligence and machine learning, has expanded the ability to interpret complex brain interactions. These technologies allow the analysis of large volumes of neuroimaging data, facilitating the identification of patterns that would be imperceptible to the naked eye and helping to refine the diagnostic and prognostic models of mental disorders (HUSSAIN et al., 2020). These innovations have the potential to transform psychiatry, providing a clearer view of the mechanisms underlying mental disorders and aiding in the creation of more effective and individualized treatments.

In summary, recent advances in neuroscience are unraveling the complex networks of interactions that underpin mental disorders, providing a solid foundation for the development of new diagnostic and therapeutic approaches. The integration of neuroimaging, genetics, epigenetics, and big data analysis techniques is shaping a future in which psychiatry can benefit from more precise and personalized interventions, significantly improving patient outcomes.

NEUROPLASTICITY AND THERAPEUTIC INTERVENTIONS

Neuroplasticity, defined as the brain's ability to reorganize and modify its neural connections in response to new experiences, learning, and environmental stimuli, has emerged as a central concept in the understanding and treatment of mental disorders. This phenomenon demonstrates that the brain is not a fixed structure, but rather a dynamic organ, capable of continuous adaptation throughout life. In recent years, advances in research on neuroplasticity have shown how this capacity for neural restructuring can be targeted through specific therapeutic interventions to promote the recovery of impaired cognitive and emotional functions (WILSON et al., 2018).

One of the most promising examples of the application of neuroplasticity in psychiatric treatments is Transcranial Magnetic Stimulation (TMS). TMS is a non-invasive technique that uses

magnetic pulses to stimulate specific regions of the brain, modulating their activity and promoting functional changes that can improve symptoms of conditions such as treatment-resistant depression and obsessive-compulsive disorder (OCD). Studies have shown that TMS is able to induce lasting changes in brain connectivity, facilitating the recovery of dysfunctional neural circuits and thus alleviating patients' symptoms (GERSHON et al., 2020).

Another neuroplasticity-based intervention that has gained prominence is neurofeedback, a technique that allows patients to learn to self-regulate their brain activity through real-time feedback. Using sensors that pick up the brain's electrical activity, neurofeedback provides information about brainwave patterns, allowing patients to adjust their neural activity to achieve more desirable mental states, such as relaxation or focus. This technique has shown efficacy in conditions such as anxiety, ADHD (Attention Deficit Hyperactivity Disorder) and even in modulating depression symptoms (THIBAUT et al., 2018).

Cognitive rehabilitation also benefits from neuroplasticity by utilizing structured exercises to train and improve specific cognitive functions, such as memory, attention, and problem-solving. Cognitive rehabilitation programs are widely used in patients who have suffered traumatic brain injuries, strokes, or who have cognitive impairments associated with psychiatric disorders. By encouraging the brain to reorganize its neural networks, these interventions help restore lost or impaired abilities, promoting an improvement in patients' functionality and quality of life (HILL et al., 2019).

In addition to clinical interventions, neuroplasticity is also influenced by lifestyle factors, such as regular physical exercise, meditation, and continuous learning. Aerobic exercise, for example, has been associated with increases in the volume of the hippocampus, a brain region crucial for memory and learning, suggesting that the patient's active involvement in his or her own recovery is an essential component in the therapeutic process (ERICKSON et al., 2011). These practices not only promote neuroplastic changes, but also help manage stress and improve overall well-being, enhancing the effects of formal therapies.

The growing body of evidence supporting the use of neuroplasticity-based interventions highlights the importance of an integrative and adaptive therapeutic approach, which considers each individual's unique ability to modify their own neural networks. Therapies that use neuroplasticity are expanding the range of treatment options, offering hope for patients who do not respond well to traditional approaches and reinforcing the notion that the brain has a remarkable capacity for recovery and adaptation. By exploring and applying the principles of neuroplasticity, clinical practice in mental health can evolve into more personalized and effective strategies that truly address the specific needs of each patient.

BIOMARKERS IN DIAGNOSIS AND TREATMENT

Biomarkers represent one of the most promising innovations in precision medicine applied to mental health, offering new possibilities for early diagnosis and personalization of the treatment of mental disorders. Biomarkers are biological indicators that can be accurately and reliably measured, such as genetic profiles, neuroimaging changes, or levels of specific proteins in the blood. In psychiatry, the identification of biomarkers has the potential to transform the clinical approach, helping to define subtypes of disorders, predict responses to therapeutic interventions, and monitor disease progression (SCHULTZ et al., 2017).

One of the main advances in the use of biomarkers in mental health has occurred through neuroimaging. Techniques such as functional magnetic resonance imaging (fMRI) and magnetic resonance spectroscopy (MRS) make it possible to visualize patterns of brain activity and identify structural changes associated with disorders such as depression, schizophrenia, and bipolar disorder. For example, studies have shown that patients with depression have hypoconnectivity between the prefrontal cortex and the amygdala, regions critical for emotional regulation. These findings not only reinforce the biological basis of mental disorders, but also pave the way for the use of neuroimaging as a diagnostic tool (WILLIAMS et al., 2016).

In addition to neuroimaging, genetic biomarkers have gained prominence in modern psychiatry. Genome-wide association studies (GWAS) have identified genetic variations that increase susceptibility to mental disorders, such as the SLC6A4 gene, which is related to stress response and often associated with depression and generalized anxiety disorder. Genetic analysis allows the stratification of patients based on their risk profile, facilitating the personalization of treatment and the choice of more appropriate pharmacological interventions (POLDERMAN et al., 2018). This is particularly relevant in a field where response to treatment is highly variable and often unpredictable.

Biochemical biomarkers, such as cortisol levels and inflammation, have also been explored in the diagnosis and management of mental disorders. Cortisol, a stress-related hormone, has consistently been found to be at high levels in patients with depression and anxiety disorders. Similarly, inflammatory markers, such as C-reactive protein (CRP), are being studied as possible indicators of an inflammatory subgroup of depression, which may respond better to anti-inflammatory therapies (MILLER; ROHLEDER, 2018). This innovative approach allows treatments to be tailored to the specific biological characteristics of each patient, improving efficacy and minimizing side effects.

In the field of treatment, the identification of biomarkers that predict response to antidepressant and antipsychotic medications is an area of intense research. Studies suggest that patients with specific brain connectivity patterns, identified through fMRI, are more likely to respond

positively to selective serotonin reuptake inhibitor (SSRI) treatments (KARG et al., 2019). This ability to predict the efficacy of a treatment even before it starts represents a significant advance, allowing for faster and more effective interventions, and reducing the time of exposure of patients to ineffective therapies.

The integration of biomarkers in the diagnosis and treatment of mental disorders is in line with the growing trend of precision medicine, which seeks to adapt medical care to the individual characteristics of each patient. Although there are still challenges for routine clinical implementation, such as the need for standardization and validation of biomarkers, the potential of these tools is undeniable. By providing a biological basis for psychiatry, biomarkers are helping to demystify mental disorders and transform clinical practice, offering a future where care will be increasingly personalized and evidence-based.

EMERGING TECHNOLOGIES AND THE FUTURE OF PSYCHIATRY

Contemporary psychiatry is undergoing a significant transformation driven by the rapid advancement of emerging technologies, which are being integrated into the diagnostic, therapeutic, and monitoring processes of mental disorders. Technologies such as artificial intelligence (AI), virtual reality (VR), and big data analytics are standing out for their ability to offer deep insights into brain functioning and personalize therapeutic interventions, enabling a more precise and individualized approach in clinical practice (RUSSO et al., 2020).

Artificial intelligence, especially machine learning, has shown enormous potential to revolutionize psychiatry by analyzing large volumes of neuropsychiatric data. With the use of advanced algorithms, it is possible to identify complex patterns of brain connectivity that are associated with different mental disorders, such as depression, schizophrenia, and bipolar disorder. These algorithms allow the creation of predictive models that help in the diagnosis and prediction of responses to treatments, enabling a preventive and personalized approach (MIKKELI et al., 2019). AI is also used in the analysis of functional magnetic resonance imaging (fMRI) data, facilitating the identification of specific biomarkers that can guide evidence-based therapeutic decisions.

In addition to AI, virtual reality (VR) has shown to be a promising tool for treating a variety of mental disorders, especially those related to phobias, post-traumatic stress disorder (PTSD), and cognitive rehabilitation. VR creates immersive environments that allow patients to confront their fears in a controlled and safe manner, which is particularly useful in exposure therapy for specific phobias. Studies indicate that VR exposure therapy is as effective as exposure in a real environment, with the advantage of being more flexible and adaptable to the patient's needs (BOTELHO et al., 2021). In addition, VR is used in the rehabilitation of cognitive functions, helping patients with brain injuries improve skills such as memory and attention through interactive and engaging activities.

Brain-computer interface (BCI) technologies represent another emerging frontier in psychiatry, allowing direct communication between the brain and external devices. BCI are especially relevant for patients with severe neurological disorders, such as paralysis, who may benefit from thought-controlled neural prostheses. In psychiatry, BCIs are being explored as tools to monitor and modulate brain activity in real time, which could potentially be used to adjust therapeutic interventions based on the patient's brain state (LEWIS; CONTE, 2019). This level of therapeutic personalization could transform the way mental disorders are treated, offering adaptive interventions that respond to the patient's momentary needs.

Another promising application of emerging technologies is telepsychiatry, which has expanded significantly during the COVID-19 pandemic. With the use of digital platforms, it is possible to carry out consultations, monitoring, and therapies at a distance, increasing access to psychiatric care, especially for populations in remote areas or with mobility difficulties. Telepsychiatry also enables the use of self-assessment tools and continuous symptom monitoring, through mobile applications and wearable devices, which collect data on mood, sleep patterns, and physical activity levels (LOURENÇO et al., 2020). These technologies facilitate a more proactive, data-driven approach that can anticipate flare-ups and adjust interventions before symptoms worsen.

Despite promising innovations, integrating these technologies into clinical practice faces significant challenges, including ethical issues such as data privacy and information security. The massive collection of brain and behavioral data raises concerns about who has access to this information and how it will be utilized. In addition, equity in access to advanced technologies is a barrier that needs to be overcome to ensure that all patients can benefit from these innovations, regardless of their geographic location or socioeconomic status (SMITH et al., 2022).

Emerging technologies are redefining the future of psychiatry, enabling more connected, personalized, and evidence-based practice. By integrating AI, VR, BCI, and other technological tools, psychiatry can move towards a model of care that not only treats but also prevents and monitors mental disorders in a continuous and adaptive manner. However, it is essential that these advances are accompanied by clear regulations and strategies that ensure the inclusion and protection of patients, ensuring that technological innovation serves as an instrument for improving global mental health.

ETHICAL IMPLICATIONS AND CHALLENGES

The advancement of neurosciences and the incorporation of emerging technologies in psychiatry have brought new possibilities for diagnosing and treating mental disorders, but they have also raised important ethical issues that need to be carefully addressed. The ethical implications associated with the use of these technologies include concerns about the privacy and security of brain

data, equity in access to treatments, and the need for regulations that ensure the responsible and ethical use of these innovations (FERREIRA; DAYS; SILVA, 2021).

One of the main ethical concerns is the privacy of brain and behavioral data collected by advanced technologies such as neuroimaging and artificial intelligence (AI). Neuroimaging, for example, can reveal sensitive information about an individual's mental state, such as predispositions to mental disorders or responses to specific stimuli, which could be used inappropriately if not properly protected. In addition, the use of AI to analyze mental health data raises questions about the transparency and interpretation of algorithms, which often function as "black boxes", whose decisions are difficult to explain and can result in biases and inadvertent discrimination (JOHNSON et al., 2020).

Unequal access to new technologies is another significant challenge affecting equity in the treatment of mental disorders. Neurotechnology-based therapies, such as transcranial magnetic stimulation (TMS) and virtual reality (VR), are often only available in large urban centers and high-tech healthcare institutions, which limits their access for vulnerable populations and rural areas. This technological disparity can exacerbate existing inequalities in mental health, creating a scenario where only a portion of the population benefits from the latest scientific advances (BASSO; OLIVE TREE; FREITAS, 2022).

In addition to access issues, the introduction of new technologies in psychiatry brings to light the risk of excessive medicalization and dependence on technological interventions to the detriment of traditional and humanized approaches. Although neurotechnologies offer a new dimension to the treatment of mental disorders, they should not replace the therapeutic relationship and psychosocial support that are fundamental to the patient's well-being. It is essential to ensure that the use of technologies is complementary to existing clinical practices, promoting a holistic and patient-centered approach (CASTRO; SANTOS, 2021).

Another relevant ethical aspect is the need for robust and adapted informed consent for the use of emerging technologies, especially in patients with cognitive impairment or comprehension difficulties. Artificial intelligence and neurotechnology tools often involve complex procedures that can be difficult for patients to fully understand, requiring healthcare providers to adopt clear and accessible communication strategies to ensure that individuals understand the benefits, risks, and limitations of proposed interventions (NHS; ANDREWS, 2020).

Finally, the regulation of these new technologies and the creation of specific ethical guidelines are essential to guide clinical practice and protect patients' rights. International organizations, such as the World Health Organization (WHO) and the American Psychiatric Association, have emphasized the importance of developing standards that regulate the use of AI, neuroimaging, and other technologies in psychiatry, so as to ensure that these tools are used safely,

effectively, and ethically (WORLD HEALTH ORGANIZATION, 2023). These regulations should also include criteria for evaluating the quality and validating technologies before their widespread implementation in clinical practice.

The ethical implications and challenges associated with the use of emerging technologies in psychiatry highlight the need for a balanced approach that considers both benefits and risks. It is crucial that scientific advances are accompanied by ongoing ethical debate and the implementation of policies that ensure patient equity, privacy, and safety. Only then will it be possible to integrate these innovations responsibly into psychiatric practice, contributing to a more accessible, safe, and patient-centered mental health.

CONCLUSION

Recent advances in neuroscience and the development of emerging technologies have transformed the understanding and treatment of mental disorders, offering new perspectives for psychiatric practice. This chapter explored how the integration between neuroscience and mental health is opening up innovative avenues for the diagnosis, treatment, and monitoring of these conditions, highlighting the importance of an interdisciplinary and evidence-based approach.

Neuroscience has provided fundamental insights into the biological mechanisms underlying mental disorders, allowing the identification of biomarkers that aid in early diagnosis and personalization of therapeutic interventions. Neuroimaging, genetics, and epigenetic techniques have revealed the complex brain interactions that contribute to conditions such as depression, schizophrenia, and anxiety disorder, enabling a deeper and more accurate understanding of these diseases. These advances reinforce the idea that mental disorders have a solid biological basis, which contributes to destigmatization and the promotion of more effective treatments.

Therapeutic interventions based on neuroplasticity, such as Transcranial Magnetic Stimulation (TMS) and neurofeedback, have demonstrated efficacy in modulating brain activity and improving symptoms in patients who do not respond well to conventional treatments. By promoting lasting changes in neural networks, these therapies offer an innovative approach that goes beyond the traditional one, allowing for a more comprehensive recovery of cognitive and emotional functions. Clinical practice can benefit enormously from incorporating these interventions, which not only treat symptoms but also target restructuring of compromised brain connections.

Emerging technologies such as artificial intelligence (AI), virtual reality (VR), and brain-computer interfaces (BCI) are reshaping the future of psychiatry, enabling more personalized, data-driven interventions. AI, for example, has proven to be a powerful tool for analyzing large volumes of data, allowing the creation of predictive models that help in diagnosis and treatment selection. VR, in turn, offers a controlled environment for exposure therapy and cognitive rehabilitation, while BCI

has significant potential to monitor and adjust interventions in real time, according to the patient's brain state.

However, the use of these technologies is not without ethical and practical challenges. Issues such as data privacy, the transparency of AI algorithms, and the equitable accessibility to these innovations need to be carefully addressed to ensure that all patients can benefit from scientific advancements. Regulation and the creation of specific guidelines for the use of these technologies are essential to protect patients' rights and ensure safe, effective, and fair clinical practice.

The continuous integration between neuroscience, technology and mental health points to a promising future, in which psychiatric care can be increasingly adapted to the individual characteristics of patients. Clinical practice is moving towards a more precise and personalized approach, which considers not only the symptoms but also the biological, genetic and behavioral characteristics of each individual. This evolution requires a continuous commitment to interdisciplinary research and to the education of health professionals, so that innovations can be correctly implemented and translated into concrete benefits for patients.

In short, the new frontiers of neuroscience and emerging technologies offer a unique opportunity to rethink psychiatry, promoting a more integrated, evidence-based, and patient-centered practice. The future of mental health will depend on our ability to balance technological innovation with ethics, accessibility, and humanization of care, ensuring that scientific advances are used to improve the lives of those facing the challenges of mental disorders.

REFERENCES

1. Basso, M. S., Oliveira, T. L., & Freitas, C. M. (2022). Disparities in access to neurotechnology: Barriers and solutions. *Social Psychiatry and Psychiatric Epidemiology, 57*, 759-767.

2. Botelho, M. A., Gomes, C. M., & Carvalho, P. (2021). Virtual reality exposure therapy in the treatment of anxiety disorders: A review of recent advances. *Clinical Psychology Review, 91*, 102107.

3. Castro, R. A., & Santos, M. C. (2021). Balancing technological advances with humanistic care in psychiatry. *Psychiatry and Clinical Neurosciences, 75*(8), 346-353.

4. Erickson, K. I., Pruitt, P. J., & King, A. C. (2011). Exercise training increases size of hippocampus and improves memory. *Proceedings of the National Academy of Sciences, 108*(7), 3017-3022.

5. Ferreira, L. M., Dias, P. R., & Silva, G. L. (2021). Ethical implications of neurotechnology in psychiatry: A review. *Journal of Medical Ethics, 47*(4), 287-293.

6. Gershon, A., Blasey, C., & Papakostas, G. I. (2020). Efficacy of transcranial magnetic stimulation for the treatment of major depressive disorder. *Clinical Psychopharmacology and Neuroscience, 18*(3), 437-447.

7. Hill, N. T., Mackinlay, C., Spence, S. H., & Richards, J. S. (2019). Rehabilitation for executive functioning: Approaches to managing cognitive and behavioural changes following traumatic brain injury. *Neuropsychological Rehabilitation, 29*(5), 665-683.

8. Hussain, A., Yu, X., & Taylor, P. N. (2020). Artificial intelligence in psychiatry: Contemporary applications and future directions. *NeuroImage, 207*, 116258.

9. Johnson, K., Jones, A., & Smith, M. (2020). Artificial intelligence in mental health: Opportunities and challenges. *Ethics in Medicine, 29*(1), 112-119.

10. Karg, K., Burmeister, M., & Sheline, Y. I. (2019). Genetic risk factors for mental disorders: A review of recent research findings. *Annual Review of Clinical Psychology, 15*, 207-228.

11. Lewis, D., & Conte, S. (2019). Brain-computer interfaces in psychiatry: Future applications and current challenges. *NeuroImage: Clinical, 21*, 101639.

12. Lourenço, L. M., Dias, A. M., & Silva, R. R. (2020). Telepsychiatry during the COVID-19 pandemic: Barriers and opportunities. *Psychiatry Research, 295*, 113558.

13. Marsh, R., Maher, B. S., & Pappenheim, K. H. (2020). Advances in neuroimaging research in psychiatry: Applications to clinical practice. *American Journal of Psychiatry, 177*(10), 940-950.

14. Mikkeli, M., Karpov, A., & Wagner, G. (2019). Machine learning in mental health research: A review of the state-of-the-art. *Current Opinion in Behavioral Sciences, 32*, 14-20.

15. Miller, G. E., & Rohleder, N. (2018). Inflammation and mental health: What do we know and where do we go? *Biological Psychiatry, 83*(4), 302-309.

16. Pizzagalli, D. A., Weber, J., Thompson, E., & Wager, T. D. (2019). Neuroimaging approaches to understanding depression: A focus on reward-related brain function. *Biological Psychiatry, 85*(5), 1-11.

17. Polderman, T. J., Benyamini, D., Deutsch, O., et al. (2018). Genetic and environmental contributions to the development of psychiatric disorders. *Nature Reviews Neuroscience, 19*, 654-668.

18. Russo, M., Mazzola, V., Aguera-Ortiz, L., et al. (2020). Artificial intelligence in psychiatry: Are we there yet? *Journal of Affective Disorders, 275*, 673-680.

19. Schizophrenia Working Group of the Psychiatric Genomics Consortium. (2018). Biological insights from 108 schizophrenia-associated genetic loci. *Nature, 511*(7510), 421-427.

20. Schultz, A. P., Clements, M. E., & Spencer, A. P. (2017). Biomarkers in psychiatric research and practice: Current trends and future directions. *Journal of Psychiatric Research, 89*, 1-9.

21. Smith, M. E., Brown, T. R., & Greene, C. (2022). Ethical implications of digital mental health technologies. *Journal of Medical Ethics, 48*(3), 178-184.

22. Tan, J., & Andrews, G. (2020). Informed consent for emerging technologies in psychiatry. *Clinical Ethics, 15*, 33-41.

23. Thibaut, A., Chatzitheodoulou, G., Vázquez Parra, J., et al. (2018). The promise of neurofeedback: Neuroplasticity mechanisms and clinical applications. *Clinical Neurophysiology, 129*(9), 1936-1946.

24. Wilson, B. A., Evans, J. J., & Gracey, F. (2018). Neuroplasticity in the context of brain injury rehabilitation. *NeuroRehabilitation, 43*(1), 1-10.

25. Williams, L. M., Etkin, A., Miller, G., et al. (2016). Neuroimaging biomarkers and predictors of treatment response in depression. *Neuropsychopharmacology, 41*(6), 1651-1661.

26. World Health Organization. (2023). Ethical considerations in neurotechnology. Geneva: WHO. Retrieved from https://www.who.int. Accessed September 8, 2024.

27. World Health Organization. (2022). Mental health and substance use. Geneva: WHO. Retrieved from https://www.who.int/mental_health. Accessed September 8, 2024.

Strategies for improvement in marketing planning: A case study in the company PDCM

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ABSTRACT

This article aims to present proposals for the optimization of the strategic marketing planning process in the PDCM company, adopting methods for a better development of the marketing strategy in the organization. Strategic marketing planning is a process of controllable and uncontrollable variables that affect the exchange relationships between companies. Modern organizations participate in constant technological changes and evolutions, in the growth and segmentation of markets, and therefore need strategies to beat competitors by reinforcing their links with their respective markets and establishing a link between the company and its consumers. Factors considered relevant for the elaboration of the article were the historical context of strategy and planning, conceptual aspects related to the subject and research based on lines of thought of renowned authors in the area, resulting in the structuring of a roadmap for the step-by-step development of an objective and easy-to-implement strategic plan.

Keywords: Marketing, Planning, Strategy.

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INTRODUCTION

The company PDCM – NTC object of study, is a company specialized in Basic Baskets, has been in the market for sixteen years, with the objective of providing the best products according to the customer's needs, always presenting quality in service.

The theme of the solution proposal arose from the realization of the organizational diagnosis work applied in the NUT company, which through data collection, and analysis of information made it possible to visualize all areas of the company, and allowed it to choose the area in which we will work to solve the problem. In view of the facts presented, the following question was formulated: How to optimize the strategic marketing planning in the PDCM company?

The choice of this problem was due to the fact that the company PDCM presents the weak points and points to improve in the strategic marketing planning, having some unsatisfactory points in the marketing strategy.

To solve this problem, the following objectives were defined: General objective: To propose the implementation of the strategic marketing planning of the PDCM company. And the specific objectives: a) To collect data on strategic marketing planning; Establish a strategy for the implementation of planning; Propose actions to optimize strategic marketing planning.

To base the solution project that deals with internal communication and an initial roadmap of the concept of planning and Marketing, types of planning and we will enter the focus of our work, which is Strategic Marketing Planning.

In the methodology, in this case, the instruments interview script, direct observation, and questionnaires were used to obtain the information for the elaboration of the solution proposal.

At the end, a solution proposal will be presented containing all the steps to solve the problem with the planning of the solution proposal and its respective stages involving time and cost.

STRATEGIC PLANNING AS A PILLAR

Strategic planning is the administrative process that provides methodological support to establish the best direction to be followed by the company, aiming at the optimized degree of interaction with external factors – not controllable – and acting in an innovative and differentiated way.

The basis of (Oliveira, 2013) states that strategic planning is usually the responsibility of the highest levels of the company and concerns both the formulation of objectives and the selection of courses of action – strategies – to be followed for its consolidation, taking into account the external and internal conditions of the company and its expected evolution.

Initially, an internal and external analysis of the organizational environment is necessary, with the identification of strengths and weaknesses as internal elements of the organization and the

external environment, the priority is to identify market opportunities and the numerous existing threats, as (Thompson and Strickland, 2003).

According to (Hara, 2003), strategic planning is the administrative process to develop and maintain a viability between organizational objectives and constantly changing market resources and opportunities. The goal of strategic planning is to set up and reconfigure the company's business and its products so that they combine profit production and growth. Thus, it is worth highlighting the importance of strategic planning to effectively direct an organization with clear objectives and specific goals for a desirable future, involving formulation, implementation and establishing long-term objectives (Kaplan and Norton, 1996), in this way, the priority is always continuous learning.

STRATEGIC MARKETING PLANNING

The process of strategic marketing planning can be complex or relatively simple. Strategic planning for a corporation divisions is more intricate than the marketing planning of a single-owner company. Although the problems are different, the planning process is the same in many ways, and essentially, the goals and objectives can be similar. In large or small companies, while achieving the objectives of their own business and marketing, for (Las Casas, 1999) strategic marketing planning carries out the goals of the organization and its resources together with market opportunities in the area of marketing.

It is worth mentioning that a well-planned marketing process presents a great participation, qualification of employees to understand, create and generate value for the customer, (Kotler, 2012). One way to think about the marketing planning process is to see it as a funnel. At the top are important corporate decisions related to the company's mission, vision, and goals, and resource allocation among business units. Planning at this level also involves decisions about whether to acquire or divest the business units themselves. These decisions trickle down the funnel to the business unit level, where planning focuses on achieving goals and objectives within decisions made at the corporate level and being consistent with them. However, in organizations that have only one business unit, the corporate strategy and the business unit strategy are the same thing.

Planning and more specific decisions take place at the bottom of the funnel. It is at this level that organizations make and implement tactical decisions regarding marketing strategy (the target markets and the marketing mix) and marketing plans. According to (Kotler and Keller, 2016), the generation and creation of value and sustainable competitive advantages is a priority in strategic marketing planning.

MARKETING IN THE ORGANIZATION

Marketing is a great process, strategies, performance and realization that companies apply to communication, creativity and granting value to the customer, in this way, it is ensuring the relationship with the customer, privileging the organization and the people involved. The joint realization of institutional processes for the creation, dissemination, delivery and transfer of a proposal with added value for customers, employees and society as a whole and the definition of marketing by the American Marketing Association (AMA, 2022).

The interest in marketing in organizations is essential to know and integrate the company with consumers and the market, thus, for the prominence of the brand, preference and stimulus in sales is a function of marketing according to (Baines and Fill, 2017). Marketing involves identifying and satisfying human and social needs. One of the most succinct and best definitions of marketing is that of "meeting needs by generating profit". We can establish definitions of marketing from the social and managerial perspectives. A social definition shows the role of marketing in society, for example, a professional in the area stated that the role of marketing is to "provide a better standard of living".

From a managerial perspective, marketing is often described as "the art of selling products," but many are surprised to hear that the most important part of marketing is not selling! Sales are the tip of the marketing iceberg. Peter Drucker, one of the leading management theorists, presents the issue as follows: It can be considered that there will always be a need to sell. But the goal of marketing is to make superfluous and sales effort. The goal of marketing is to know and understand the customer so well that the product or service can suit them and sell itself. Ideally, marketing should result in a customer willing to buy. The only thing needed, then, would be to make the product available. (Hara, 2003) states that marketing is to understand and comprehend the needs of customers, always valuing a product or service that meets the needs and affirms the organizational objectives.

The process for implementing marketing strategies in an organization is above all a great investigation of numerous factors that may have internal, external, financial limitations and with major digital transformations in a constantly growing world with the demand for quick and assertive responses. The studies of (Morgan et al., 2018) direct that an interaction between sales and the marketing department is necessary, otherwise, the end result can be a low amplitude of advertising campaigns and inefficient strategies to reach the customer, resulting in a valuable loss of advancing the market with the conquest of customers.

It is worth mentioning the difficulties inherent in marketing initiatives along with the organization's objectives such as revenue, growth, and exploration of new markets, which can be an

aggravating factor in connecting marketing performance to the company's large-scale objectives (Wind, 2022).

From this perspective, marketing is parallel and other business functions such as production, research, general management, human resources, and accounting. As a function of business, the goal of marketing is to connect the organization with its customers. Other people, particularly those who perform marketing tasks, tend to view it as a process of managing the flow of products from the place of conception to the place of consumption.

THE USE OF THE MARKETING PLAN IN ORGANIZATIONS

A good marketing plan requires a lot of information from a number of different sources. An important consideration when gathering all of this information is to keep a bird's-eye view while paying attention to the details. This requires looking at the marketing plan holistically, rather than as a set of related elements. Unfortunately, adopting a holistic perspective is particularly difficult in practice. It's easy to get deeply involved in developing a marketing strategy only to later find that it's inadequate for the organization's resources or marketing environment.

The indication that a marketing plan has been well developed is its ability to accomplish stated goals and objectives. According to (Ferrell, 2009) when undertaking a business, whether it is a product or service, the day-to-day with financial limitations, growth in a sustainable way, in parallel with people management and the risks and uncertainties of the market, it is necessary and extensive that can detail the perspectives of an organization.

For (McDonald and Wilson, 2013) the market opportunities of an organization enable the more effective elaboration of a well-structured marketing plan, in addition, decision-making in a more assertive way is facilitated with the allocation of financial resources and labor according to (Homburg, Jozić and Kuehnl, 2009). Thus, the remarkable importance of the marketing plan for the organization in organizing the marketing activities with the strategic planning of the organization.

The application of the marketing plan covers the applicability in the development practice and methods to achieve the purposes of the organization's marketing area. This support is necessary for the identification, idealization and implementation of advertising campaigns, dissemination, pricing and other marketing actions, according to (Wood, 2017). By highlighting that the marketing plan must be changeable, since adjustments and adaptations are necessary according to the market and the results achieved, highlighting that the effectiveness of the marketing plan is necessary for a continuous and coherent evaluation, aiming to achieve the established goals, as (Armstrong and Cunningham, 2020).

PLANNING TOOLS

The tools applied during the study that were most relevant for the conclusion of the results will be presented.

Elseograma

The flowchart uses a set of standardized symbols to represent the stages of the process, the people or sectors involved, the sequence of operations and the circulation of data and documents, (Alves, 2012) explains that the graphic representation through a mapping of several periods in a continuous and rational way, showing in a broad way the flow of a process, which enables management in an agile way and identifies possible failures and situations for improvement.

For (Kinga, Lima and Costa, 2014) the application of the flowchart is necessary for the mapping of a process, ensuring standardization and the absence of product defects. With regard to (Carvalho and Rabechini Junior, 2015) the allocation of resources and the monitoring of growth requires the help of a flowchart, as a versatile tool with its applicability in various segments of organizational management.

Goal Setting

All companies currently have a planned future, for this they have set objectives and goals to achieve them, to turn a dream into reality through the efforts and resources that over time companies can conquer, for (Costa, 2007) the goal are fundamental principles and standards that can be quantitative and qualitative to be achieved at a given time.

METHODOLOGY

This scientific article was prepared through research carried out through planned technical visits with the application of instruments for the development of the project.

The first visit used a document collection method, with the aid of a document analysis Chek List to collect information on documents related to the organization, with the objective of systematizing and analyzing them.

In the second visit, an interview was applied with a questionnaire of ten (10) questions for the company's Owner-Director and with a person from the administrative sector, whose objective was to obtain qualitative information aimed at strategic marketing planning, among others.

According to (Marconi and Lakatos, 2008), an interview is a meeting between two people, so that one of them obtains information about a certain subject, through a conversation of a professional nature.

On the third visit, a direct observation survey was carried out at the company Ntc, with the objective of gathering information and observing the organizational structure, as well as the opinion of employees regarding the company's strategic marketing planning. In this direct observation analysis, the points to improve in the organization's marketing were analyzed.

DOCUMENTARY ANALYSIS

For (Severino, 2007) of documentary research, the source is documents in the broad sense, that is, not only printed documents, but especially other types of documents, such as newspapers, photos, films, recordings, legal documents. Depending on the objectives outlined, documentary analysis will be carried out with the help of a Check List of documentary analysis, where documents of important relevance to the research will be requested.

INTERVIEW

As stated by (Marconi and Lakatos, 2008), an interview is a meeting between two people, so that one of them obtains information about a certain subject, through a conversation of a professional nature.

The interview for information collection and analysis will be carried out with the Director owner of the company, and with another person who is part of the administrative sector. The interview will be guided by a script previously prepared by the researchers.

DIRECT OBSERVATION

According to (Marconi and Lakatos, 2008) Direct observation is carried out through two techniques: observation and interview. A field visit will be carried out at the company, where researchers with an already prepared script will have the opportunity to make relevant observations for the collection of information.

This process was very important for them to obtain the necessary information, together with the representatives of the Ntc company, regarding the main processes, such as weaknesses, strengths, among others.

Therefore, based on these processes and follow-ups, it was possible to conclude this article and contributed to the elaboration of the proposal for the implementation of strategic planning and improvements to the company.

INCOME STATEMENT

It is in the statement of results that it finds a way to demonstrate that the entire process done resulted in improvements or not for the company, in a summarized and orderly way the data collected by the instruments used, which informed the main facts recorded, are presented.

For this project, the following general objective was defined as a solution proposal: To propose the improvement of the strategic marketing planning in the company Paulo da Silva, contributing to the improvement of the existing processes established in the company.

Strategic marketing planning is focused on the act of thinking and making plans in a more strategic way, due to the possibility of growth, generating good results for the organization.

PDCM is a company that cares about its employees, the good structure that directly or indirectly influences the good organizational climate that the company already has. We analyzed the current flowchart of the aforementioned company in which specific goals and objectives were established for an improvement proposal.

Which were as follows:

- Collect data on strategic marketing planning;
- Establish a strategy for the implementation of planning;
- Propose actions to optimize strategic marketing planning.

Goal 1 – Improvements in the current process of how strategic planning is being applied internally.

Goal 2 – Analyze the projects applied, their strengths and weaknesses, the project aims to implement processes in which it will develop the strategic marketing work in the company.

Goal 3 – Once implemented, promote incentive lectures for employees and training such as specialized courses in the areas of activity. Therefore, it is through these statements that its main objectives are achieved, aiming to provide information to the manager for decision-making.

Based on the concepts of an improvement proposal, which aim to look for the main causes and possible solutions, thus allowing a broad and integrated view of the company/organization. In this sense, it seeks to overcome obstacles and better direct investments, in the face of a specific problem.

Based on the data collected in the surveys, possible solutions to problems related to the company's strategic marketing planning are sought. Based on the above, some demands were detected regarding the marketing of the company Ntc. The company has a website that does not show much information to the customer, as well as the look of the organization did not look good. However, during this project, the company underwent a major change, both in its operational staff, in the field of activity, as well as in infrastructure.

It was observed that in the current process flowchart the activities were done in summarized ways, so it was proposed to improve sales activities, so that there is a more detailed flow of activities to be carried out, and aiming at a better monitoring of the processes.

The Flowchart aims to identify the real and ideal path for a product or service in order to identify deviations. According to (Marshall Junior et al. 2008) it is a graphic representation that allows easy visualization of the steps of a process.

It presents the logical sequence and chain of activities and decisions, in order to obtain an integrated view of the flow of a technical, administrative or managerial process, which allows the performance of critical analysis to detect failures and opportunities for improvement".

In other words: it is the graphic representation of the sequence of a task, system or work routine, identifying the processing and correlating it with the organizational units that the sectors perform them.

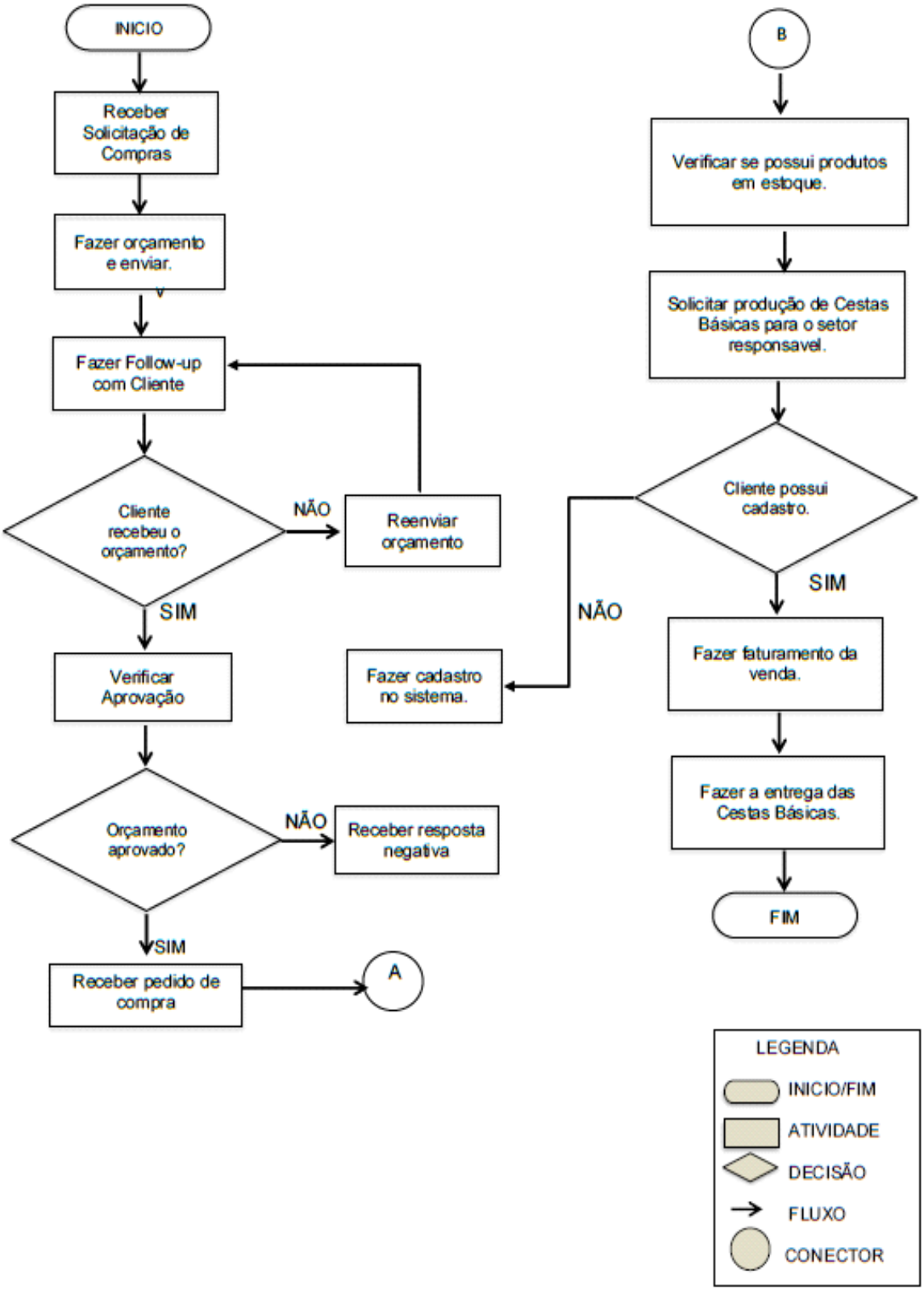
It is a sequential illustration of all the steps in a process, showing how each step is related. It uses easily recognized symbols to denote the different types of operations in a process.

The proposed flowchart was made in order to facilitate the organization of work within the Ntc company, so that the customer can make their requests and with the help of a system that allows the attendant to speed up the fulfillment of the necessary demands until delivery to the desired address. With these improvements, customers would be satisfied in terms of agility and fulfillment of their orders;

This flowchart must be made clearly so that all employees can understand the flow of the process. In such a way that this established process facilitates the focus of the activities of those who perform them.

The flowchart is not limited only to the activities of a process, but also to the people involved in it, as well as the departments and sectors. (Clarke, 2001) completes the statement by emphasizing that this graphic and detailed representation in a sequential way that identifies the processes.

Figure 03: Proposed Flowchart



Source: Lima and Pereira, 2023.

In the Gráf. 01 of Ishikawa are represented the problematic factors of the Paulo da Silva Company, where it can be observed:

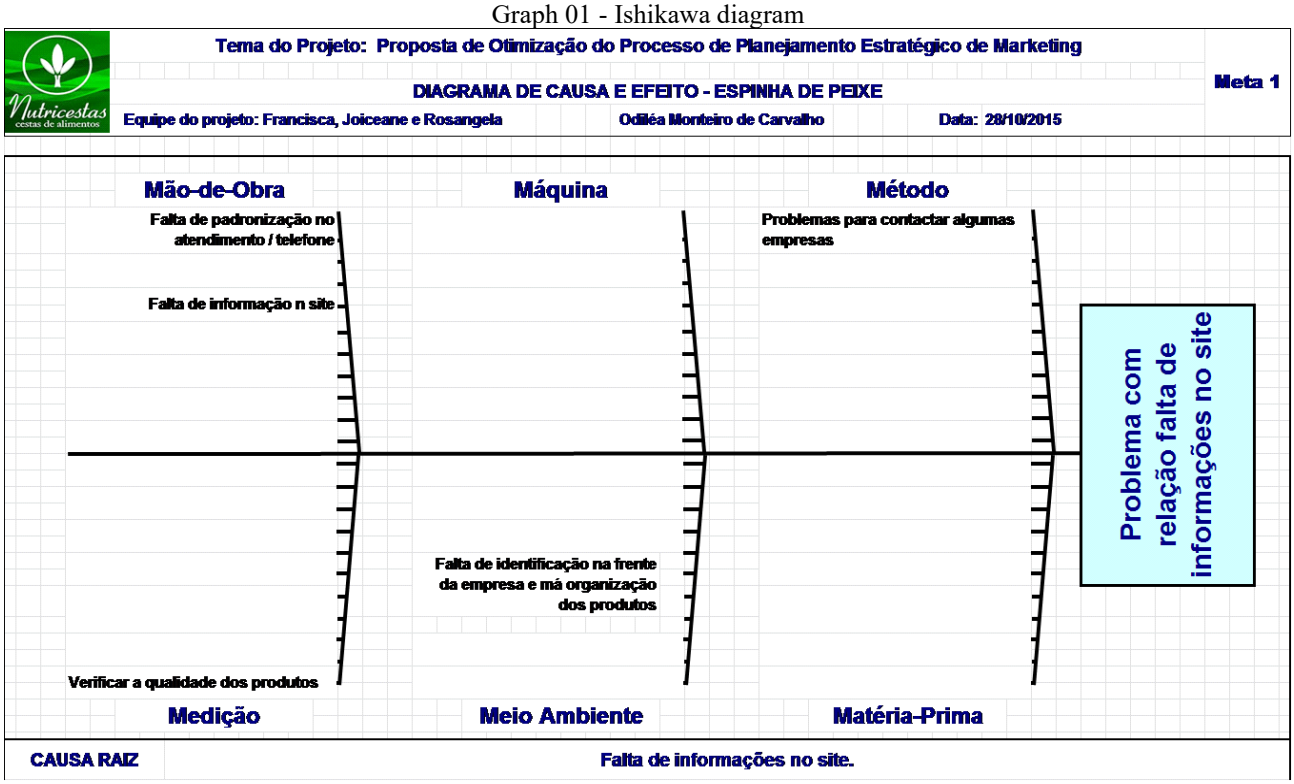
Also known as the Fishbone Diagram, its purpose is to explore and indicate all the possible causes of a specific condition or problem. For (Aguiar, 2006) it is often applied to identify the problem and how it will be necessary to evidence corrective actions.

In the graph presented, the Ntc Company presents several problems, where the following can be highlighted: the lack of standardization in the service/telephone, lack of identification in front of the company, among others.

Satisfied or dissatisfied customers contribute a lot to the future of each business/company. According to (Kotler, 2000), research reports that consumer dissatisfaction is often reported negatively with family and friends, broadly with other people. On the other hand, customer satisfaction is also disseminated in a positive way, but in a smaller number of people.

Based on this, it can be seen that dissatisfied customers can cause a lot of damage to a company, as factors that evidently influence the result of customer satisfaction.

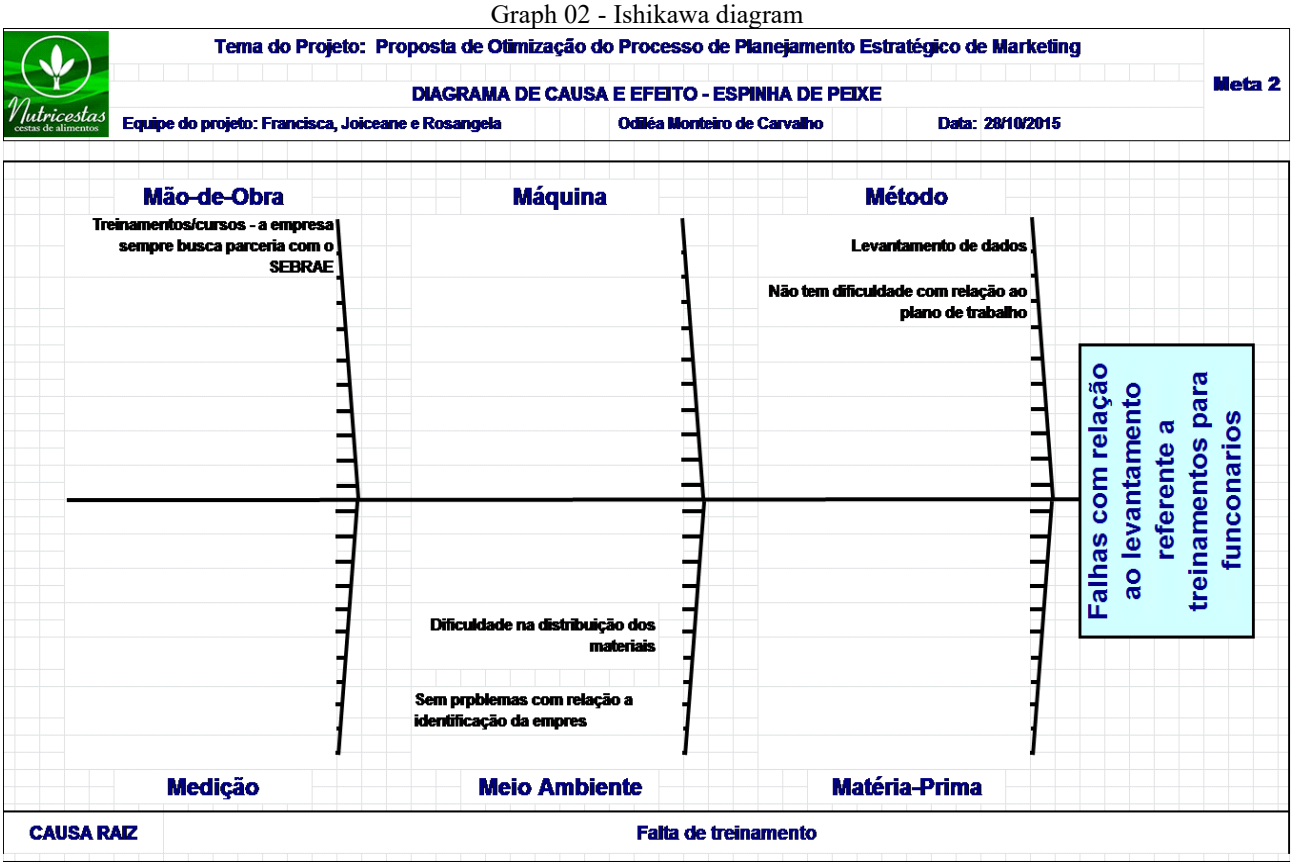
Graph 01 - Ishikawa diagram



Source: Lima and Pereira, 2023.

In this way, it was found that the company needs to invest in this item, as well as in training programs, as the negative aspects and to improve lead to the main problem, which is failures in customer service. The proposal to optimize the strategic marketing planning process in the company Ntc, aims to present the result with technical analyses aimed at good management within the organization.

Graph 02 - Ishikawa diagram

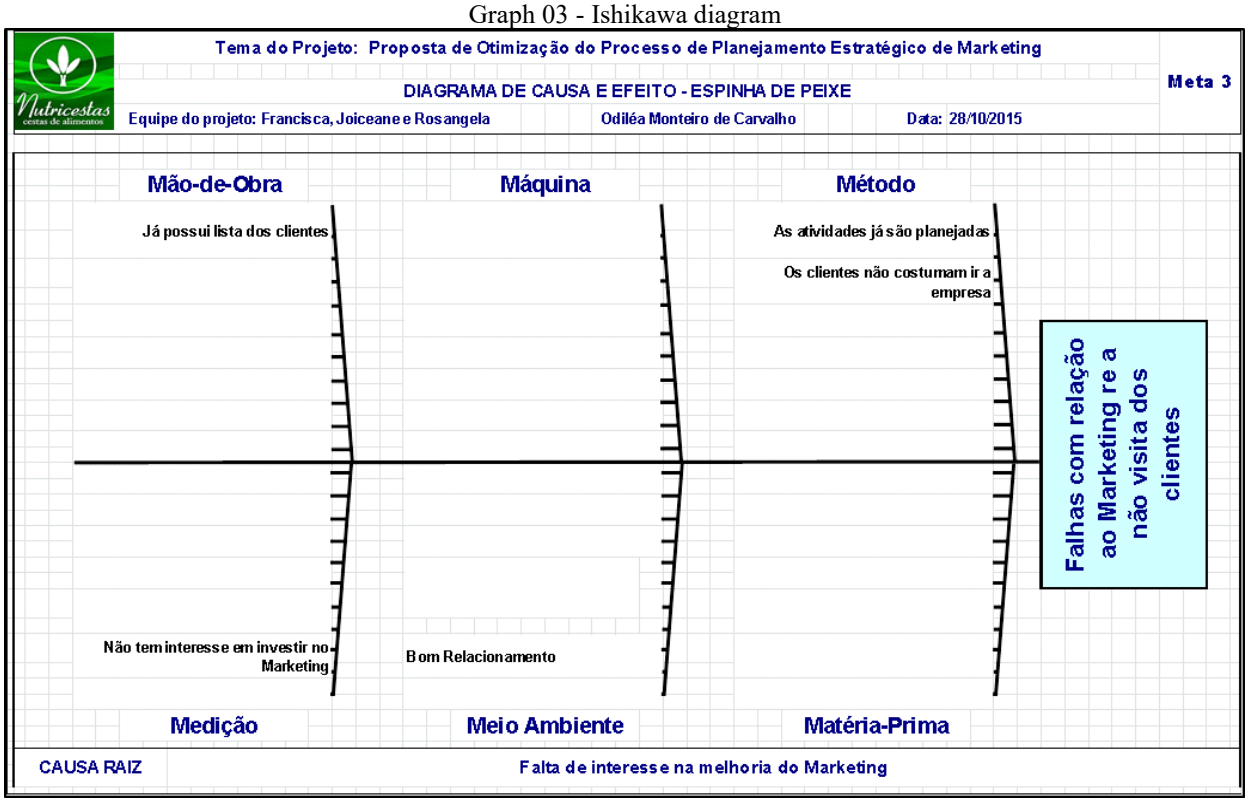


Source: Lima and Pereira, 2023.

In the Gráf. 02 shows that the training carried out in the company is of great importance for employees to be able to make decisions within their function and propose improvements. At the Ntc company, for some time training was provided for employees, but it was not continued, which does not contribute much to the performance of employees.

Thus, (Chiavenato and Marras, 2000) contribute to affirming that training and practice prepare the employee for routine processes and tasks, in order to prepare the company for long-term growth in the market.

Graph 03 - Ishikawa diagram



Source: Lima and Pereira, 2023

According to Gráf. 3, it was observed that the company has a good interpersonal relationship between manager and employees, this contributes to a good performance in the activities to be performed, since to solve some existing problems in a company or organization it is necessary to define the objectives to be achieved, through decisions involving both internal and external relationship processes, vertical integration, adopting a flexible policy in the use of resources, discussing and analyzing the service strategies adopted.

According to (Kotler, 1998) in order to understand the company's relationship marketing with customers, it is necessary to initially identify the processes involved in this chain so that over time this attraction is more lasting.

CONCLUSION AND RECOMMENDATIONS

In this academic article it can be concluded that strategic marketing planning is of interest to the whole society, and not only companies or even students in administration. The study aimed to diagnose the current situation of the Ntc company and create an action plan that predicts possible problems, through scientific studies and methodologies used, such as direct observation, questionnaires and interviews.

The organization is currently considered a micro company that sells basic and Christmas baskets and has as its main vision the fulfillment and satisfaction of consumers in general. For this

reason, it was recommended that the company continue to invest in people who are able to perform functions that require operational and daily tasks according to each position.

The success of the Organization depends only on good strategic planning and the same depends on the people at the hierarchical levels, who seek continuous improvement. With this, there will be a range of information to be offered to the company, creating clear and effective strategies to solve the problem.

Based on the organizational diagnosis, a problem was identified in the company, in which the marketing item does not have an evident performance, leaving something to be desired in important aspects. Therefore, it was found the importance of improving the way the organization identifies and manages activities aimed at knowing the needs of its consumers, with the main objective of customer loyalty, leading the company to achieve the planned goals and reach new market levels.

In view of this information, it is important to highlight the potential of the company, which despite the competition in the market has a great differential and its services. Based on the content studied by this company, we had to elaborate a range of suggestions for improvement that will be available to the owner partner to put into practice the proposed actions and solutions.

In view of this, the researchers recommend that the best path to follow to carry out a research with the topic addressed is to opt for companies that already have a marketing plan and search other sources for content, such as the media, websites, since the subject is in evidence in these media, so that in this way it can facilitate understanding and stimulate the dissemination of the theme.

REFERENCES

1. American Marketing Association (AMA). (2023). *Definition of Marketing*. Disponível em: <https://www.ama.org/the-definition-of-marketing/>. Acesso em: 15 fev, 2024.

2. Aguiar, S. (2006). *Integração das Ferramentas da Qualidade ao PDCA e ao Programa Seis Sigma*. Nova Lima: INDG.

3. Alves, V. L. S. (2012). *Gestão da Qualidade: Ferramentas utilizadas no contexto*. São Paulo: Martinari.

4. Armstrong, G., Kotler, P., & Opresnik, M. O. (2023). *Marketing: An Introduction* (14ª ed.). Harlow: Pearson.

5. Baines, P., & Fill, C. (2017). *Marketing* (6ª ed.). Oxford: Oxford University Press.

6. Carvalho, M. M., & Rabechini Junior, R. (2015). *Fundamentos em Gestão de Projetos: Construindo Competências para Gerenciar Projetos* (4ª ed.). São Paulo: Editora Atlas (Grupo GEN).

7. Clarke, G. (2001). *Marketing de serviços e resultados*. São Paulo: Futura.

8. Costa, E. A. (2007). *Gestão Estratégica*. São Paulo: Saraiva.

9. Ferrel, O. C. (2009). *Estratégia de Marketing*. São Paulo: Cengage Learning.

10. Hara, C. M. (2003). *A Influência do Marketing no Consumo*. Campinas: Editora Alínea.

11. Homburg, C., Jozzi, A., & Kuehnl, C. (2009). *Marketing Management: A Contemporary Perspective* (3ª ed.). London: Routledge.

12. Kaplan, R. S., & Norton, D. P. (1996). *The Balanced Scorecard: Traduzindo Estratégia em Ação*. Boston: Harvard Business School Press.

13. Kinga, N. C. de O., Lima, E. P. de, & Costa, S. E. G. da. (2014). Produtividade sistêmica: conceitos e aplicações. *Production*, 24(1), 160-176.

14. Kotler, P. (2012). *Administração de Marketing* (14ª ed.). São Paulo: Pearson Education do Brasil.

15. Kotler, P. (2000). *Administração de marketing: A edição do novo milênio*. São Paulo: Prentice Hall.

16. Kotler, P., & Keller, K. L. (2016). *Marketing Management* (15ª ed.). Harlow: Pearson.

17. Las Casas, A. L. (1992). *Marketing de Varejo*. São Paulo: Atlas.

18. Marconi, M. A., & Lakatos, E. M. (2005). *Fundamentos de metodologia científica* (6ª ed.). São Paulo: Atlas.

19. McDonald, M., & Wilson, H. (2013). *Plano de Marketing* (7ª ed.). Elsevier.

20. Marshall Junior, I. (2008). *Gestão da Qualidade*. Rio de Janeiro: FGV.

21. Morgan, N. A., Whitler, K. A., Feng, H., & Chari, S. (2018). O papel do marketing no sucesso da empresa. *Journal of Marketing*, 86(1), 1-20.

22. Oliveira, D. P. (2013). *Planejamento Estratégico*. São Paulo: Atlas.

23. Severino, A. J. (2007). *Metodologia do Trabalho Científico* (22ª ed.). São Paulo: Cortez.

24. Thompson, A. A., & Strickland, A. J. (2003). *Gestão Estratégica: Conceitos e Cases*. New York: McGraw-Hill/Irwin.

25. Wind, Y. (2022). Desafio do marketing: Alinhamento com a estratégia corporativa. *Journal of Marketing*, 87(1), 1-10.

26. Wood, M. B. (2017). *Essential Guide to Marketing Planning* (5ª ed.). London: Pearson..

School leadership in adverse contexts

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ABSTRACT

Two qualitative methods (semi-structured interviews and field research) were used to analyze the work developed by thirty-one elementary school directors from the municipal school system of Ribeirão Preto in the state of São Paulo. The result of this work reinforces the essential role of these professionals for the proper functioning of schools, while at the same time pointing out challenges that permeate the work developed by them and, not infrequently, inhibit the ability of these leaders to act successfully. These results also draw attention to the importance of developing school leaders with attributions that go far beyond administrative issues. The transformation in the role of principals implies preparing professionals capable of establishing direction for the school, developing the team, configuring a successful organizational culture, managing the educational program and the school's resources, as well as establishing a positive relationship with the external context. It is evident that in order to enable the formation of school leaders in this perspective, it is necessary that the political and technical actors that make up the education networks understand the importance of allocating efforts both to the professional development of principals and to enable adequate working conditions. Based on the evidence on the subject, this paper presents seven recommendations to support public managers in the professional development of school principals, as well as a checklist with questions to support analyses about the conditions in which they operate.

Keywords: School Leadership, Principals, Professional Development, Elementary Education, Municipal Schools of Ribeirão Preto.

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INTRODUCTION

Despite the vast literature on school leadership developed in the last forty decades in the field of research on school effectiveness, in the Brazilian context the view of principals as leaders has been little explored both from an academic and political point of view. This situation has shown signs of change, particularly after the resolution of the National Education Council with the Competence Matrix of School Directors, approved in 2022.

This paper presents the results of the investigation conducted during the postdoctoral research of one of the authors of this article on the performance of principals of the municipal school system of Ribeirão Preto (SP), mapping the attributions present in the daily life of these professionals and identifying to what extent they converge to the development of principals as educational leaders capable of positively influencing the functioning of schools and the successful trajectory of their students.

Through qualitative research supported by the methods of semi-structured interview and field research, this article presents the findings of the investigation, as well as a set of factors aimed at the professional development of principals. The objective of this article is to contribute to the training and performance of school leaders from a competency view, considering to what extent the context and processes that guide the functioning of schools enable or hinder the development of these professionals.

THEORETICAL FRAMEWORK

Since the 60s, after the set of studies that resulted in the Equality of Educational Opportunity, widely known as the Coleman Report (Coleman et al., 1972), several studies have been developed seeking to identify possible relationships between the performance achieved by students and the various characteristics of schools. These studies have advanced significantly due to improvements in the field of statistical analysis, which have allowed the observation of a greater number of variables and samples, as well as the adoption of systematic evaluations of educational results over long periods. These studies focused on mapping what was happening within each school and how these actions related to student learning outcomes.

These studies identified common elements in schools considered effective, such as an organized environment, the existence of teachers committed to curriculum planning, intellectually challenging teaching, high expectations about the school trajectory of all students, the use of time in academic interactions to the detriment of exclusively administrative activities, the appropriate use of incentives and the presence of a school leadership actively involved in the functioning of the school (Brookover et al., 1978; Teddlie & Stringfield, 1993; Teddlie & Reynolds 2003). In relation to this last element, several studies indicate that school leadership is the second most relevant factor on the

academic performance of students, and it is very rare for schools to improve their educational results without the presence of effective leadership (Leithwood & Duke, 1988).

These findings have influenced several other studies in relation to the way school leadership is configured (Sammons 1999; Reynolds & Teddlie 2000; Leithwood et al., 2006) who, in turn, pointed to common factors, such as i) objective and consistent action, capable of solving problems and establishing a course for school organization, ii) participatory, capable of ensuring the involvement of other people in the functioning of the school; and iii) pedagogical, capable of defining learning objectives and supervising teaching, promoting a collaborative and committed learning environment.

The concept of leadership identified in these studies points to a structure characterized by interactions and composed of four central components: relational, political, with common goals, and intentional. In this sense, the concept of leadership is closely linked to the ability to influence and aggregate people (Brazer; Bauer; Johnson, 2019).

Such a perspective on the role of school leadership culminated in the concept of "transformational leadership", which implies the ability of the school principal to create a sense of commitment to the organization's objectives. Transformational school leadership is capable of: i) building a common vision for the school; ii) establish common objectives; iii) to promote intellectual stimulation;

iv) offer individualized support; v) model best practices and organizational values; vi) demonstrate high expectations in relation to the performance of the team and students; vii) create a productive organizational culture; viii) develop structures to foster participatory decision-making (Leithwood & Duke, 1998).

In the current context, marked by new demands in relation to the role of schools, school leadership becomes even more complex in terms of managing people, resources and results, which implies the need for training that appropriately trains these leaders to lead with the various demands that exist in school organizations. Such a perspective has motivated the definition of necessary competencies for those who wish to pursue a career as a school principal.

Several countries have developed conceptual frameworks with the necessary competencies for school leadership, as is the case of Chile, with the Framework for Good School Management and Leadership (MINEDUC, 2015), which defines the practices, skills and knowledge for leadership development, as well as other organizations such as the National Policy Board for Educational Administration (NPBEA, 2008), which defines a set of competencies to support the professional development and performance of school leaders, gathered in the document Standards for School Leaders. It is also worth noting the work of the Organization for Economic Cooperation and Development (OECD) (OECD, 2008), in developing studies on the importance of school leadership,

providing tools for the improvement of this career with modules involving: i) building distributive leadership, ii) developing skills for effective school leadership, iii) building school leadership and career attractiveness, iv) (re)definition of roles and responsibilities of school leadership.

All these productions have in common the look at the development of skills that enable the training of professionals trained to perform the role of school leadership. This perspective seeks to overcome a shallower understanding of pointing out only specific activities to be carried out for a more comprehensive view, which focuses on the knowledge and skills necessary for a professional and motivating performance, in line with the sense of leadership under discussion.

In Brazil, the debate on the role of school leadership has begun to gain clearer contours, despite the little visibility it has historically received both in terms of public policies and in the field of academic studies. Considering that the country has about 180 thousand schools, 81% of which are public, with a significant variety in relation to size, number of shifts, number and complexity of modalities and stages offered, it is essential to investigate to what extent school principals are prepared to occupy this function and what processes exist to support them in service.

That said, the question that arises is how to ensure the effective functioning of this complex and diversified school ecosystem, at the same time that the figure of the school principal is still of low relevance in discussions about the quality of learning in Brazil. This scenario required the construction of a common national base of the school principal's competencies, indicating, for example, the knowledge and practices required for the exercise of the function. This came to occur in 2021, with the advent of the School Principal's Competence Matrix prepared by the National Council of Education (CNE) (BRASIL, 2021), and forwarded to the Ministry of Education. This CNE initiative, together with the requirements set out in the new FUNDEB (Fund for the Maintenance and Development of Basic Education and the Valorization of Education Professionals) and in the National Education Plan itself from 2014 to 2024, has contributed to spreading the importance of school leadership in the student learning process and the need to improve selection processes. training and monitoring of directors based on competencies.

METHODOLOGY

The research used two qualitative methods: semi-structured interviews with the 31 principals of Elementary Education of the municipal school network of Ribeirão Preto and field research in nine schools. The deepening of the qualitative methodology allowed, over a year of research, to investigate the perspective of the principals themselves in relation to their attributions and the challenges faced in the exercise of the function. During individual interviews with all 31 directors of the network, held in August and September 2022, questions were raised about the training of these directors, how long they have been in the position, the selection process they went through to occupy

the position, their attributions and work routine, as well as the relationship with other education professionals, with the secretariat, with the students and their guardians. In addition, two interviews were also conducted with employees of the secretariat who work directly with the principals in the elementary education division and an interview with the municipal secretary of education.

The interviews were conducted online through the Zoom platform, recorded after authorization from the interviewees and followed a semi-structured script of questions. After each interview, the ethics protocol was sent, attesting to the commitment not to disclose the identity of the interviewee and not to bring names and information that allow the identification of the school in direct quotes. All interviews were transcribed and coded according to the following categories:

1. Professional career
a. Training
b. Time in office
c. Access to the position
d. Motivation for Driving
2. Director's role
a. Duties of the position
3. Management
a. Resource management
b. People management: relationship with the family
c. People management: relationship with the team

Regarding the field research, the nine schools were selected based on criteria observed during the interviews. This selection sought to build a diverse sample of schools, therefore, principals with more and less time in the position were identified, principals who had held the position of vice president before assuming the position and others who did not, older and younger principals, smaller and larger schools, schools in the city center and on the outskirts. In this selection, issues related to the topics that each principal showed greater interest were also taken into account, for example, those who focused most of their time on addressing issues of violence, others who focused on the relationship with the team, or the influence of the family, on the challenges in student learning, on the management of resources and on the impact caused by the social vulnerability of students and the community in which they are inserted.

RESULTS AND DISCUSSIONS

The data collected show that different paths led these teachers to school management, but that, in general, the trajectory did not include experiences specifically designed to prepare them for the management position. The absence of a more structured prior knowledge about the function,

added to a lack of in-service training, contributes to creating a situation in which it is not known for sure what the expectations of these professionals are.

The investigation points to a poorly structured routine in terms of the organization of demands, with overlapping activities and the execution of many tasks throughout the day, mostly focused on operational and administrative issues, such as taking care of finances and organizing funds; taking care of outsourced workers; monitor building works and maintenance and even take over the classroom in the absence of teachers. In general, despite reporting on the importance of the teaching and learning processes, there was no evidence of the allocation of time in the principals' routine so that they have instructional initiatives, such as monitoring the performance of teachers more closely, getting involved in teaching strategies, formulating pedagogical interventions, among others.

No specific examples or evidence were reported that there are frequent and planned moments in the principals' agenda to deal with pedagogical and strategic issues of the school, in addition to the moments established by the Secretariat, such as Class Council and Collective Teaching Work meetings, in which topics of different natures make up the agenda.

It is worth emphasizing that, throughout the survey, principals frequently argue about the importance of learning, indicating it as the main objective to be achieved. In this sense, the study does not question the intention shown by the interviewees to ensure quality education, nor does it question the commitment of these professionals to the function, but rather sought to observe how and at what times the principals effectively carry out activities aimed at this objective.

The descriptions made throughout the interviews, as well as the observation carried out in the field, allow us to identify that, in addition to the posture of commitment to learning and awareness of its importance, in general the principals did not demonstrate mastery of the level of general proficiency of the classes or the greatest challenges in terms of learning, as well as the pedagogical strategies in place to overcome gaps. Thus, there is insufficient evidence that the instructional perspective (on curriculum and teaching practices) is part of the principals' routine in a systematic and permanent way.

Thus, based on the results of this research, but also taking into account the evidence obtained and recommendations of the doctoral work entitled "School effectiveness, leadership and learning in Brazilian state schools: a multivariate panel analysis" (SIQUEIRA E SILVA, 2020) and also the Opinion of the National Council of Education (CNE) entitled "National Common Base of School Principal's Competencies (BNC-Academic Director)" (BRAZIL, 2021), seven recommendations were prepared to support public managers in the professional development of principals, in addition to a set of issues that can contribute to technicians and decision-makers analyzing the extent to which their structures and practices are aligned with the recommendations suggested here.

1. **Skills.** Describe the role of principals as school leaders, focusing not on the attributions widely established in the regulations, but rather on the expectations and competencies necessary for those who wish to pursue the career.
2. **Training.** Organize well-planned training moments with explicit objectives related to the professional development of directors as managers and leaders, which lead to the improvement of the central responsibilities of the school board.
3. **Collaboration.** Enable and foster spaces for exchange among the group of directors, encouraging collaborative work, exchange of good practices and team spirit.
4. **Support.** Properly train the technical team of the secretariat responsible for monitoring the work of the school board, ensuring that they are highly prepared professionals who understand the function.
5. **Evaluation.** To build processes for monitoring and evaluating principals in line with the description of the attributions and competencies established by the network and that allow their full development.
6. **Selection.** Establish director selection processes based on technical criteria aligned with the attributions and competencies defined by the network for the function.
7. **Appreciation.** Develop a culture of valuing school leadership that involves both the secretariat and the school community.

Complementary questions are presented below with the objective of offering a checklist that allows public managers, responsible for the development of school leadership, to analyze whether their structures and practices are aligned with the aforementioned recommendations:

1. Describe the duties of school principals, highlighting the expectations of the function as well as the skills necessary for those who wish to pursue the career;
2. Organize well-planned training moments with explicit objectives, which lead to the improvement of the core competencies of school management and the successful execution of responsibilities on a daily basis;
3. Enable and foster spaces for exchange among the group of directors, encouraging collaborative work, team spirit, intellectual development and the sharing of good practices for the exercise of the function;
4. Adequately train the technical team of the secretariat responsible for monitoring the work of the school board, ensuring that they are highly prepared professionals who understand the function;
5. Build processes for monitoring and evaluating principals in line with the description of the attributions and competencies established by the network that contribute to the continuous development of professionals in the function;

6. Establish selection processes for the position of director guided by technical criteria aligned with the attributions and competencies defined by the network for the function;

Develop a culture of valuing school leadership that involves both the secretariat and the school community.

CONCLUSION

It is concluded that the adverse context, both in intra-school terms (school operational issues, limitations on the management of the teaching team and its teaching strategies) and extra-school (engagement and socioeconomic situation of the students' families), and the absence of an understanding of the responsibilities of the principal with the management of learning significantly preclude the performance of principals as school leaders.

This characteristic absence of the group of directors as a whole and not as something specific to one or another professional raises the hypothesis that, more than a question of the directors' engagement with the function, it may be the reflection of a system that does not, in fact, attribute such functions to the directors and does not prepare them. In this sense, it is questioned, therefore, to what extent the institutional arrangement in which public schools operate favors a concentrated action on teaching issues. In other words, to inquire how instruments and repertoire are offered for principals to deal with instructional issues, and if there is clarity and incentives for acting in this area. Guiding the training and performance of these professionals by a vision of competencies is an important step to reformat a profile that is mostly administrative towards one of leadership. However, in order for this leadership to find an environment conducive to development, it is necessary to discuss the context and processes that guide the functioning of schools as a whole, and to adjust the attributions of principals. In this sense, this article helps public managers to understand the relevance of this function, redefining the role of principals towards a vision of leadership and promoting professional development actions that enhance the qualification of principals and, in turn, the successful functioning of schools. In addition to the practical contribution, the results of this study also offer evidence to foster the field of research on school leadership in developing country contexts, a topic that is still incipient in Brazilian academia.

It is known that the performance of a well-prepared school leadership has the potential to influence the learning result of students; However, this action will only materialize when it is encouraged by an institutional arrangement that enables the perspective of principals as learning-oriented leaders. This study did not address the characteristics of this arrangement and the reasons that hinder the development of the necessary competencies and a view of principals as school leaders. Therefore, further research in this direction may contribute to broadening the analysis by exploring

the extent to which the current arrangement restricts the potential of directors and, in turn, the exercise of leadership.

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REFERENCES

1. Brasil. (2021). *Parecer CNE/CP nº 4/2021, aprovado em 11 de maio de 2021 - Base Nacional Comum de Competências do Diretor Escolar (BNC-Diretor Escolar)*. Disponível em: http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=191151-pcp004-21&category_slug=junho-2021-pdf&Itemid=30192

2. Brazer, D., Bauer, S., & Johnson, B. L. (2019). *Leading schools to learn, grow and thrive: using theory to strengthen practice*. New York: Routledge.

3. Brookover, W. B., et al. (1978). *School social systems and student achievement: schools make a difference*. New York: Praeger.

4. Coleman, J. S., et al. (1972). The evaluation of equality of educational opportunity. In: Mosteller, F., & Moynhan, D. P. (Eds.). *On equality of educational opportunity* (pp. 1-32). New York: Vintage Books.

5. Leithwood, K., et al. (2004). *How leadership influences student learning*. The Wallace Foundation. Disponível em: https://www.wallacefoundation.org/knowledge-center/school-leadership/key-research/Pages/How-Leadership-Influences-Student-Learning.aspx

6. Leithwood, K., & Duke, D. (1998). Mapping the conceptual terrain of leadership: a critical point of departure for cross-cultural studies. *Peabody Journal of Education*, 73(2), 31-50.

7. Leithwood, K., Day, C., Sammons, P., Harris, A., & Hopkins, D. (2006). *Seven strong claims about successful school leadership*. The National College for School Leadership. Nottingham, UK.

8. MINEDUC – Ministerio de Educación de Chile. (2015). *Marco para la buena dirección y el liderazgo escolar*. Santiago, Chile.

9. NPBEA – National Policy Board for Educational Administration. (2008). *Educational leadership policy standards: ISLLC*. Washington, DC.

10. OCDE – Organização para Cooperação e Desenvolvimento Econômico. (2008). *Improving school leadership, Vol. 1: Policy and practice*.

11. MEC – Ministério da Educação. (2019). *Censo Escolar 2019, Brasil*. Disponível em: https://download.inep.gov.br/educacao_basica/censo_escolar/press_kit/2019/press_kit_censo_escolar_2019.pdf

12. Siqueira, F., & Neves, M. R. (2022). Transformações da escola e do cenário educacional no Brasil: novas percepções e novos caminhos. In L. A. Crivelaro & N. M. Guiomar (Eds.), *Novas percepções e novos caminhos* (pp. 45-70). Campinas, SP: Alínea.

13. Siqueira e Silva, M. (2020). *Eficácia escolar, liderança e aprendizagem nas escolas estaduais brasileiras: uma análise multivariada em painel* (Tese de Doutorado). Disponível em: https://bibliotecadigital.fgv.br/dspace/handle/10438/29107

14. Siqueira e Silva, M. (2023). *Liderança Escolar em Contextos Adversos* (Relatório de Pós-Doutorado). Instituto de Estudos Avançados – IEA/USP Ribeirão Preto Cátedra Sérgio Henrique Ferreira. Disponível em: https://drive.google.com/file/d/1HnYBrjWRLE8iK8MTC2r6J042JjMUKetw/view?pli=1

15. Teddle, C., & Stringfield, S. (1993). *Schools to make a difference: lessons learned from a 10-year study of school effects*. New York: Teachers College Press.

16. Teddlie, C., & Reynolds, D. (2003). *The international handbook of school effectiveness research*. London: Flamer Press.

Cannabis sativa: Benefits and difficulties of using it for medicinal purposes

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ABSTRACT

Cannabis sativa was used for religious, economic, recreational, and therapeutic purposes. In Brazil, the plant is correlated with the country's history since 1500 with the arrival of the first Portuguese caravels, and with African slaves. However, in 1924, in Geneva there was the II International Opium Conference, which disapproved of the use of *Cannabis.* Scholars believed that it was possible that delta-9 tetrahydrocannabinol and cannabidiol were an alternative for the treatment of various diseases, with cannabidiol as the main non-psychotropic compound, which acts chemically on mental activity. In view of this, this research brings a major problem, which is: What are the challenges faced by the population that needs the use of cannabidiol for medicinal purposes? One of the questions that the survey cites is the issue of obtaining *Cannabis sativa*, where a large part with 75% acquired its herb and/or its medicine legally, through ANVISA authorization and medical consultation. However, another 12.5% of the participants acquired it illegally. It is possible to observe that most patients improved, with 93.8% of them noting that anxiety (31.3%) and depression (25.0%) are the diseases that are most treated through the herb by the participants, followed by migraine, Parkinson's disease, headache, chronic pain, skin lesions, fibromyalgia, epilepsy and quality of life. In the report of improvement, a decrease in pain, insomnia, anxiety, depression, as well as muscle recovery, improvement in focus concentration, increased disposition and energy, that is, medical *cannabis* brought quality of life to the participants. In conclusion, the present work brought blurring of authors and laws, as well as of the comorbidities themselves who make medicinal use of *Cannabis sativa*. Emphasizing the historical facts, benefits of the plant for the treatment and improvement of comorbidities, the advances through state laws that have been happening in Brazil on medical *cannabis*, in addition to the harm that patients face during this journey, such as preconception and high cost.

Keywords: Cannabidiol, Δ9-tetrahydrocannabinol, Medicinal, ANVISA.

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INTRODUCTION

In 1753, the Swedish botanist Carlos Linnaeus named a species of plant, *Cannabis sativa Linnaeus* (France, 2022). In Latin, *Cannabis* means hemp, where the genus of the plant family is established, and *sativa* which means planted or sThe authors, being the species and nature of the plant's development. It comes from Asia, that is, it is not native to Brazil, however it has long leaves, and can reach 6 meters in height (Fioravante, 2006), of the Cannabaceae family containing four subspecies *Cannabis indica*, *Cannabis ruderalis* and *Cannabis spontanea* (Sawler et al. 2015 *apud* Borille, 2016, p.1). *Cannabis sativa* was supposedly cultivated and used for therapeutic purposes by ancestral healers (Pamplona, 2014). Cannabis derivatives can be found by various names such as marijuana, hashish, charas, bhang, ganja and sinsemilla (Reckziegel et al, 2019).

In Brazil, *Cannabis sativa* is correlated with the country's history since 1500 with the arrival of the first Portuguese man-o-wars. The plant was cultivated by indigenous people and blacks, as soon as enslaved Africans brought them, to benefit from the herb for therapeutic, religious and recreational purposes, however, it ended up dissipating quickly (Carlini, 2006).

In 1924, in Geneva, there was the II International Opium Conference, which led to the disapproval of the use of *Cannabis* (Carlini, 2006). This Conference was created in order to help China in the fight against opium, which is a substance extracted from *Papaver somniferum,* this plant has sedative and hypnotic properties. The Conference, in addition to opium, also fought in the control of other narcotics such as cocaine (Perfeito, 2018, Rodrigues, 2006, Duarte, 2005).

In 1964, marijuana, as it is popularly knThe authors in Brazil, was on the rise among scholars such as chemists, botanists and pharmacologists, the aim was to increase research to discover the main substances that can be found in the plant. It was believed that it was possible for these chemical substances to be an alternative for the treatment of various diseases, with Cannabidiol as the main non-psychotropic compound, which acts chemically on mental activity (Matos et al., 2017).

In 2015, the Resolution of the Collegiate Board, which is an example of technical regulation established by ANVISA, allowed the importation of Cannabidiol-based products, based on medical prescription (Brasil, 2015).

Some studies mention that individuals who benefit from *Cannabis sativa* argue for their The authors use in order to reduce levels of stress, anxiety, chronic pain, among others (Lessa et al., 2016).

However, even with countless research proving the benefits of the active ingredient Cannabidiol (CBD) to health, arguments about its efficacy continue to be a problem. Frequent use of marijuana, accompanied by high doses, that is, when used inappropriately, can lead to tolerance.

In addition, marijuana is still widely used as an illicit drug, that is, as hallucinogens. Self-use, unauthorized production and illicit trafficking are defined as crimes. This illegal use of marijuana

includes another issue that makes it difficult for those who really need it for medicinal purposes to delay.

Despite the administrative regulation, individuals with a medical indication for the use of CBD continue to have to resort to the Judiciary to obtain the drug for the treatment of the diseases that affect them, considering that in some locations in the country they still do not provide treatment through the SUS.

The importance of the theme for the community that needs the *Cannabis sativa plant is remarkable*, for those who have some comorbidity or know someone who may have it and have no idea of the effectiveness of marijuana, as well as for the population that has a deep-rooted preconception. In my family circle, for example, there are those who do not know marijuana as a medicinal plant for their respective disease, and those who still have a certain preconception towards the plant.

In my case, there was also a preconception about marijuana because I only knew the illegal side of it. However, through research on some comorbidities such as epilepsy and autism, I ended up coming across the medicinal side of the plant where it aroused a great interest in the subject, becoming my main focus for the area of studies and research.

In view of this, this research brings a major problem, which is: What are the challenges faced by the population that needs the use of cannabidiol for medicinal purposes?

This search for *Cannabis* for the treatment of various disorders and diseases has been growing over the years, several studies point to its effectiveness, due to the lower side effects, such as those of the authors Bergamaschi et al., (2011), Zuardi (2018), Matos et al., (2017), among others. On 06/14/2022, the STJ allowed safe conduct for three patients where they allow the cultivation of *Cannabis sativa* in order to extract the medicinal oil for their The authors use.

However, there are still certain difficulties, such as the high cost, to guarantee the plant for treatment, especially for the lower-class population that looks to *Cannabis* as the last resort for the treatment of specific disorders, with public health as the only source of search. However, it is necessary to advance information about the use of *Cannabis sativa* for therapeutic purposes and the difficulties of acquiring it, being a public health problem.

The present work aims to discuss the benefits for medicinal purposes of *Cannabis sativa* and the difficulties of acquiring permission for legal use. To do this, we will analyze the history of the plant; provide information on the benefits and harms for medicinal purposes and verify the possible adversities faced by the population that depends on the cannabidiol compound.

With this, during the course of the work, the history and benefits and legal frameworks of Cannabis will be clarified, as well as the difficulties in acquiring it and the importance of disseminating the benefits of *Cannabis*.

THEORETICAL FRAMEWORK

HISTORICAL

Described by Carlos Lineu, *Cannabis sativa* is an ancient herb and is one of the first plants to be cultivated by man (Ribeiro, 2014). It was used for religious, economic, recreational, and therapeutic purposes (Correia-da-Silva, et al., 2019). The herb for religious purposes was a tradition for African, indigenous and European peoples, they attributed marijuana as divine nectar, which connects them with spirits and divinity, in addition to relating it to joy, happiness, courage, liberation and good luck. In 1917, the herb was usually found in tobacco shops, however, it was only in 1960 that the custom of smoking marijuana took hold in Europe and the United States, inserting it into the capitalist consumer society (Reckziegel et al., 2019).

The first uses of *Cannabis* for medicinal purposes began with the Chinese emperor Shen Neng, in 2737 B.C., he used the herb to treat pain, epilepsy, arthritis, malaria, "poor memory", among others (Grieco, 2021)

In Brazil, it is believed that the herb was introduced in 1549, through the tying of the ends of the loincloths of the rag dolls that were brought by slaves (Pedro Rosado, 1959 *apud* Carline, 2006, p.315).

Like the rigging of the sails of the vessels, they were also made from hemp fiber. As a result, there was dispersion in Brazil, at that time restricted only to the socioeconomically disadvantaged class, the indigenous and black people. In the nineteenth century, information about the hedonistic effects, a doctrine that seeks pleasure, of marijuana, began to arrive in Brazil, having the greatest penetration in the environment at the time, at that time the herb began to be related to prohibited substances such as opium and cocaine, consequently it became a problem to be questioned (Carlini, 2006; Garcia et al, 2023).

In 1930, the repulsion of marijuana use began in Brazil, due to the collaboration of the Brazilian delegate, Dr. Pernambuco Filho, as well as other delegates representing 40 countries at the II International Conference on Opium, however the representatives did not really know *Cannabis sativa* and its hedonistic effects (Carlini, 2006).

Getúlio Vargas, the president of Brazil at the time, consented to Decree-Law 891 of the Federal Government, chapter II, article 2, on November 25, 1938: "The planting, cultivation, harvesting and exploitation of hemp "Cannabis sativa" and its variety are prohibited in the national territory." (Brasil, 1938, chap. II, art. 2).

In the 60s, Israeli professor and researcher Raphael Mechoulam was one of the initiators in the study of the physicochemical properties of *Cannabis* (Matos et al., 2017), more precisely in 1964, Delta9-tetrahydrocannabinol (Delta9-THC) was discovered, which is one of the active ingredients of the plant (Mechoulam, 2010). In addition to this substance, *Cannabis sativa* also has the compound

called cannabidiol (CBD), both are the main substances extracted from the plant for medicinal purposes (Gonçalves, 2014).

CBD and THC They are phytocannabinoid substances, produced by cannabinoids. These cannabinoids have multiple chemical compounds that act on cell receptors (CB), modifying the dispersion of neurotransmitters in the brain. There are two types of CB receptors, the CB1 (cannabinoid receptor type 1) o CB2 (cannabinoid receptor type 2) (Lima, et al., 2022). CB1 is found in the brain and peripheral tissues, while CB2 it is found in immune cells (Larrinaga et al., 2010).

CBD is mostly metabolized by the liver, then it goes towards the brain, as the compound has lipophilic properties, which has chemical affinity for fats (Matos et al., 2018). This substance acts by inducing the CB2 receptor. THC, on the other hand, develops psychoactive activity when bound to the brain's CB receptor, causing euphoria and hallucinations, it acts by inducing the CB1 receptor (Lima, et al., 2022).

Some researches such as the one recently done by the Federal University of the Southern Border using Cannabis-based oil in the worm *Caenorhabditis elegans*, which has a certain comparison with the genes and molecular pathways of the human body. It brings the finding that THC and CBD oils direct neurochemical, neuroprotective, neuroantioxidant, and neuroanti-inflammatory processes, which is directly linked to the benefits of THC and CBD compounds for the central nervous system and for the advancement of science, bringing important milestones to the population.

BENEFITS AND LEGAL FRAMEWORKS

According to Bergeret et al., (1991 *apud* Gotiès, 2003) the proper use of marijuana does not lead to tolerance. However, the effects that marijuana brings will depend on some factors such as the dose, emotional structure and state of mind due to the exclusively personal problems of the bearer. Thus, according to Carlini (1980 *apud* Gotiès, 2003) the symptoms that the marijuana user can express are psychic alterations, with losses of temporal and spatial discrimination, accompanied by drowsiness, apathy and disinterest in the environment, which can obtain hallucinatory crises and panic reactions.

Lutge et al., 2013, mentions that THC and Cannabidiol have been analyzed as drugs for various comorbidities, gastrointestinal conditions, treatment of atherosclerosis, relief of symptoms of multiple sclerosis, Alzheimer's and amyotrophic lateral sclerosis, relief of Tourette's syndrome symptoms, attention deficit hyperactivity disorder (ADHD), depression, brain injury, treatment of neuroleptic-associated tardive dyskinesia, treatment of glaucoma, cough, and cholestatic pruritus 7. Zuardi (2018) also mentions these substances as drugs for other diseases such as epilepsy,

schizophrenia, Parkinson's disease, diabetes, cancer, nausea, in addition to being effective as an immunosuppressant.

According to the Resolution of the Collegiate Board (RDC) – N° 17, of May 2015 (Brasil, 2015, p.2):

> "... the criteria and procedures for importing, on an exceptional basis, a Cannabidiol-based product in association with other cannabinoids, by an individual, for their The authors use, upon prescription by a legally qualified professional, for health treatment."

Nguyen, et al (2022) developed recent research done in vitro and tested in mice, showing that cannabidiol can block viral infection by SARS-CoV-2 in the early stages and after infection. Preclinical studies done on the lungs and nasal conchae of mice infected with SARS-CoV-2 show that treatment with CBD decreased viral titers.

Several advances have been happening in Brazil, when it comes to *Cannabis sativa* for medicinal purposes. Recently, the Mayor of Salvador, Bruno Reis, sanctioned Law 9663 of 03/06/2023, which states:

> Art. 1 It is the patient's right to receive free of charge from the Government national and/or imported medicines based on medical cannabis that contain the substance Cannabidiol (CBD) and/or Tetrahydrocannabinol (THC) in their formula, provided that they are duly authorized by court order and/or prescribed by a medical professional accompanied by the due report of the reasons for the prescription, in the municipal public health units operating in the municipality of Salvador, the assumptions of article 196 of the Federal Constitution of 1988 were met (Salvador, 2023).

In São Paulo, Governor Tarcísio de Freitas also sanctioned Law 17.618/2023 of 01/31/2023 which states:

> Art. 1 The state policy of free supply of cannabidiol-based plant-derived medicines, in association with other cannabinoid substances, including tetrahydrocannabinol, is hereby instituted on an exceptional basis by the Executive Branch in state public and private health units affiliated with the Unified Health System – SUS (São Paulo, 2023).

In addition, the Federal University of Rio Grande do Norte became the first University in Brazil to secure authorization to work with *Cannabis sativa*, the release came through the National Health Surveillance Agency (ANVISA) for the controlled cultivation and processing of the *Cannabis sativa plant* for scientific research purposes.

A UFRN has been doing multiple researches on the herb *Cannabis sativa*, until he obtained permission from ANVISA to actually work with the *Cannabis.* The research refers to the socioeconomic impacts of the legalization of *Cannabis sativa* for recreational purposes in the light of the economic analysis of law, the concepts and prejudices of society regarding the medicinal use of the *Cannabis*, modernity, biopower and *Cannabis sativa*, the mobilization and articulation for the

therapeutic use of marijuana in Paraíba, the problem and detection of *Cannabis sp*., in recreational sweets and about the prohibitionist nature of drug policy in Brazil and the discussion about the legalization of marijuana. According to the rector of UFRN, José Daniel Diniz (2023) "It represents an important step for the advancement of research developed at UFRN and a historic milestone for Brazilian science."

Currently, researchers at the Federal University of Rio de Janeiro (UFRJ)) discovered the presence of the compound cannabidiol in the *Mitrantic blume trembles* which is a plant native to Brazil, the plant is part of the family of *Cannabis sativa*. It is still a recent research, the researchers found an important amount of cannabidiol in the plant, in approximately 6 months, the researchers began in vitro analyses in order to find out if the properties of this cannabidiol are consistent with the cannabidiol of the *Cannabis sativa*. According to the research coordinator and professor at the Institute of Biology at UFRJ, Rodrigo Soares Moura Neto, what drove the research was due to the discovery of cannabidiol in a *Umlaut* Asian, through this they decided to explore the only *Umlaut* Brazilian.

This discovery is extremely important for medicine and science as it will contribute to the national production of the compound and develop more research in the area that aims to bring quality of life to patients with various diseases, in addition, the demystification of cannabidiol. Consequently, this advance will facilitate the search for patients when it comes to difficulties in acquiring.

DIFFICULTY IN ACQUIRING

In 2006, former President of the Republic Luiz Inácio Lula da Silva sanctioned Law 11.343, of August 23, 2006, knThe authors as the "Anti-Drug Law", which says:

> "Establishes the National System of Public Policies on Drugs – SISNAD; prescribe measures to prevent misuse, care and social reintegration of drug users and dependents; establishes rules for the repression of unauthorized production and illicit drug trafficking; defines crimes and provides another measure (Brasil, 2006)."

Still, to UNODC (United Nations Office on Drugs and Crime) reports that river, air, and land routes for drug trafficking purposes have been increasing. In 2019, there were large marijuana seizures in the United States, Paraguay, Colombia, India, Nigeria, and Brazil.

In 2018, *Cannabis* was the most used substance in the world, about 192 million individuals consumed it. In 2020, about 284 million people used drugs, emphasizing the age group from 15 to 64 years old. Young people have been using more and more drugs, on the continents of Africa and Latin America, people under 35 years of age are undergoing treatment for disorders arising from rampant drug use (UNODC, 2022).

According to historian Jean Marcel Carvalho França, writer of the book "The History of *Cannabis* in Brazil", marijuana associated with criminal behavior, vagrancy and psychic disorders harms those who need the plant for the treatment of their respective comorbidities, since these stigmas have brought to the prohibition of marijuana:

> "Marijuana helps finance organized crime and is linked to violence. In the discussions to be made, it is necessary to show that it is indeed possible to remove Cannabis from the circuit of crime. When there is legalized, controlled planting for medicinal and scientific purposes, trafficking loses ground, and the lives of patients, doctors, and researchers become easier (França, 2022)."

The illegal use of marijuana limits access to medicine, leading to smuggling and reducing the advance of scientific research. However, the individual and the scientist who seeks legal use end up submitting to a complicated, bureaucratic and high-cost administrative process, which may or may not be accepted, making it difficult to study scientific studies and/or improve comorbidities (Bezzera, 2019).

In 2015, according to ANVISA, about 850 authorizations were granted for the import of cannabidiol-based medicines, the year in which the use of these medicines began to be allowed. From then on, in 7 years this number increased reaching 9311%, concluding about 79,995 new patients authorized in 2022, compared to the year 2021 with 40,040.

Even so, experts point out that even with scientific evidence of the medicinal use of cannabidiol and the leverage of import permissions, there is still, for example, a lack of knowledge among doctors to prescribe them as medicines. Elisa Rezende, deputy coordinator of the scientific department of Cognitive Neurology of the Brazilian Academy of Neurology (ABN), says that the lack of prescriptions by doctors is due to prejudice in relation to the use of cannabidiol, but she believes that Anvisa's authorizations do research on them.

Allan Patioti, former director of the Oswaldo Cruz Hospital and CEO of Connect, a startup specializing in *medical cannabis*, mentions in an interview with the newspaper "O Globo", that one of the major problems of the absence of medicines is the high cost for trade in large drugstore chains. As a result, cannabidiol-based products become increasingly scarce and more expensive in drugstores in Brazil, automatically leading patients to import, which is a process that takes 10 to 15 days.

According to Eliane Nunes, psychiatrist and director of the Brazilian Society for the Study of *Cannabis sativa* (SBEC), Brazil has the capacity to produce the products, this would facilitate access and later the value when thinking about low-income families. Emilio Figueiredo, a lawyer with the Legal Network for Drug Policy Reform (Rede Reforma), says that low-income families have found a more economical way to get medicines through the SUS (Unified Health System). But only Salvador

and São Paulo have sanctioned in law the release by the Unified Health System to cannabidiol-based medicines.

Regarding the difficulties in obtaining *Cannabis* for medicinal purposes, such as trafficking and illegal use of the herb, even with confirmations of efficacy, the Brazilian legislation is objective when it mentions in article 196 of the Federal Constitution that health is a fundamental and social right, and it is the duty of the Government to ensure citizens access to the necessary treatment for their clinical cases.

In view of this, it is the duty of the State, due to public policies (social and economic), to ensure the universal and equal admission of citizens to health services, thus leading to a reduction in diseases (Gurgel et al., 2019).

THE IMPORTANCE OF SPREADING THE WORD ABOUT THE BENEFITS OF CANNABIS

According to the National Health Surveillance Agency (ANVISA), drug import authorizations have been leveraging over the years since 2015, where about 850 authorizations were granted, in 2022 it grew by 93.11%, reaching a total of 79,995 authorizations for new patients, almost double compared to the previous year, with about 40,070 releases.

TV shows, websites and social networks are strong disseminators of information, bringing focus to social networks, according to the 2023 report by We Are Social there are about 4.76 billion users worldwide, in addition it was reported that people spend more than 2 and a half hours on social media every day.

Through this, several Brazilian artists have been defending through their social networks the medicinal use of *Cannabis sativa* in order to improve their comorbidities. Actresses Cláudia Rodriges and Guta Stresser who suffer from multiple sclerosis informed about the use of the medicinal plant and the improvement of symptoms (Uol, 2022). Chef Henrique Fogaça celebrated his daughter's improvement on his social network, which he quotes: "It brought joy and peace to Olivia", he also mentions that she suffers from a rare condition not yet knThe authors to doctors (Marie Claire, 2022).

The great samba singer, Arlindo Cruz, suffered a stroke in 2017 (Stroke) that left sequelae, during his treatment his wife Babi Cruz mentioned on her social network the use of cannabidiol and with it the evolution in treatment (Veja, 2022). Trap singer Matheus Brasileiro Aguiar, better knThe authors as Matuê, came through his Instagram stories to show ANVISA's authorization to import cannabidiol-based products for the treatment of anxiety (Sechat, 2023).

In addition to the spread about *medical cannabis* on social media, this information is also being taken to the population through reports, whether on television or on a communication site. Recently, Profissão Repórter, a program well knThe authors for bringing little-talked about issues to

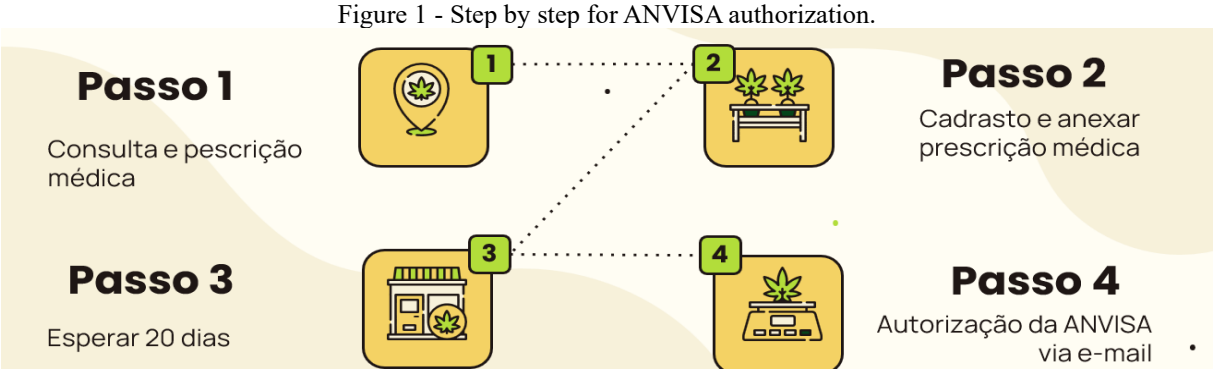
the public, televised by Rede Globo, brought medical *cannabis* as the theme of the program, where it focused on stories of individuals who use it for medicinal purposes.

Through this report it was possible to notice how well it is working, reporter Caco Barcellos brought the city of Búzios, on the coast of Rio de Janeiro as an example, since there was the approval of the municipal law that allows the use and distribution of *medical cannabis*, about 400 children and adolescents with autism and epilepsy are undergoing treatment using the plant as a medicinal source, and has been showing good results. As in the case of 3-year-old Nykollas, according to Lidiane Oliveira (mother): "The teacher said that after he started taking the medicine, he learned a lot, he was developing things that he didn't do (Oliveira, 2023)."

Brazilian society associates the use of marijuana with marginality, much of this prejudice comes precisely through the media, more precisely television news. However, these same programs, as well as social media, are important tools for the dissemination of scientific information, as Mariluce Moura, journalist and creator of the Pesquisa Fapesp magazine, points out. The approach to medical marijuana in the media is of great relevance, as it brings the benefits of marijuana to the public in an informal way, that is, more layman, and consequently to the demystification of the illegal use of the plant.

The official website of the Federal Government (gov.br) objectively shows step by step to request authorization to import products derived from *Cannabis,* if the patient wishes to import. At first, it is necessary for the patient to go through the health professional to obtain the medical prescription, later the patient or his guardian will register and attach this prescription. After that, the patient will wait at least 20 days of analysis to receive authorization from ANVISA, which will be automatic by email.

Figure 1 - Step by step for ANVISA authorization.



Source: Propria, 2023.

METHODOLOGY

Qualitative research directs to establish studies that provide understanding, describing and interpreting facts. Quantitative research, on the other hand, is a study that aims at a plan previously

calculated by the researcher, it has the function of enumerating and measuring procedures in a concrete and objective way (Proetti, 2004).

The two methodologies do not cancel each other out, and help in the compression and evaluation of the methodological and essential aspects of a veracity or phenomenon studied. These are rational, intuitive and descriptive researches that help researchers in their scientific and professional studies (Proetti, 2004).

The methodology adopted in this research refers to both the qualitative and quantitative types. However, the main focus is on the qualitative type, as the survey brings the difficulties that patients face to acquire medical *cannabis* and few enumerated data.

According to the difficulties presented to contact individuals who need to obtain *Cannabis sativa* for medicinal and therapeutic purposes, the social media Instagram/WhatsApp and Google Form were used as a collection instrument, at first there was a survey on these social media in search of individuals who use, who have already used or still know someone who uses *Cannabis sativa* for medicinal purposes.

The proposal for the participants was that the data collection would take place through the Google Form, a tool that provides an online form that allows the user to formulate multiple choice and discursive questions, in addition to presenting statistical evaluations, which can be sent through a link, either by email or social networks, facilitating the data collection process. With that, they answered some questions about *Cannabis sativa*, its medicinal use, its benefits, its harms and how it is obtained.

The Google Form is a tool that began to be widely used in the period of the Covid-19 pandemic, being very effective in supporting teachers in their assessments. This tool has several advantages, as it provides sharing properties that help in the practical improvement of evaluations, access anywhere and time, agility in data collection and analysis of results, in addition to ease of use (Martins, 2020; Mota, 2019).

Contact was made via Instagram with 38 accounts of individuals who talk about medical *cannabis* and 2 people via WhatsApp, 16 of them accepted to be part of the proposed research. Few people accepted to participate, since there was no return from some carriers.

With this, there was a data survey through the platform itself (Google Form), which directs the answers of the individuals to the Google Spreadsheet, on this platform it was possible to observe the questions and answers and through this the formulation of the graphs was obtained, which can be accessed through this link https://forms.gle/1vGvHv7FPkf236bb9.

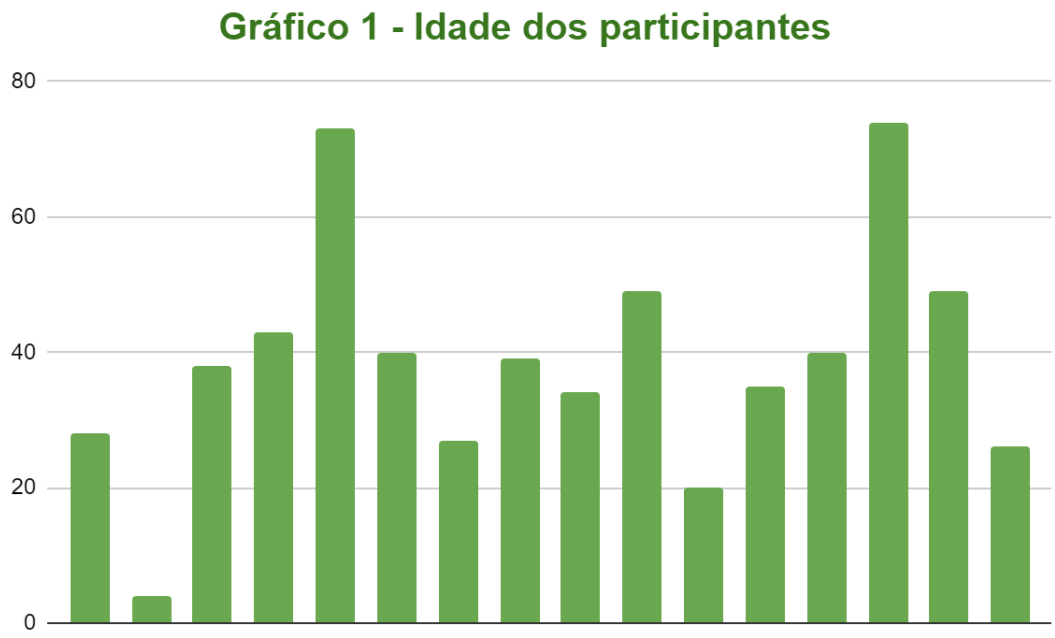
Figure 2 - Cannabis sativa form: benefits and difficulty of use for medicinal purposes.

Source: Google form, 2023.

RESULTS AND DISCUSSIONS

Among the 16 participants who answered the form, their ages ranged from 30 to 70 years old. Most of them, 9 of them, have their ages ranging from 30 to 40 years, as shThe authors in graph 1. (**Erro! Fonte de referência não encontrada.**)

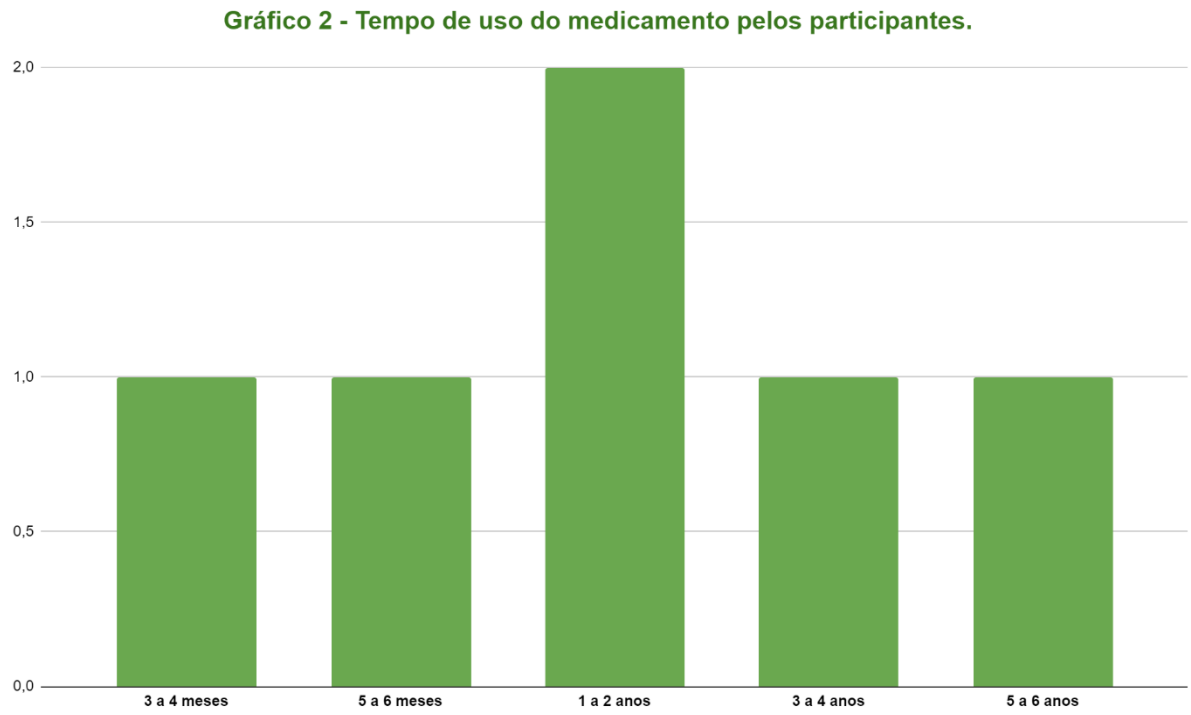
Figure 3 - Age of the participants.



Source: The authors, 2023

The time of use of the drug by the participants is still a problem, we already know about the effectiveness of the *Cannabis* for medicinal purposes, which is already an advance, but why is there still this delay? The delay is related to the process of acquiring the medicine, from the medical consultation to the arrival of the product, making it difficult to start the treatment of patients. The bureaucracy for filling out the documentation, the arrival of cannabidiol-based drugs and the high cost of it, being between R$ 2 thousand and R$ 3 thousand for a 30ml bottle of the drug, are the main reasons for the delay for patients to start making legal use of the drug and or stay on it, even with the Resolution of the Collegiate Board authorized by ANVISA, which aims to reduce the waiting time of patients and the analysis queues, in addition to the non-solution of the problem of the high cost of the drug (Andrade, 2022). Santos (2023), questions the high cost of the cannabidiol-based medicine and relates that the patient has the right to health according to Art.5 of the Federal Constitution of 1988. Therefore, the participants' time of use varies from 1 to 3 years (Graph 2) (**Erro! Fonte de referência não encontrada.**).

Figure 4 - Time of medication use by the participants.

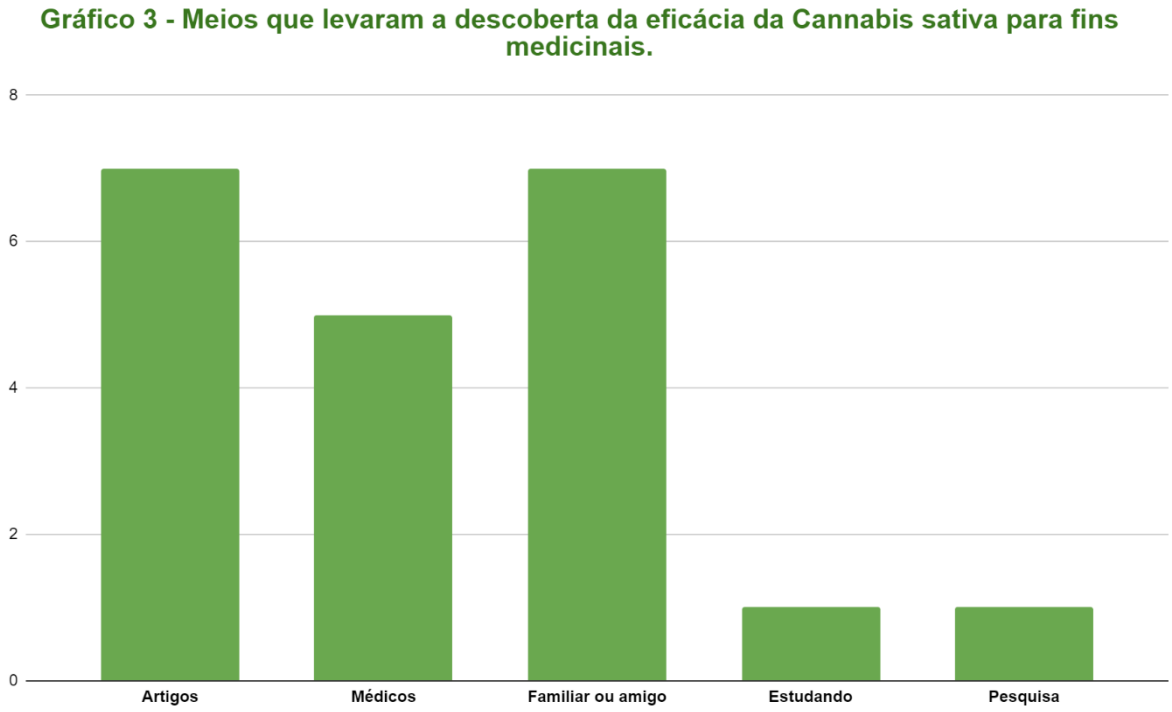


Source: The authors, 2023

Bring information about the benefits of *Cannabis sativa* is extremely relevant for Brazil and the world, we know that knowledge about the herb is not so positive, with this information many carriers would know and understand the effectiveness of the herb *Cannabis* for their respective comorbidities. It can be seen in graph 3 (**Erro! Fonte de referência não encontrada.**) the number of means by which users discovered the effectiveness of the *Cannabis* for medicinal purposes,

emphasizing medical and/or family articles. Articles about the *Cannabis* and its medicinal benefit began to be published in the 90s, the peak of research took place in 2002, at the moment there are more than 5,000 articles referring to the medicinal use of the *Cannabis* (Caetano, 2019). There are a number of doctors who support and cite the herb as a medicinal source and as a consequence its benefits, one of them being Dr. Elisaldo Carlini, a doctor specializing in psychopharmacology, university professor and Brazilian researcher, Carlini was knThe authors as the "Father of marijuana", he researched the *Cannabis sativa* for 50 years, becoming one of the pioneering doctors in the study of the herb. In Brazil, Carlini led a research group, they discovered that cannabidiol had an antiepileptic effect, but this discovery was "forgotten" for decades. Dr. Elisaldo Carlini has some articles on the subject, such as "History of marijuana in Brazil", "*Cannabis sativa* L. (marijuana) medicine that is reborn?" and "Research with marijuana in Brazil". AMA+ME (Brazilian Association of Pediatric Patients) *Cannabis* Medicinal) mentions a list of doctors who prescribe medical marijuana, more than 200 doctors among them it is possible to find pediatricians, psychiatrists, neurosurgeons, neuropsychiatrist, among others. However, AME+ME mentions that there are still few doctors who study and prescribe medical marijuana, which makes it even more difficult for patients to access it. Oliveira (2016), cites in his research how the pioneering families of the use of the *Cannabis* exchanged information with each other about use, such as ideal dosages, access to the bureaucratic part, among others. According to the CFM (National Council of Medicine) only specialists in neurology and their areas of expertise, neurosurgery and psychiatry can prescribe cannabidiol. Currently this exchange of information between family members continues, as shThe authors in graph 3, more than 5 of the participants discovered the effectiveness of the *Cannabis* through family members. The development of scientific, research, and medical articles that prescribe on the *Cannabis* and its benefits are extremely important for this information to reach the population with foundation, especially the less disadvantaged classes that need this knowledge.

Figure 5 - Means that led to the discovery of the efficacy of Cannabis sativa for medicinal purposes.

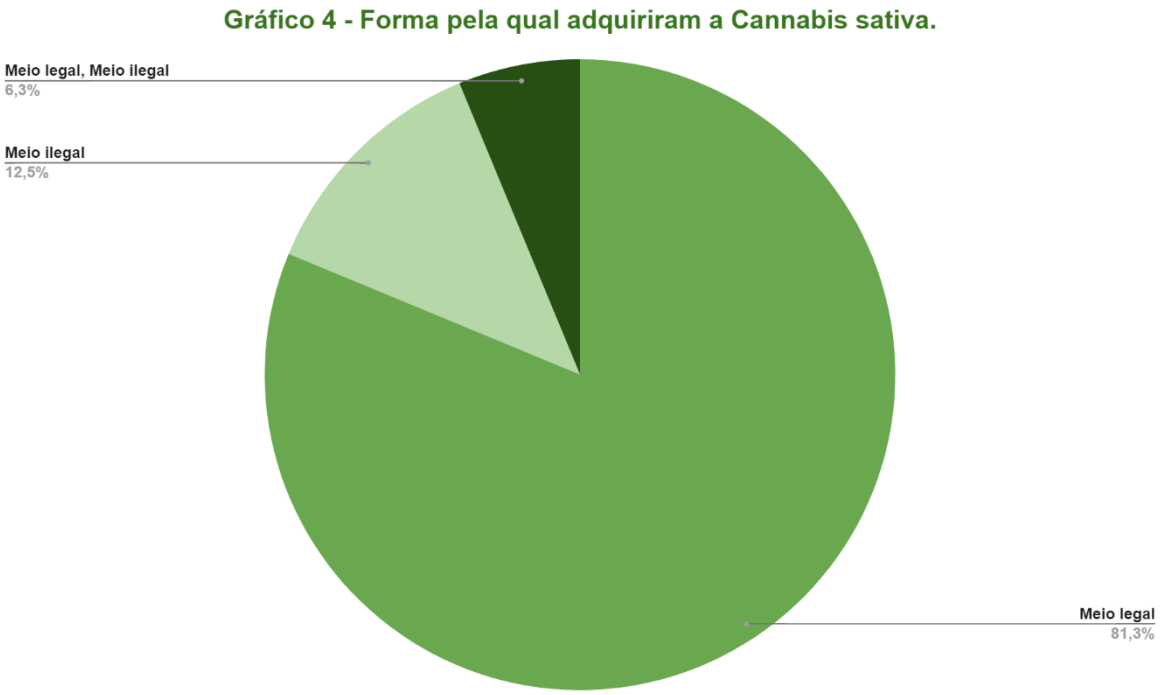


Source: The authors, 2023

The fourth question mentions the issue of obtaining the *Cannabis sativa*, a large part of which 75% acquired their herb and/or medicine legally, through ANVISA authorization and medical consultation, as shThe authors in graph 4 (**Erro! Fonte de referência não encontrada.**). Even with the legal form, they reported difficulties in acquiring and remaining legal, such as high cost, bureaucracy, misinformation, criminalization, high cost of consultation, access to the drug on the market, delay in getting the product, and few doctors who prescribe cannabidiol (Graph 4.1) (**Erro! Fonte de referência não encontrada.**). It was possible to observe that the high cost has been cited as the main factor in both situations, both to remain legal, and those who, not by choice, seek the illegal drug. Followed by the bureaucracy, some participants commented on the diversity of papers to fill out and the lack of specific people to request help, in addition to the delay for their authorization or their drug to arrive. Misinformation along with criminalization continues to be a problem, the population has a deep-rooted preconception in relation to marijuana, Brazil is dominated by the crime of drug trafficking, ranking first in the ranking of the most common crimes, in 2019 about 163.2 thousand were incidences for drug trafficking. The entire Brazilian population and especially the less favored end up living with the marginalized part of marijuana, bringing certain difficulties to those who need the medicines based on marijuana *cannabis*, with this, the medical information about marijuana needs to be propagated so that it can be demystified. Few doctors prescribing the *cannabis* for medicinal purposes is also a problem, since the medical prescription is the first step of several steps to obtain authorization from ANVISA, without the prescription there is no authorization.

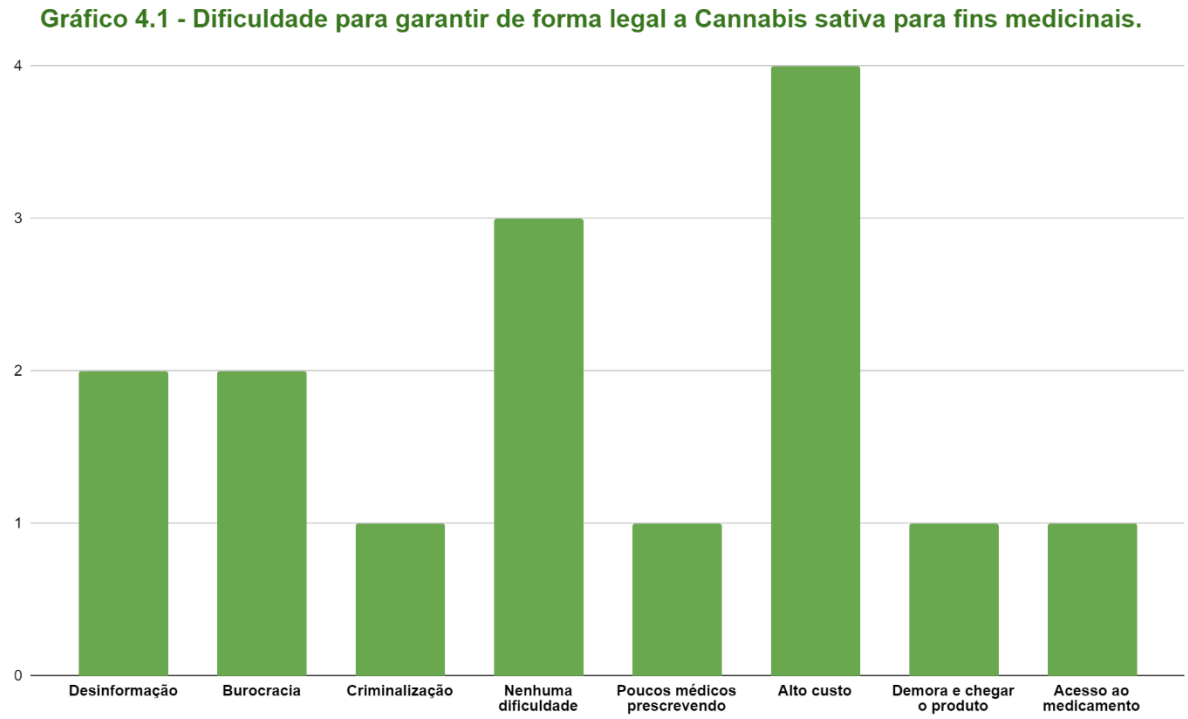
However, another 12.5% of the participants acquired it illegally (graph 4), we can observe that even if the percentage comparing obtaining it by legal means is small, it is still recurrent, we know that even with the release of ANVISA through authorization, the drug is quite expensive, in addition to the delay and bureaucracy related to documentation, these points being one of the main reasons end up leading users or their families, especially the lower class, looking for the product illegally, where it will guarantee low cost and agility. The survey "Map of the New Poverty" developed by FGV Social with data provided by the IBGE, showed that in 2021 the per capita household income was R$497.00 per month and affected about 62.9 million Brazilians, that is, 29.6% of the population of our country has a very low income. Regarding the price of the drug, in pharmacies that already have authorization from ANVISA to produce and sell products based on *Cannabis*, 200mg/30ml cannabidiol costs around R$ 2,143.30. It is notable that a family that earns R$497.00.00 per month will not be able to obtain the drug legally.

Figure 6 - How they acquired Cannabis sativa.



Source: The authors, 2023

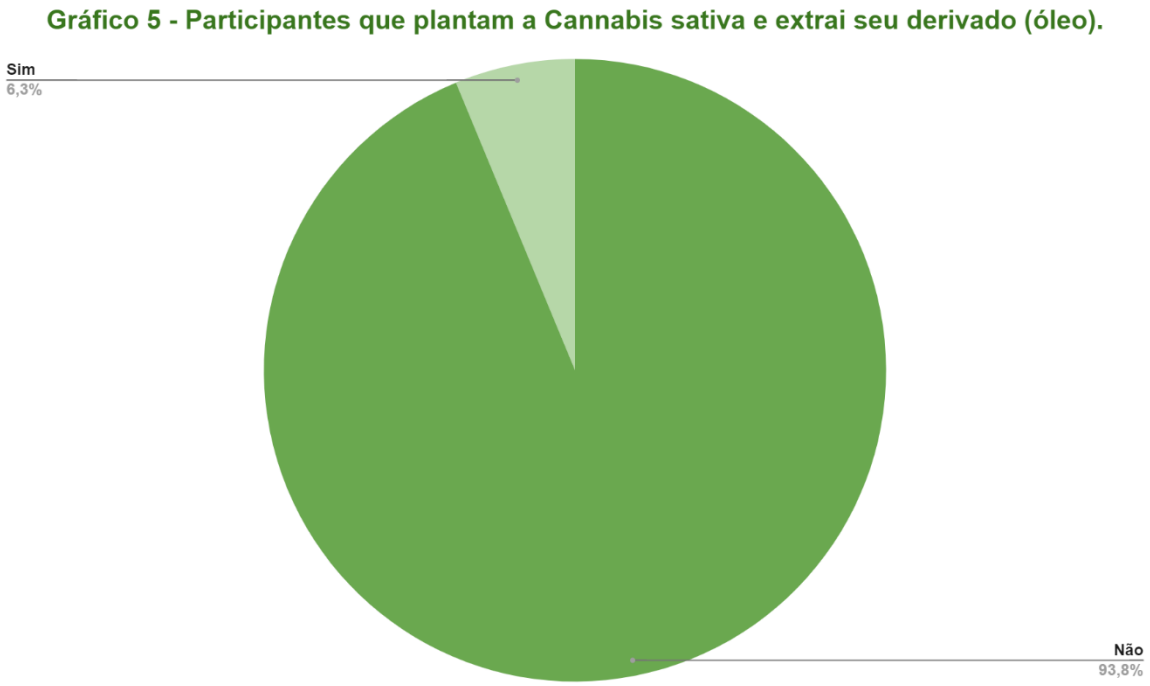
Figure 7 - Difficulties to legally guarantee Cannabis sativa for medicinal purposes.



Source: The authors, 2023

No graph 5 (**Erro! Fonte de referência não encontrada.**), it is possible to observe that about 6.3% of the participants plant the *Cannabis sativa* and extracts its oil, for treatment. And the other 93.8% do not obtain their medicine through cultivation and extraction of the oil. Growing and extracting the oil from *Cannabis* by the patient or family member, it would bring some benefits such as ease of treatment, low cost and consequently legal use. It is possible to grow the herb in two ways, indoors and outdoors, the way will imply the quality of the product. Indoor cultivation, or outdoor, is a less laborious and more familiar gardening cultivation, but this form of cultivation will be exposed to natural phenomena, bringing certain damage to the plants. Indoor cultivation, on the other hand, usually generates a superior product, as it has specific care such as air control, lighting levels and humidity, that is, more laborious and later less economical (The Canningma). Regarding extraction, there are some ways such as solvent or solvent extraction. Solvent extraction, which can be other vegetable oils, will depend on the polarity of the solvent and the plant's secondary metabolites. Solvent-free extraction, by physical friction, is one of the oldest extractions, this technique concludes a high-quality solution much more than the most current processes (Raber, 2015 *apud* Souza, 2022).

Figure 8 - Participants who plant Cannabis sativa and extract its derivative.



Source: The authors, 2023

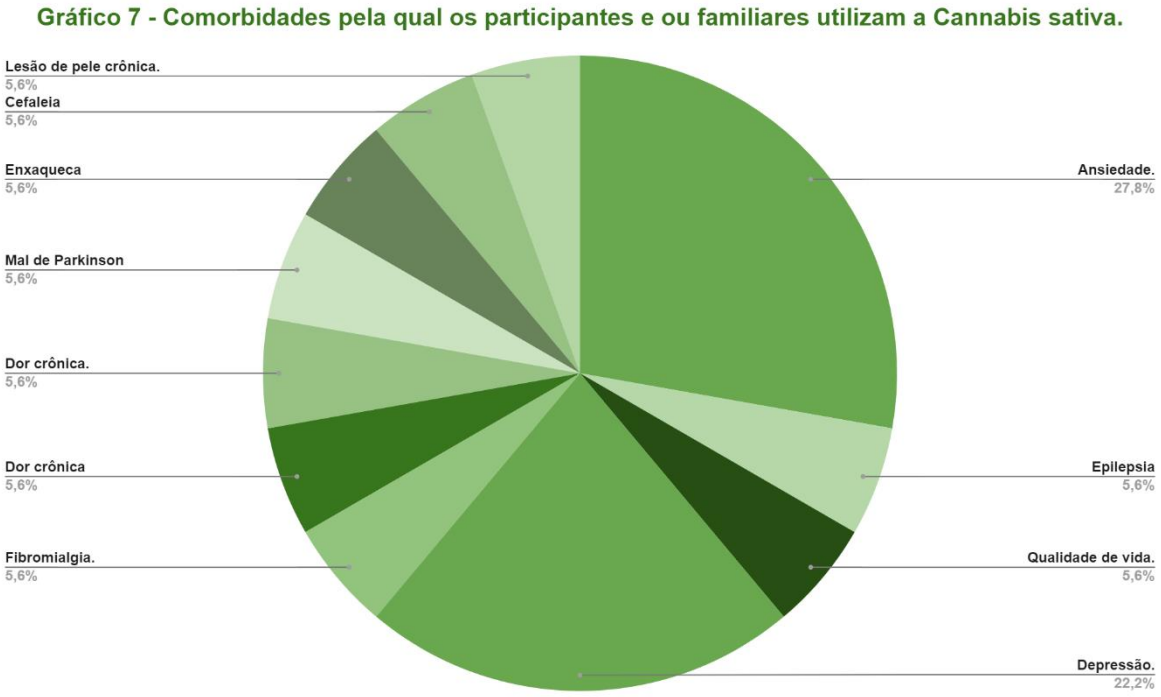
Specifically about the oil of *Cannabis sativa* we obtained 50% of the data that acquires while the other 50% do not acquire (Graph 6) (**Erro! Fonte de referência não encontrada.**), those that do not acquire either cultivation or oil, can possibly be used through other means, such as drugs, ointments, sprays or vaporizers. The substances extracted from the herb are effective and widely used in the global pharmaceutical industry. There are some marijuana-based medicines, such as: Metavyl, Marinol, Cesamet, Sativex (oral spray), Bebrocan, among others (Penha et al, 2019), in addition to marijuana oil that is rich in cannabidiol (Oliveira, 2016). The advantages of using oral drugs in addition to the pharmaceutical property, it has standardized concentrations/doses and a calmer way to be ingested. Medications made through cannabinoids, such as transdermal, nasal, pulmonary inhalation, and oral transmucosal enable action directly in the blood (Bruni et al, 2018). There is no doubt that substances extracted from the *Cannabis sativa* show good results for the treatment of several chronic, neurological or terminal diseases (Penha et al, 2019). Medical marijuana is not like any other medicine, each patient reacts in a different way, so the doses and the form of use differ according to each patient.

Figure 9 - Participants who purchase only the derivative (oil).

Source: The authors, 2023

Throughout this work, we were presented with the benefits of *Cannabis sativa* For several comorbidities, the graph shows the diseases highlighted by the patients in this study. In Graph 7 (**Erro! Fonte de referência não encontrada.**), noted that anxiety (31.3%) and depression (25.0%) are the diseases that are most treated through the herb by the participants, followed by migraine, Parkinson's disease, headache, chronic pain, skin lesions, fibromyalgia, epilepsy and quality of life. As mentioned by Mendes (2019), about the benefits that *cannabis* brings to the treatment of chronic diseases such as epilepsy, chronic pain, anxiety and depression. According to the WHO (World Health Organization), the prevalence of depression in Brazil is 15.5%, ranking 4th in the ranking of the main causes of burden, which is linked to overload, while anxiety takes over the ranking, with 18.6 million people who are affected by this disorder. The pandemic has increased about 25% in cases of anxiety and depression. According to the neuroscientist, professor at the Federal University of Rio Grande do Norte (UFRN) and researcher at the Center for Strategic Studies at Fiocruz, Sidarta Ribeiro, the comorbidities with the most evidence and the most indicated are Autism, Parkinson's, Alzheimer's, Tourette's Syndrome, Crohn's Disease, among others.

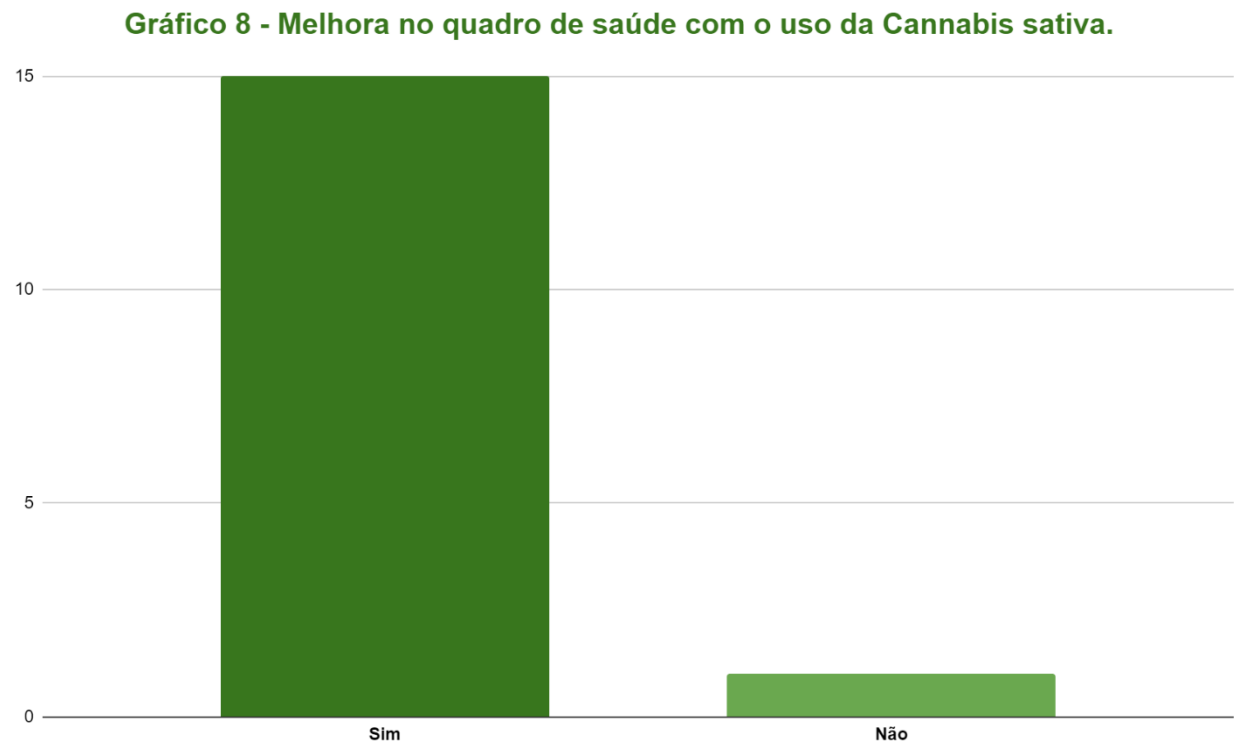
Figure 10 - Comorbidities for which participants and/or family members use Cannabis sativa.



Source: The authors, 2023

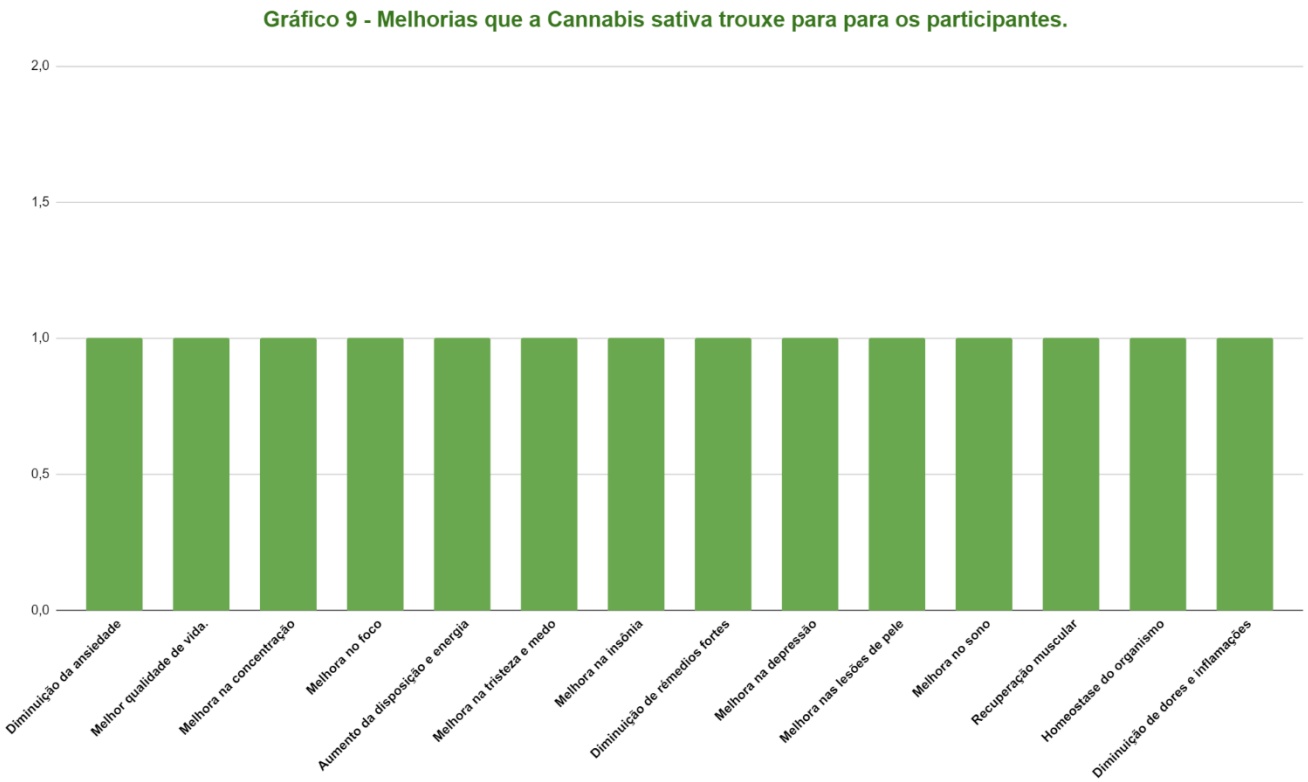
No graph 8 (**Erro! Fonte de referência não encontrada.**) It was observed that most of the patients improved their comorbidities, with 93.8% of them. In the report of improvement, a decrease in pain, insomnia, anxiety, depression, as well as muscle recovery, improvement in focus concentration, increased disposition and energy (Graph 9) (**Erro! Fonte de referência não encontrada.**), that is, the *Cannabis* brought quality of life to the participants. The *Cannabis sativa* is increasingly being used as a treatment for various comorbidities, its effects are related to the stimulation of the mind, increased energy, creativity, insomnia, even in the replacement of some medications such as opioids, which are drugs with analgesic effect used to contain pain, these opioids have been causing serious problems such as addictions and in some cases death by overdose (Vigil, et al, 2017; Schuckit, 2016; Rudd, et al 2016; Silva, et al, 2018; Nascimento, et al, 2019; Aguiar, et al, 2023). Dr Alline Cristina de Campos, PhD in the Department of Pharmacology at the Ribeirão Preto Medical School, mentions through her preclinical studies that cannabidiol has antidepressant and anxiolytic properties. Through the data, the effectiveness of the *Cannabis sativa* For the treatment of various comorbidities, we cannot deny that it brings quality of life to patients.

Figure 11 - Improvement in health with the use of Cannabis sativa.



Source: The authors, 2023

Figure 12 - Improvements that Cannabis sativa brought to the participants.



Source: The authors, 2023

CONCLUSION

The current work aimed, through the research developed with the carrier public and its results, to show the benefits of *Cannabis sativa* for medicinal purposes and the difficulties of acquiring permission for legal use.

During the course of the work, the history of the plant was analyzed, being knThe authors as an ancient herb from Asia, used for medicinal, recreational, hedonistic and religious purposes.

In this way, information was made available about the benefits of the plant as a medicinal source for the treatment and improvement of various comorbidities such as anxiety, depression, reduction of chronic pain, insomnia, muscle recovery, improvement in concentration and focus, as well as increased disposition and energy.

Advances in Brazil have facilitated patients' access to medical *cannabis*. The laws sanctioned in São Paulo, Salvador and Rio de Janeiro provide patients with free access through medical prescription and SUS to medicines based on compounds extracted from *Cannabis sativa*. These advances bring benefits to all patients with the various comorbidities, especially the low-income classes, since medical consultations and medications have high costs.

However, it was possible to analyze the harm and adversities that patients go through to obtain ANVISA authorization and access to medicines based on *Cannabis sativa,* the work unraveled the difficulties of the participants when it comes to obtaining their rights. Even with the evidence of the medicinal efficacy of the cannabidiol and THC compounds, there is still repulsion due to the deep-rooted preconception, in addition to the difficult access to the drug, which will depend on the medical consultation that requires a high cost, thus making it difficult for low-income individuals to access it, as well as the permanence of the use of those who already do it.

In conclusion, the present work fulfilled the objectives and the problem in question, providing both blurring of authors and laws, as well as of the comorbidities themselves who make medicinal use of *Cannabis sativa*.

REFERENCES

1. Aguiar, M., et al. (2023). Canabidiol (CBD) e seus efeitos terapêuticos para a ansiedade no ser humano. *Research, Society and Development*, 1-9.

2. Andrade, N. (2022). *Políticas Públicas de Saúde-Acesso a medicamentos especiais: Caso Canabidiol (CBD)*. Universidade de Brasília, Departamento de Gestão de Políticas Públicas, Curso de Gestão de Políticas Públicas, Brasília.

3. Associação Brasileira de Pacientes de Cannabis Medicinais. (2021, junho). Lista de prescritores de Cannabis.

4. Bergamaschi, M., et al. (2011). Cannabidiol reduces the anxiety induced by simulated public speaking in treatment-naïve social phobia patients. *Neuropsychopharmacology*, 36(6), 1219-1226.

5. Bezzera, G. (2019). *A legalização da Cannabis para fins medicinais*. Universidade Federal Rural do Semiárido, Departamento de Agrotecnologia e Ciências Sociais, Curso de Direito, Mossoró.

6. Bolsoni, L., et al. (2012). Specific mental disorder screening compilation may detect general mental disorders. *Revista Brasileira de Medicina de Família e Comunidade*, 7(2), 1-13.

7. Brandão, M. (2014). Ciclos de atenção à maconha no Brasil. *Revista da Biologia*, 12(1), 1-10.

8. Brasil. (2023). Lei N° 17.618, de janeiro de 2023. Assembleia Legislativa do Estado de São Paulo.

9. Brasil. (2023). Lei N° 9.663 de 06 de março de 2023. Salvador.

10. Brasil. (2006). Lei N° 11.343, de agosto de 2006. Presidente da República, Brasília.

11. Brasil. (2022). Resolução RDC Nº 660, de 30 de março de 2022. *Diário Oficial da República Federativa do Brasil*, Brasília, DF, 24 ago. 2011.

12. Brasil. (1988). *Constituição da República Federativa do Brasil*. Brasília, DF: Senado Federal: Centro Gráfico.

13. Brasil. (1938). Lei Nº 981, de 25 de novembro de 1938. Capítulo II – DA PRODUÇÃO, DO TRÁFICO E DO CONSUMO.

14. Bruni, N., et al. (2018). Sistema de administração de canabinóides para tratamento de dor e inflamação. *Molecules*, 23(1), 1-25.

15. Caetano, R. (2019). *Influência de aspectos políticos e culturais no desenvolvimento de pesquisas que empregam o uso de canabinoides*. Universidade Federal de Ouro Preto, Ouro Preto.

16. Campos, N. (2019). *O remédio vem de uma planta que eu não posso plantar: Mobilização e articulação pelo uso terapêutico da maconha na Paraíba*. Universidade Federal do Rio Grande do Norte, Centro de Ciências Humanas, Letras e Artes, Programa de Pós-Graduação em Antropologia Social, Natal.

17. Conselho Federal de Medicina. (2014). Resolução CFM 2113-2014.

18. Carlini, E. (2006). A história da maconha no Brasil. *Revista de Literatura*, 1(4), 314-317.

19. Centro Brasileiro de Informações sobre Drogas Psicotrópicas. (n.d.). *Livreto informativo sobre drogas psicotrópicas*. São Paulo, 1-62.

20. Crippa, J., et al. (2009). Translational investigation of the therapeutic potential of cannabidiol (CBD): Toward a new age. *Frontiers in Immunology*, 1-16.

21. Duarte, D. (2005). Uma breve história do ópio e dos opioides. *Revista Brasileira Anestesiol*, 55(1), 1-14.

22. Escola Politécnica de Saúde Joaquim Venâncio-Fiocruz. (2023). *Novos tempos: Cannabis medicinal ganha espaço no SUS*.

23. Fioravanti, C. (2006). Extraído da maconha, canabidiol age contra ansiedade e outros distúrbios mentais. *Pesquisa FAPESP*. São Paulo, julho.

24. França, J. (2022). *História da maconha no Brasil*. São Paulo: Jandaíra.

25. Garcia, J., et al. (2023). Efeitos adversos do uso dos canabinoides: Qual o paradigma de segurança?. *BrJP*, 6(1), 38-46.

26. Gomes, M. (2018). *Impactos socioeconômico da legalização da Cannabis sativa para fins recreativos à luz da análise econômica do direito*. Universidade Federal do Rio Grande do Norte, Centro de Ciências Sociais Aplicadas, Curso de Graduação em Direito, Natal.

27. Governo Federal (GOV). (2023). *Saúde e Vigilância Sanitária. Solicitar autorização para importar produtos derivados de Cannabis*.

28. Gurgel, H., et al. (2019). Uso terapêutico do canabidiol: A demanda judicial no estado de Pernambuco, Brasil. *Saúde e Sociedade*, 28(2), 283-295.

29. Ghezelbash, P. (2021). *Guia do processo de cultivo da Cannabis*. The Cannigma, junho.

30. Larrigana, G., et al. (2010). Expression of cannabinoid receptors in human kidney. *Histology and Histopathology*, 25(8), 1133-1138.

31. Lessa, M., et al. (2016). Derivados canabinóides e o tratamento farmacológico da dor. *Revista Dor*, 17(1), 47-51.

32. Lima, B., et al. (2022). Ação do canabidiol em doenças neurológicas. *Revista Neurociências*, 30(1), 1-17.

33. Lima, E. (2009). *Estudo da modelagem molecular do receptor canabinoide CB1 e suas interações com o delta9-THC*. Universidade de São Paulo, Instituto de Química de São Carlos, São Carlos.

34. Lima, J. (2015). "A lei é contra paz": A natureza proibicionista da política de drogas no Brasil e a discussão sobre a legalização da maconha. Universidade Federal do Rio Grande do Norte, Centro de Ciências Sociais Aplicadas, Natal, 1-55.

35. Lima, L. (2022). Alimentos mágicos: Problema e detecção da Cannabis sp. em doces recreativos. Universidade Federal do Rio Grande do Norte, Centro de Ciências da Saúde, Curso de Graduação em Farmácia, Natal, 1-29.

36. Lutge, E. E., et al. (2013). The medical use of cannabis for reducing morbidity and mortality in patients with HIV/AIDS. *Cochrane Database of Systematic Reviews*, April.

37. Rodrigues, L. (2006). *Controle penal sobre as drogas ilícitas: O impacto do proibicionismo no sistema penal e na sociedade*. Universidade de São Paulo, Faculdade de Direito. Tese de doutorado. São Paulo.

38. Rudd, R., et al. (2016). Aumento de mortes por overdose de drogas e opioides. *Centers for Disease Control and Prevention*, 50-51, dezembro.

39. Schuckit, M. (2016). Tratamento de distúrbios por uso de opioides. *Journal of Medicine*, 357-368, julho.

40. Machado, A., et al. (2020). A diferença entre o cânhamo e a maconha e sua comercialização e 'estado-da-arte' no sistema jurídico brasileiro.

41. Marinho, P. (2008). Da felicidade à loucura: Modernidade, bio-poder e Cannabis sativa. Universidade Federal do Rio Grande do Norte, Centro de Ciências Humanas, Letras e Artes, Curso de Graduação em História, Natal, 1-68.

42. Martis, F. (2020). Google Forms como ferramenta de apoio: Experiência docente em meio à pandemia da coronavírus. *Congresso Internacional de Educação e Tecnologias*.

43. Matos, R. L. A., et al. (2017). O uso do canabidiol no tratamento da epilepsia. *Revista Virtual de Química*, 9(2), 786-814, março.

44. Mechoulam, R. (2010). Endocanabinoides e transtornos psiquiátricos: A estrada à frente. *Revista Brasileira de Psiquiatria*, 32(Supl I), maio.

45. Medeiros, C. (2018). Mariluce Moura: "Redes sociais são fundamentais na disseminação de informação, formatos e experimentação". *Revista Eletrônica de Jornalismo Científico*, abril.

46. Melo, L., et al. (2016). O uso do canabidiol no Brasil e o posicionamento do órgão regulador. *Caderno Ibero-Americanos*, Brasília, 43-55, abril/junho.

47. Mendes, J. (2021). *A descriminalização ou legalização da maconha no Brasil e suas vantagens para o uso medicinal*. Anápolis.

48. Ministério da Saúde, ANSIVA. (2015). *Diário Oficial da União. Resolução da diretoria colegiada, N° 17, de 16 de maio de 2015*.

49. Mota, J. (2019). Utilização do Google Forms na pesquisa acadêmica. *Revista Humanidade e Inovação*, 6(12).

50. Nascimento, D., et al. (2019). Uso terapêutico da Cannabis sativa: Uma breve revisão. *Brazilian Journal of Surgery & Clinical Research*, 164-169.

51. Neri, M. (2022). *Mapa da nova pobreza*. FGV Social.

52. Nguyen, L., et al. (2022). Cannabidiol inhibits SARS-CoV-2 replication through induction of the host ER stress and innate immune responses. *Science Advances, 8*, 1-18, fevereiro.

53. We Are Social. (2023). *O mundo digital em mudanças em 2023*.

54. Oliveira, F. (2016). *Maconheirinhos: Cuidado, solidariedade, ativismo de pacientes e seus familiares em torno do óleo de maconha rico em canabidiol (CBD)*. Universidade de Brasília, Instituto de Departamento Sociais, Departamento de Antropologia, Programa de Pós-Graduação em Antropologia Social, Brasília.

55. Organização das Nações Unidas (ONU). (2021). Perspectiva global: Cerca de 275 milhões de pessoas consumiram drogas em 2020. *ONU NEWS*, junho.

56. Pamplona, F. (2014). Quais são e para que servem os medicamentos à base de Cannabis? *Revista da Biologia*, Rio de Janeiro, 28-35, setembro.

57. Penha, E., et al. (2019). A regulação de medicamentos derivados da Cannabis sativa no Brasil. *Brazilian Journal of Forensic Sciences, Medical Law and Bioethics*, 125-145, São Paulo.

58. Perfeito, N. (2018). *A influência das convenções internacionais e do proibicionismo nas políticas de drogas adotadas pelo Brasil*. Universidade Federal de Santa Catarina, Centro de Ciências Jurídicas, Departamento de Direito, Florianópolis.

59. G1. (2022). Profissão Reporter mostra as histórias de quem vem optando pelo uso da Cannabis medicinal.

60. Queiroga, A. (2022). Uso de Cannabis de forma medicinal: Conceitos e preconceitos na sociedade. Universidade Federal do Rio Grande do Norte, Centro de Ciências da Saúde, Curso de Graduação em Farmácia, Natal, 1-26.

61. Ribeiro, J. (2014). *A Cannabis e suas aplicações terapêuticas*. Porto.

62. Santos, A. (2023). Direito à saúde: Os reflexos da judicialização do acesso a medicamentos à base de Cannabis no Brasil. Curso de Pós-Graduação MP em Ação, Rio de Janeiro.

63. Sawler, J., et al. (2015). The genetic structure of marijuana and hemp. *PLoS ONE*, 1-9, agosto.

64. Fiocruz. (2022). Seminário apresenta os benefícios do uso medicinal da Cannabis.

65. Uol. (2022). Claúdia Rodrigues exalta tratamento com Cannabis: “Tem me feito muito bem”.

66. Uol. (2022). Guta Stresser detalha tratamento com remédio disponível no SUS e canabidiol.

67. Redação Marie Claire. (2022). Henrique Fogaça sobre a filha: “Cada dia mais linda e feliz fazendo o uso do canabidiol”.

68. Redação Sechat. (2023). ANVISA: Rapper Matuê é autorizado a importar derivados da Cannabis.

69. Silva, W. (2022). Anvisa autoriza cultivo de Cannabis para pesquisa na UFRN (Universidade Federal do Rio Grande do Norte), dezembro.

70. Silva, A., et al. (2018). A maconha nas perspectivas contemporâneas: Benefícios e malefícios. *Revista Científica da Faculdade de Educação e Meio Ambiente*, 786-795, junho-dezembro.

71. Souza, M. (2022). *Avaliação dos processos de produção caseira de extratos de Cannabis sativa L. para fins medicinais*. Universidade Estadual Paulista, Faculdade de Ciências Farmacêuticas, Curso de Graduação Farmácia-Bioquímica, São Paulo.

72. Sollitto, A. (2022). O tratamento à base de Cannabis que está ajudando o músico Arlindo Cruz. *Veja*, novembro.

73. STJ. (2022). Sexta turma dá salvo-conduto para pacientes cultivarem Cannabis com fim medicinal.

74. Universidade Federal do Rio de Janeiro, Conexão UFRJ. (2023). Pesquisadores da UFRJ encontram canabidiol em planta nativa. Junho.

75. Vanin, A. (2022). *Potencial neuroprotetor de óleos à base de Cannabis sativa em Caenorhabditis elegans*. Universidade Federal da Fronteira Sul, Programa de Pós-Graduação em Ciência e Tecnologia Ambiental, Erechim, RS.

76. Vidal, S. (n.d.). A regulamentação do cultivo de maconha para consumo próprio: Uma proposta de redução de danos, 61-96.

77. Vieira, L., et al. (2020). O uso de Cannabis sativa para fins terapêuticos no Brasil: Uma revisão de literatura. *Scientia Naturalis*, Rio Branco, 901-919.

78. UNODC. (2020). *Relatório Mundial sobre Drogas 2020 do UNODC*. Viena, junho.

79. UNODC. (2022). *Relatório Mundial sobre Drogas 2022 do UNODC*. Viena, junho.

80. Vigil, J., et al. (2017). Associações entre Cannabis medicinal e uso de opioides prescritos na dor crônica de pacientes: Um estudo de corte preliminar. *PLOS ONE*, 1-13, novembro.

81. Wessler, B. (2014). *Efeitos neuroquímicos e comportamentais causados pelo uso da Cannabis sativa*. Universidade do Extremo Sul Cararinense, Pós-Graduação em Farmacologia, Criciúma, 1-48.

82. Westin, R. (2022). Preconceito atrapalha debate sobre Cannabis medicinal. *Agência Senado*, novembro.

83. Yoneshigue, B. (2023). Cannabis medicinal: Demanda no Brasil cresceu 9.311% desde autorização, mas enfrentam desafios no acesso e no preparo de médicos. *O Globo*.

84. Xavier, C., et al. (2021). Uso do cannabidiol para tratar depressão e ansiedade depende de mais estudos. *Lamparina*, UFOP, agosto.

85. Zuardi, A. (2008). Cannabidiol: De um canabinóide inativo a uma droga com amplo espectro de ação. *Revista Brasileira de Psiquiatria*, 271-280.

Use of modeling and simulation: Tools necessary for the formation of a virtual library for practical disciplines in higher education

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ABSTRACT

The use of modeling and simulation tools in current education systems has become fundamental pieces in student learning, increasing the possibility of acquiring knowledge and practical skills. In the present work, the authors present the didactic proposal for the development of a virtual library using Matlab® tools to be used in activities of practical disciplines in higher education, which can be extended to other types of education, such as technological. The discipline of Control Systems in the Electrical Engineering course is taken as an example for the development, dividing the methodological procedure for its realization into stages. In these stages, the purpose of offering students specific and ready-made virtual resources are designed that can also be used in other disciplines, with wide iterativeness, which undoubtedly improves the acquisition of knowledge and improves learning. The modular organization of the library, with the creation of specific subsystems in blocks, allows for a personalized approach that is adaptable to the individual knowledge needs of students. This tool can be part of an active teaching methodology.

Keywords: Virtual Library, Higher Education, Modeling and Simulation, Control Systems.

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INTRODUCTION

In an increasingly industrialized and technological world, there is a need for progress and expansion of computational resources in various areas of education, since the study of different processes and areas has become fundamental to mitigate energy and input costs. Currently these processes, which can be industrial, economic and even the study of human health, can be partially optimized by such tools, it is not new that technology has made life easier for human beings, both in the professional and personal fields. Therefore, these systems are fundamental in the process of developing research and modernization in various scientific and technological sectors. Aiming at the great growth in the technological field in recent years, in the midst of the need to develop more sophisticated systems for the creation, analysis and simulation of mathematical models applied to the most diverse areas, Matlab® (CHAPMAN, 2003) emerges, which came as a mathematical tool for calculation and simulation to help professionals from the most diverse areas. In this way, this system can help with: mathematical calculations or modeling, as well as simulation and visualization of dynamic system behaviors.

From this context, the work presented here by the authors focuses on showing how to make the proposal of modeling and conformation of a virtual library for practical disciplines in higher education, with the help of Matlab®/Simulink®'s virtual tools (MATHWORKS, 2024). This aims to help students who have a certain difficulty in modeling real systems and designing simulations by implementing the use of Simulink®, (GUZMAN et al, 2021; PET, 2009), a tool that is also a component of Matlab®, which adds value and makes it possible to design and simulate any system of interest to the user. The general objective is to know how to model and conform a virtual library with Matlab®/Simulink® for practical disciplines in higher education courses, such as engineering and medicine courses.

MATERIALS AND METHODS

The development of the research is justified by the need to support the development of practical activities that exist today in higher education courses. This is how the use of virtual techniques is proposed to help the development of these activities, starting a bibliographic research in the areas of interest of implementation and development, such as systems, virtual libraries, modeling and simulation. The development of the research allows the selection and description of the main parameters or utility equipment in the area of the discipline object of the analysis of the specific higher education course where it is intended to be implemented, for example it can be for the discipline of Control Systems, in the course of Electrical Engineering; then it is possible to carry out a study that allows to justify the selection of the program to be used, in this case, Matlab®/Simulink®, to show its characteristics, programming, editing and graphic tools available, in

order to establish, develop or select from the variables or parameters of interest in the disciplines, the models of practical activities that allow their implementation in the virtual environment of the program, even developing the conformation of the virtual library to meet the demands of the students of the discipline.

EXAMPLE OF HOW IT CAN BE APPLIED IN A HIGHER EDUCATION DISCIPLINE

When developing this work, the discipline of Control Systems in the Electrical Engineering course was taken as an example. The methodological procedure for its realization is divided into stages.

In the first step, the bibliography research necessary for the understanding and realization of the work in the areas of mathematical modeling of dynamic systems, processes, control, components and simulation is presented, as well as the description of the main characteristics of parameters to be researched. Next, a study of the tools of the program to be used, in this case Matlab®/Simulink®, is carried out to know everything related to its programming, editing and graphics utilities available, which justifies the need for its use, thus showing the advantages of the development and subsequent implementation of the research, such as its use to carry out virtual laboratories. This is how the modeling and simulation methods to be applied for the conformation of virtual blocks in the form of a library are determined, making a choice of the most used system models in the large area of the specific course, for example in electrical engineering, which can be those related to energy efficiency, components of industrial and control systems (DORF and BISHOP, 2013), everything can be done from the previous works developed or from the bibliographic review, thus establishing the theoretical basis that supports the research.

In a second stage, the choice of the model or system typology is made, forming the blocks in Matlab®/Simulink®. It should be noted that this choice for the conformation of models or systems is based on those areas of greater academic interest (based on the content of the discipline where it will be used). Finally, the design and conformation of the blocks is carried out in Matlab®/Simulink®, allowing facilities for the insertion of parameters with their magnitudes, which allows the choice and use in the simulation of virtual practices. Finally, the virtual tool now created is available in the form of a virtual platform for its use in the practical classes of the selected discipline. This procedure can be used by any other discipline of a higher education course as one has in economics or medicine.

RESULTS

One of the fundamental reasons for choosing Matlab®/Simulink® is its wide acceptance in both the academic and scientific community and industry. The popularity and widespread adoption of this tool provides students with familiarity with a virtual development environment that is widely

used in both spheres, preparing them for their life as a professional. This program stands out for the complete integration of its system modeling and simulation tools. This characteristic allows students to understand and apply in a practical way the theoretical concepts received in the classroom, for example in the discipline of Control Systems of the electrical engineering course; here in its content different dynamic systems used in different engineering courses are presented (OGATA, 2010), thus allowing to model and simulate systems or carry out projects in a single unified platform.

RESULT OF APPLICATION IN THE DISCIPLINES OF HIGHER EDUCATION CONTROL AND ELECTRICAL CIRCUITS

The virtual library (NIASAR, 2021), designed based on the advantages and benefits of this program, proves to be a highly effective tool in the teaching and learning process in higher education courses that need practical activities. The continuation in Figure 1 shows an example of a virtual library created to carry out practical activities in the discipline of Control Systems, (JUNIOR, 2023) where the main components used were then image components and buttons, and for the image components it is enough to select an image stored on the computer and for the buttons to program its function (MATLAB® *App Building*, 2024).

In the library window, buttons were programmed for the different laboratories to be carried out and a button called "Help" was programmed which, when clicked, opens a file where the application's instruction manual was placed for the user to read and familiarize themselves with the application, as well as a general guide with instructions for running the laboratory.

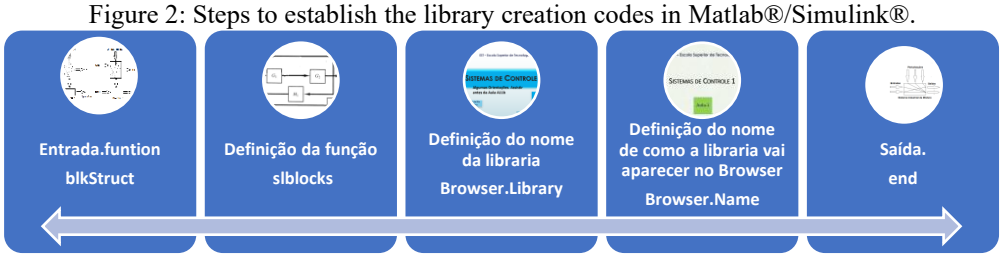
Figure 1. Home page of a virtual library created for Control Labs.

Source: The author.

Figure 2 shows the steps to follow to establish the codes for **creating other components, blocks, of the library in Matlab®**/Simulink®.

The following Figures 3, 4 and 5 present visual evidence of the interactive resources employed, simulations and examples of system models created to enrich the students' experience in the practices. These concrete results reflect the practical application of the theoretical principles of the discipline shown here as an example, Control Systems (OGATA, 2010), allowing students to understand, experiment and improve their skills.

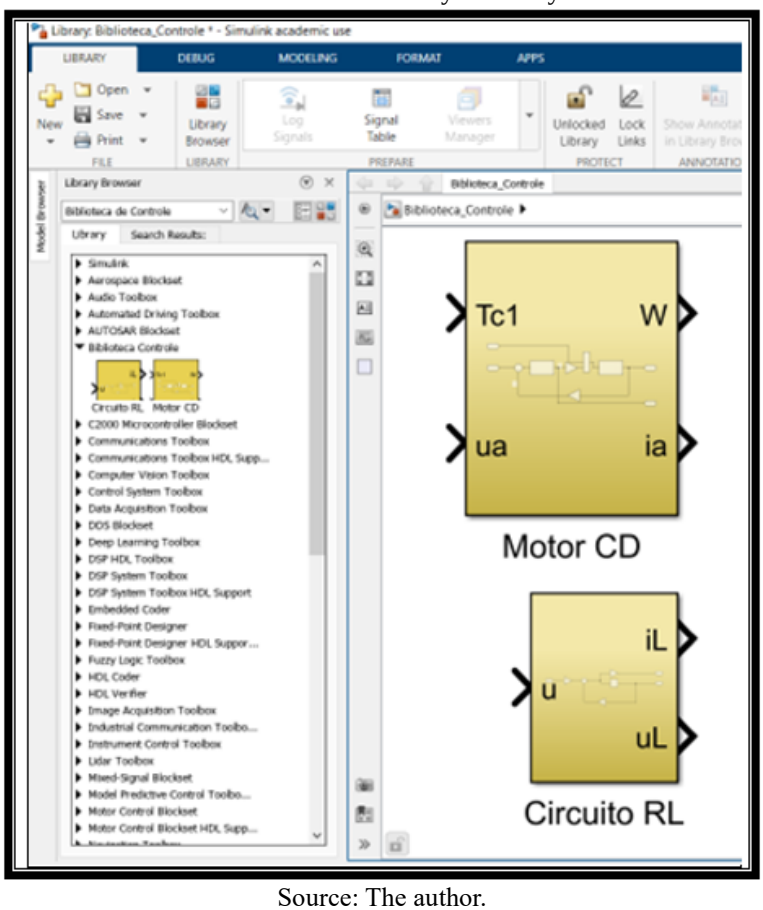
Figure 2: Steps to establish the library creation codes in Matlab®/Simulink®.



Source: The author.

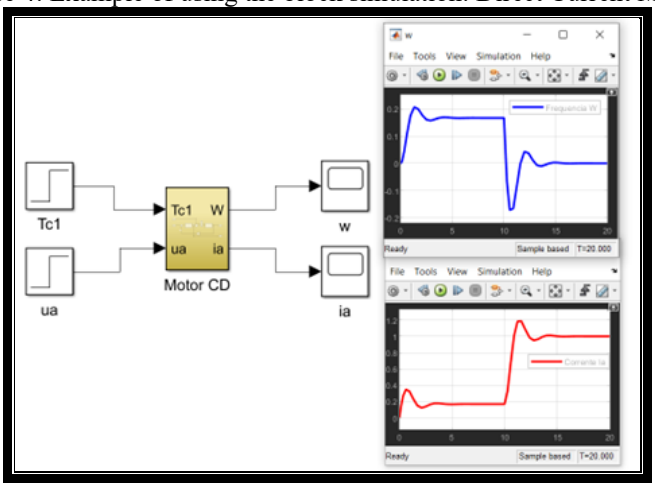
In the conformation of the virtual library blocks, a strategy is adopted that involves the creation of independent and reusable subsystem blocks, where the parameters of the variables can be inserted. These subsystems are designed with the purpose of offering students specific and ready-to-use virtual resources in various disciplines, with wide iterativeness, which undoubtedly improves the acquisition of knowledge about dynamic and control systems (SILVA et al, 2024).

Figure 3: Access to the blocks within the library or library in Matlab®/Simulink®.



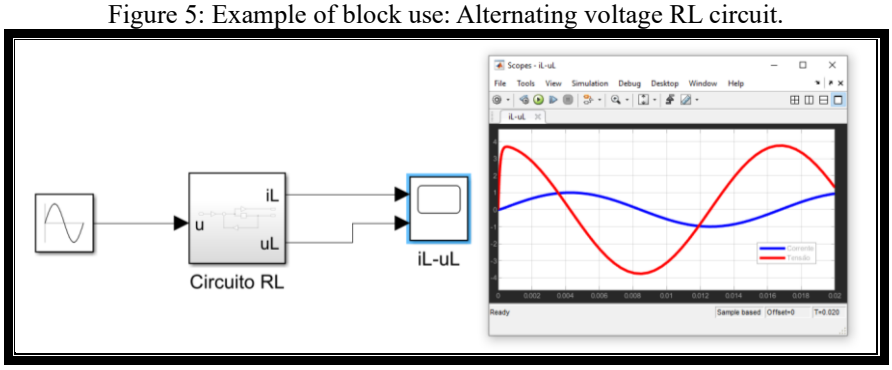
Source: The author.

Figure 4: Example of using the block simulation: Direct Current Motor.



Source: The author.

Figure 5: Example of block use: Alternating voltage RL circuit.



Source: The author.

FINAL CONSIDERATIONS

By implementing examples of how to create a virtual library with Matlab®/Simulink® to be used in higher education courses, it demonstrates how computer technologies used for educational purposes can significantly improve the learning experience in the courses. The availability of interactive resources, practical simulations and system models, helps students in understanding and understanding the concepts and dynamic phenomena or behavior of a given system, which prepares them for challenges in the real and technological world.

In addition, the modular organization of the library, with the creation of specific subsystems in blocks, allows for a personalized approach that is adaptable to the individual knowledge needs of students. This approach not only strengthens the teaching of the discipline now researched, as for example it was in the Control System laboratories, but also promotes a solid basis for the study and use in other disciplines of higher education courses, where the use of modeling and simulation of systems and components is widely recognized and valued.

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REFERENCES

1. Ogata, K. (2010). *Engenharia de controle moderno* (H. C. Souza, Trad.; E. A. Tannuri, Rev. téc.). 5ª ed. Pearson Prentice Hall.

2. Dorf, R. C., & Bishop, R. H. B. (2013). *Sistemas de controle modernos* (12ª ed.). LTC - Livros Técnicos e Científicos.

3. Chapman, S. J. (2003). *Programação em Matlab para Engenheiros*. Pioneira Thomson Learning Ltda.

4. Guzman, D., et al. (2021). Simulação da eficiência energética: Uma ferramenta prática de uso como laboratório virtual de apoio ao ensino da engenharia. *Anais do 1º Latin American Congress of Education*. Curitiba, Brasil. Disponível em: https://latinamericanpublicacoes.com.br/lace2021/anais/index.php?t=TC2021051397214. Acesso em: 6 de julho 2023.

5. PET Engenharia de Computação. (2009). *Mini-curso de Simulink*. Universidade Federal de Espírito Santo.

6. High Voltage Engineering by MG Niasar. (2024). How to add your own library in MATLAB Simulink Library Browser (Create Custom Library). Disponível em: <https://www.youtube.com/watch?v=WxFBXEZo0VI>. Acesso em: 23 jun. 2024.

7. Junior, E. P. P. (2023). *Elaboração de ambientes virtuais para auxiliar a automação de práticas laboratoriais de sistemas de controle em engenharia elétrica e eletrônica* (Trabalho de Conclusão de Curso). Universidade do Estado do Amazonas, Manaus.

8. MathWorks. (2024). MATLAB Access for UEA Universidade do Estado do Amazonas. Disponível em: MathWorks - Centro de licencias. Acesso em: 4 de maio 2024.

9. Silva, C. C. M., Guzman, D., et al. (2024). Elementos para a conformação de uma biblioteca virtual com Matlab® para a disciplina de Sistemas de Controle no curso de Engenharia Elétrica. *3rd Amazon Stem Academy Conference*. Editora Amplla.

The worker's fulfillment is to be valued by the organization! Factorial evidence and proposal of a labor diagnosis of the perception of organizational support in workers of organizations after social isolation

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ABSTRACT

In this chapter, we sought to verify the organization, consistency and variation of the factorial structure of the scale of perception of organizational support (EPSO) in Brazilian workers. Brazilian workers in various professional specialties answered a questionnaire with sociodemographic data and the Organizational Support Perception Scale (EPSO). For convergence and divergence analysis, the organizational turnover scale and positive psychological capital were answered. In all statistical analyses (discriminatory, representativeness, exploratory and confirmatory) they observed psychometric indicators that ensured the quality of EPSO. Not only is the scale reliable for assessing this construct in workers, but that, with the proper findings in the study, it is possible to propose the development of a psychological test at the organizational and individual levels (i.e., specifically, for workers).

Keywords: Organizational support, Scale, Exploratory and confirmatory analysis, Brazilian workers.

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INTRODUCTION

Since the industrial revolution, organizations have experienced an increasing speed in their human, economic and functional dimensions, which is due not only to the new structural perspectives of the world of work, but also to contemporary human resources trends related to management practices and policies and organizational behavior (Perello-Marin & Marin-Garcia; Marcos-Cuevas, 2013; Tachizawa, 2015; Quagraine, Adu, Ashie & Opoku, 2019).

In view of these conditions, especially in periods with characteristics of social, economic, and health risks, as occurred in the last 3 years with the Covid-19 pandemic, it became evident that the relationship between organization and worker transcended material, legal, and technical demands (Habtoor, 2016; Rohm & Lopes, 2015).

In this condition, it became important to highlight human factors that associate professional and workspace valorization, as well as to understand the existence, implementation, and maintenance of organizational conduct related to involvement, engagement, recognition, social relationships, and rewards.

According to Rohm and Lopes (2015), work is a viable perspective of people's relationship with the work environment and the productive function, becoming both a source and an organized structure for the construction of subjectivity, the meaning of existence and the meaning of life. Thus, the meaning of work for the individual represents the value he attributes to work, the motivations and objectives that guide his actions, and satisfaction is in the balance between what he expects and what he can effectively accomplish (Schweitzer et al., 2016; Tomé & Formiga, 2021).

In this sense, the World Health Organization (WHO, 2020) has a significant direction in relation to the issue of work. According to this institution, work should not be the only and exclusive human activity, not limiting people's lives only to the working condition. It is necessary for work to go beyond the process of survival and consumption, also suggesting the need to develop a social discourse of work, with an appreciation of the world of work for productive professionals, providing a fair distribution and interaction in relation to rights and duties in the work-organization relationship and quality of life.

Since the foundation of administrative science, with Henry Fayol as its first precursor (cf. Melo Neto, 2008; Andrade & Amboni, 2011), organizational management was mainly associated with the economic dimension, prioritizing only competitiveness and financial incentives as foundations for the success and satisfaction of workers (Verstegen, 2011; Fidelis & Formiga, 2023). Thus, efficient management was based on actions related to planning, organization, command, coordination, and control (Fayol, 2016). In addition, the development of organizations was associated with two main strategies: cost leadership and differentiation (Porter, 2008; Yoo, Lemak & Choi, 2006).

The use of similar management strategies to deal with the heterogeneity of contemporary demands has become increasingly limited, requiring the reformulation and reinvention of practices in the workplace (Braia, Curral & Gomes, 2014). In this context, there is a need to understand aspects that require a broader understanding of "being professional", which go beyond the unidirectional economic perspective and stimulate new management approaches, in order to understand and apply the processes of human interaction in the organization-worker relationship, professional performance and productivity (Formiga, Freire, Batista & Estevam, 2017; Scorsolini-Comin, Inocente & Miura, 2012; Tamayo & Paschoal, 2003).

Currently, organizations seek to establish in their processes that employee performance is based on competencies and skills that go beyond the mechanical and dualistic execution of functional demands in the organization, since assertive performance influences the construction and pursuit of organizational objectives (Almatrooshi, Singh & Farouk, 2016; Kuo, 2011; Randeree & Al Youha, 2009).

Thus, it is evident that organizational performance involves not only technical factors, but also human factors, since the development of tasks does not occur in an organizational vacuum, but is associated with worker behavior, involvement, social relationships, recognition, and rewards (Habtoor, 2016).

The relationship between organization and worker transcends general aspects with material and normative demands of society. Thus, in the "work" system, human factors are of crucial importance in the implementation of characteristics of professional valorization, which, for the most part, are associated with the development of work activities in the organizational environment, specifically in organizational conduct, involvement, engagement, recognition, social relationships, and rewards (Habtoor, 2016; Formiga et al., 2019).

Rohm and Lopes (2015) rescue the perspective of work as a "fundamental condition in human existence", because from it man relates dialectically to the external environment, building his internal reality, participating in social groups, assuming social roles and acting in his environments, perpetuating his existence. Therefore, work is characterized by enabling the relationship of individuals with the environment, in a given context, being an incessant source of construction of subjectivity, producing meaning for existence and the meaning of life (Rohm & Lopes, 2015).

According to Tomé and Formiga (2021), according to the phenomenological humanist perspective, human beings need to give meaning to their acts, making them acceptable to themselves and to society. In this line, the meaning of work for the individual represents the value he attributes to work, the motivations and objectives that guide his actions, and satisfaction is in the balance between what he expects and what he can effectively accomplish (Morin, 2001; Schweitzer et al., 2016).

Although work is not the only human activity, it is highlighted that life should not be limited only to the working condition. The relevance of work in people's lives should result both from the internalization of the social discourse about valuing the world of work, as it is productive and part of the world, and from the remuneration originated in and by work, whether subjectively or materially. These conditions establish work as an experience and a life of interaction between the individual and society (WHO, 2020).

In the context mentioned above, it is important to understand the historical phases and identify the crucial transformations that impacted individual behaviors in the professional sphere. In the study by Habtoor (2016), the results indicate that human factors directly influence these practices, especially those aimed at improving organizational quality and performance, including in general quality management practices.

It is a fact that the meaning attributed by people to the world of work, and specifically to the concrete category of work, that is, the act of working, is subjective and social, as it is related to individual history, but is shared with the historical and social condition, conferring on individual consciousness the affective, cognitive and intellectual dimensions (Tomé & Formiga, 2021).

In this way, an individual's involvement with their work comprises the degree to which the work done is able to provide satisfaction to them, completely absorbing them while performing tasks and being important to their life. This concept is represented by an affective bond developed by the individual himself in relation to the work he performs (Siqueira, 2008; 2014).

In this sense, the theoretical orientation of this chapter has its importance in the evaluation of organizational support, which, when understood as a mediating construct of the organization-worker relationship, reinforces the need and the applied structuring of the perspective of recognition and appreciation of professional performance (Kurtessis, Eisenberger, Ford, Buffardi & Stewart; Addis 2015). Thus, according to Oliveira-Castro, Pilati and Borges-Andrade (1999), a favorable perception of support strengthens the employee's affective involvement with the organization, resulting in a greater effort on the part of the employee to achieve the objectives established by the company.

A diversity of research in the last ten years, since the original production in the late 1980s in the 20th century, developed by Eisenberger, Huntington, Hutchison and Sowa (1986), has highlighted the importance of organizational support in various areas, such as cultural diversity studies (Leveson, Joiner & Bakalis, 2009), implementation of technologies (Lee, Lee, Olson & Chung, etc.). 2010), violation of the psychological contract (Suazo & Stone-Romero, 2011; Formiga et al., 2021), employee health and emotions (Mishra, 2014), risk-taking (Neves & Eisenberger, 2014), responsibility and job satisfaction (Wikhamn & Hall, 2014), well-being (Caesens, Stinglhamber & Ohana, 2016; Formiga et al., 2019) and control of employee misconduct in the organization (Fandiño, Formiga, Menezes & Bentes, 2015).

Thus, organizational support can be highlighted as an important tool to assist workers in the management of cultural diversity in the company, as well as in the development of affective commitment (Leveson, Joiner & Bakalis, 2009; Formiga et al., 2019). When organizations implement policies that encourage cultural diversity, employees perceive these actions as care and support, which strengthens the bond of trust between the organization and the worker (Randeree & Youha, 2009; Fleury et al., 2017).

In addition, employees who perceive that the organization values their well-being and professional development are more likely to take risks, become motivated, and invest in the development of the organization, becoming more responsible, engaged, and satisfied with their work (Caesens, Stinglhamber, & Ohana, 2016; Wikhamn & Hall, 2014; Formiga et al., 2019).

In this way, organizational support not only plays an important role in promoting human practices in organizational dynamics, but also facilitates the introduction of technologies in the workplace, allowing employees to realize their value and usefulness in utilizing these new technologies. Therefore, organizational support is a construct that mediates the subjectivity of "being professional" and the contemporary organizational challenges related to work performance, organizational citizenship, creativity and innovation (Oliveira-Castro, Pilati & Borges-Andrade, 1999; Formiga et al., 2021).

Considering contemporary work processes, whether during a pandemic or post-pandemic, worker well-being remains a central concern for researchers and managers in organizations. According to Kogut and Zander (1996), the company plays an important role in the formation of organizational identity and it is necessary to establish and maintain social practices, coordination and learning between worker and organization to improve dynamics and productivity. The value given by the organization to the employee plays a crucial role in this context.

It is believed that the organizational environment can contribute to a functional and productive work practice. As highlighted by Eisenberger, Huntington, Hutchison and Sowa (1986), workers construct perceptions about the recognition and appreciation attributed by the organization to professional practices, which influences their commitment and the affective bond between them and the company. When these work demands are balanced, professionals are more committed and engaged.

Research in the area of evaluation and development of human behavior in organizations in the last ten years has revealed a number of studies that contemplate not only variables focused on the social and emotional skills of workers as protective factors in the organizational environment, but also highlight statistical parameters aimed at the evaluation and diagnosis of workers' performance and productivity. as well as their interpersonal relationship in the workplace (Limongi-França, 2008; Puente-Palacios & Peixoto, 2015; Hutz, Bandeira, Trentini & Vasquez, 2020).

According to Beserra's (2022) conception, it is possible that the development and modification in the dynamics and applicability of attitudinal and behavioral criteria in people management have influenced the different forms of transformation in the business environment, especially in the work context. This proposes alternatives and updates in organizational policies and in the application of techniques in the area of people management, providing tools to specialists in human and social sciences applied to organizations and the world of work in studies on satisfaction, emotion, thinking and social behavior of workers in the functional environment of the organization.

Among the various constructs in the area of psychological science applied to the world of work, the ability to assess the importance of the perception and attitude of professionals in relation to emotional and behavioral factors in the organizational environment has stood out as one of the great influencers of productivity and occupational health. This involves assessing the intensity and frequency of the bond and involvement between the organization and the worker, as well as their functional demands.

The construct of organizational support applied to work activities can not only be considered a study that will contribute to the work environment of professionals in their various specialties, but it was also not found in scientific research that reports the theme, especially in the proposal for the development and evaluation of a measure on the perception of organizational support as a criterion for psychological testing in the organizational environment in workers after isolation social; a condition which he will take as his main interest for the development of this chapter.

METHOD

TYPE OF SURVEY AND SAMPLE

This study was developed based on a post-positivist epistemological orientation, adopting a research strategy based on the quantitative method, of the descriptive, exploratory and correlational type (Creswell & Clark, 2013; Flick, 2013) with workers from different professional areas in Brazil. Regarding the inclusion criteria, participants were considered to be over 21 years of age, employed for more than one year, active in their work sectors and who fit the labor regulations of the Consolidation of Labor Laws (CLT), with a working day of 20 to 40 hours and belonging to different professional specialties.

The sample analysis was performed with the aid of the G Power 3.2 statistical package, a software used to calculate the statistical power required for the survey, considering a probability of 95% ($p < 0.05$), magnitude of the sampling effect ($r \geq 0.50$) and a hypothetical power ($\pi \geq 0.80$). Based on these indicators, a minimum sample of 260 Brazilian professionals was considered sufficient to carry out the research, presenting reliable statistical indicators (e.g.: $t \geq 1.97$; $\pi = 0.98$; $p < 0.05$).

To participate in the research, the professionals individually marked the Informed Consent Form (ICF) on an electronic form, in accordance with the guidelines established by Resolution 466/12 for research involving human beings. The study was approved by the Research Ethics Committee (CAAE: 63498422.4.0000.5296). Participants were presented with the benefits of the research, as well as the possible risks involved, which were minimal (e.g., feeling embarrassed, inhibited, or suspicious, etc.), and there were no reports of these effects.

Despite the possibility of risks related to moral damages or embarrassment due to the questions or the interaction between the researcher and respondents, the participant was informed that he was not obliged to continue and could withdraw from the research at any time, without suffering losses or insistence from the researcher. The questionnaire was made available electronically for a period of two months, and the estimated time to complete it was approximately five minutes.

The study was conducted electronically using *Google Forms* and involved workers from different sectors and types of organizations throughout the national territory. Those who wished to participate received the link to access the electronic form through social networks and/or emails.

RESEARCH INSTRUMENTS

The participants answered the following instruments:

Organizational Support Perception Scale (EPSO) - This is a scale composed of 9 items, developed by Eisenberger et al. (1986) and adapted and validated for the Brazilian context by Siqueira (1995). This measure aims to assess the extent to which people (who work in public and/or private organizations) perceive that the company cares about the employee's well-being. To respond to the construct, participants were asked to indicate their perception by marking the corresponding response on a seven-point scale, ranging from 1 = strongly disagree to 7 = strongly agree.

Regarding the reliability of the scale, in the pioneering study by Siqueira (1995), an alpha of 0.86 was observed; in a sample of Brazilian workers, Formiga, Fleury and Souza (2014) conducted a study to verify the consistency of the scale's factor structure and observed psychometric indicators that confirmed the factor structure proposed by the EPSO scale, such as the chi-square index divided by degrees of freedom ($\chi^2/gl = 1.42$), Residual Root Mean Square (RMR = 0.02), Goodness-of-Fit Index (GFI = 0.99), Adjusted Goodness-of-Fit Index (AGFI = 0.97), Comparative Fit Index (CFI = 0.99), Tucker-Lewis Index (TLI = 0.99), and Root Mean Square Error of Approximation (RMSEA = 0.03).

To carry out the criterion analysis, the following instruments were inserted:

The Positive Psychological Capital at Work (ECPP) scale used in the study was developed by Luthans, Youssef and Avolio (2007), and the reduced form with 12 items developed by Viseu et

al. (2012) for the Portuguese context was adopted. This scale is composed of four factors: Optimism (OTIM) with 2 items, Resilience (RESIL) with 3 items, Self-efficacy (AE) with 3 items, and Hope (ESPER) with 4 items. Participants answered on a six-point Likert scale, indicating their degree of agreement with each item, ranging from 1 - Strongly disagree to 6 - Strongly agree. In the study conducted by Formiga, Viseu and Jesus (2014) for the Brazilian context, reliable psychometric indicators were observed, such as the chi-square index divided by degrees of freedom ($\chi^2/gl = 1.32$), Residual Root Mean Square (RMR = 0.05), Goodness-of-Fit Index (GFI = 0.98), Adjusted Goodness-of-Fit Index (AGFI = 0.95), Comparative Fit Index (CFI = 0.99), Tucker-Lewis Index (TLI = 0.99) and Root Mean Square Error of Approximation (RMSEA = 0.03). These indicators confirmed the four-factor structure of the PPEC proposed by the authors.

Turnover Intention Scale (EIR) – This is a measure developed by Siqueira et al. (1997); it is composed of three items (for example, Do you think about leaving the organization where you work; You plan to leave the organization where you work; You want to leave the organization where you work), for which the respondent must indicate on a five-point Likert scale, ranging from 1 (never) to 5 (always), how much they agree or disagree with the information expressed in the items. The intention to use this measure is due both to the reason that it presents a precision index above 0.70 ($\alpha = 0.95$), as well as because it is a short instrument that includes a clear and applied definition for the evaluation of the phenomenon intended in this dissertation.

In addition to these measures, issues related to sociodemographic and professional data will be considered, such as gender, age, economic income, type of organization and length of service, among others.

DATA COLLECTION TECHNIQUE

As for the data collection technique, the research will adopt four stages, which are: descriptive and inferential statistics, exploratory analysis, confirmatory analysis and verification of the analysis of convergent and divergent criteria. For the first two stages, the statistical software SPSS (version 25.0) will be used. In the first step, Student's t-test and Pearson's correlation will be calculated. In the second stage, an exploratory factor analysis of the construct and the internal consistency of the factors was performed by calculating Cronbach's alpha. In the third stage, a confirmatory factor analysis and Structural Equation Modeling (MEE) were carried out through the AMOS Graphics program (version 24.0) in order to test the theoretical structure observed in the exploratory analysis and possible alternative factor structures and, finally, in the fourth stage, aimed at convergent and divergent evaluation, Pearson and chi-square correlation calculations will be performed to evaluate the association between the variables of the organizational culture and the type of organization in which the participants work.

RESULTS AND DISUSION

After data collection and organization in the statistical program spreadsheet, the following sociodemographic information was observed: 599 workers participated, with a mean age of 43.75 years (s.d. = 9.45), ranging from 23 to 68 years, 78% were female, 31% were from the city of Natal-RN (the other capitals did not present a frequency of participants above 5%, a condition that does not need to be presented in this information), there was an equitable distribution among the functional specialties occupied by the participants [33% bank employees, 33% health professionals and 34% education], 67% had a higher education degree, with more than 16 years of service and 67% worked in both shifts (morning and afternoon).

For the development of this study, the proposal elaborated by Eisenberger *et al*. (1986) and evaluated in the Brazilian context by Siqueira, (2014; Formiga, Fleury & Souza, 2014) in workers before social isolation. They observed the existence of a single-factor factorial structure, both in terms of the content of the items and their exploratory and confirmatory factorization, independent of the sample of workers.

Considering the originality of the proposed measure, as well as the psychometric indicators observed in the pioneering study by Eisenberger et al. (1986) and Siqueira (2014) for the Brazilian context; the discriminative power of the items and their representativeness of the content of the items was initially verified, aiming at greater specificity in the statistical analysis for the organization and empirical verification of the factoriality of the scale in question.

In the **first study**, 200 workers, men and women, from public and private organizations were part of this stage; based on the assumptions of the Classical Theory of Tests (TCT), it was evaluated, how much the items had the ability to discriminate the magnitudes close to the mean scores of the lower and upper groups in relation to the measured construct (Pasquali, 2011).

To meet this stage of the study, a total score of the scale was calculated and then its median. Thus, respondents with scores below the median were classified as being in the lower group, while those with scores above the median were defined as being in the upper group. Considering each of the items of the scale, a t-test was performed for independent samples and the two groups were compared observing which of the items of the scale discriminate against people with similar magnitudes, which are statistically significant (Table 1).

Table 1 shows that all items were significant, both in terms of discrimination and representativeness; This condition indicates that they correspond to the content expressed by the authors who developed the scale, as well as that the respondents recognized in the expression of each item the reality measured by the construct.

Table 1. Descriptive analysis and discriminative power and representativeness of EPSO's content

EPSO items	Min	Max	Average (p.p.)	Discrimination	Representativeness
				t (≥ 1,96)	r (total score
1.This company ignores any complaint on my part	1	7	4,19 (1,69)	-9,86	0,53*
2. This company does not consider my interests when making decisions that affect me	1	7	4,51 (1,72)	-10,45	0,53*
3.Is it possible to get help from this company when I have a problem	1	7	4,10 (1,63)	-22,08	0,71*
4.This company really cares about my well-being	1	7	4,59 (1,73)	-21,37	0,75*
5. This company would be willing to enlarge its facilities to help me utilize my best skills in performing my work	1	7	4,98 (1,72)	-16,81	0,67*
6.This company is ready to help me when I need a special favor	1	7	4,09 (1,72)	-21,45	0,80*
7.This company cares about my job satisfaction	1	7	4,30 (1,83)	-22,35	0,81*
8. This company cares more about its profits than me	1	7	4,95 (1,28)	-9,78	0,54*
9. This company try to make my work as interesting as possible	1	7	4,75 (1,83)	-17,82	0,74*

Nota: * p < 0,001.

In Table 1, the EPSO items detailed how much the respondent is able to evaluate organizational support, from the perspective of the workers who are part of the organization (Eisenberger et al., 1986; Siqueira, 2014; Formiga, Fleury & Souza, 2014); with regard to the content of the items, based on their representativeness behavior-domain, the ability of the items to systematically evaluate the theoretical relationship highlighted in the scale that measured the perception of organizational support is highlighted, which highlight that the situations specified in the items represent the aspects theoretically expected by the authors who addressed the theme and proposed such an evaluation in the organizational and work context (Cunha, 2000; Pasquali, 2011).

With the Pearson correlation calculation (r), it can be highlighted that the evaluation of the items referring to the scale itself not only presented strong (> 0.50) and positive correlations, related to the general construct of the EPSO (total score of the scale), but also significant correlations, not excluding any of the items of the intended measure (see table 1). Thus, once the conceptual and empirical condition of the EPSO construct was guaranteed, the second stage (factor analysis) was completed, highlighted below.

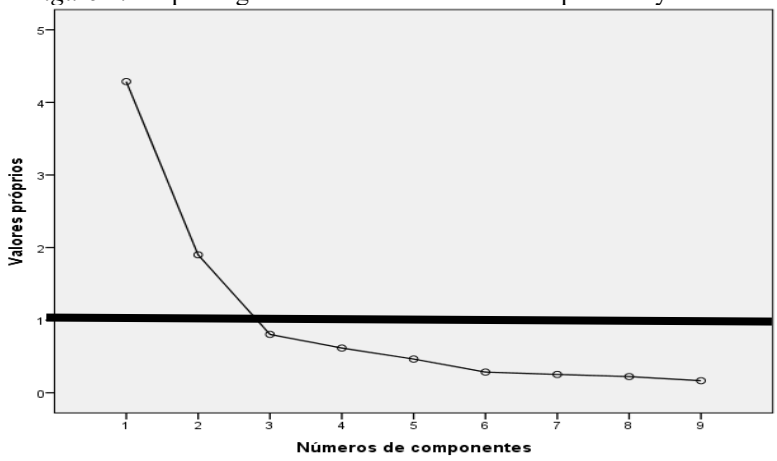
In this second study, 198 workers participated, with characteristics similar to the first sample; guided by the results observed in the discriminative analysis and representativeness of content, a factor analysis was performed; for these, the calculation was performed with the factorial method of the Principal Components (PC), without specifying the number of factors to be extracted, without

factorial rotation and assuming saturation of ± 0.30.

For a security in the decision making in the choice of factors, the criterion referring to the number of *eigenvalues* equal to or greater than 1 (Kaiser's Criterion), the graphical distribution of eigenvalues, taking as reference the point from which no other factor contributes considerably to the structure (Cattell's Criterion) and the parallel analysis (O'Connor, 2000; Dancey, & Reidy, 2006).

Once the psychometric evaluation criteria were defined, the results of the analyses allowed us to identify the adequacy of the correlation matrix: KMO = 0.83 and the *Bartlett Sphericity Test*, χ^2/gl = 3102.81/36, $p < 0.001$. In the graphical distribution based on eigenvalues (Cattell's criterion), six factors were identified on the scale (see Figure 1).

Figure 1: Slope diagram of the number of factors plotted by EPSO



According to Kaiser's criterion (i.e., *eigenvalues*), the existence of two factors with eigenvalues greater than 1 (one) was also identified, jointly explaining 68.74% of the total variance of the measured phenomenon. In order to leave no doubts about the factorial organization of the scale, the parallel analysis was performed, assuming the same parameters as the original database. That is, 198 participants and 9 (nine) variables, with their eigenvalues generated in 1,000 random simulations with the items (see Table 2).

Table 2: Distribution of the factors of the PC analysis according to the Kaiser criterion and parallel analysis

Kaiser's criterion	Parallel analysis
4,29	1,56
1,32	1,39
0,80	1,22

Comparing the eigenvalues, those observed in the Kaiser criteria and in the parallel analysis, it is highlighted that those observed in the Kaiser criterion presented values higher than the simulated ones (parallel analysis) and it was identified that the scale presents a unifactorial organization (see table 2). Seeking better decision-making for the interpretation of the item-factor distribution, two

judges with experience in the area of psychological assessment and psychometrics contributed with their judgment regarding the distribution.

With this, they confirmed the expected factorial decision: the unifactoriality of EPSO, the factor analysis of the Principal Components (PC) was performed with oblique rotation, *eigenvalue* (eigenvalue) > 1.00 to define the factor and saturation of ±0.30 for item retention. The use of this technique was shown to be quite adequate through the following indicators: KMO = 0.83 and the *Bartlett Sphericity Test*, χ^2/gl = 3102.81/36, $p < 0.001$. The results of the extraction revealed the presence of a single factor, similar to what was previously presented by Eisenberger et al. (1986), adapted by Siqueira (2014) and validated in its factorial structure by Formiga, Fleury and Souza (2014), as well as with what was compared in the analysis for decision making (namely: *eigenvalues*) equal to or greater than 1 (Kaiser's criterion), graphical distribution of eigenvalues (Cattell's criterion) and parallel analysis).

Thus, a single factor jointly explained 58.93% of the variance of the factor, while the second factor explained 13.82% (see Table 3). To facilitate the reader's understanding, the content of each item, its saturation (factor loading) and commonality were presented, as well as the indicators of internal consistency (Cronbach's alpha) and variance explained by the factor. It can be observed that all these indicators were within the psychometric standard required by the literature (Pasquali, 2011; Hair et al., 2005; Dancey & Reidy, 2006).

Table 3: Analysis of EPSO's main components (CP) (n = 198)

Factors	Items	aif	H2	Own values	% Explained	Alpha	ICC
EPSO	**1**. This company ignores any complaint on my part.	0,88	0,54	4,28	47,63	0,83	0,83
	2. This company does not consider my interests when it makes decisions that affect me.	0,87	0,52				
	3. It is possible to get help from this company when I have a problem.	0,85	0,57				
	4. This company really cares about my well-being.	0,76	0,54				
	5. This company would be willing to enlarge its facilities to help me utilize my best skills in performing my job.	0,76	0,44				
	6. This company is ready to help me when I need a special favor.	0,75	0,46				
	7. This company cares about my job satisfaction.	0,73	0,47				
	8. This company cares more about its profits than it does about me.	0,77	0,56				
	9.This company try to make my work as interesting as possible.	0,75	0,54				

Notes: aif = Item-factor ratio; h2 = Commonality.

Considering the results presented in table 3, from a classic perspective of evaluation, EPSO's factorial organization had its items distributed in a single factor; this, in turn, reveals that such a scale is consistent, as it corroborated the proposal of the authors who developed the measure (cf. Eisenberger et al., 1986; Siqueira, 2014; Formiga, Fleury & Souza, 2014), as well as in the verification of the ICC, considered as intraclass correlation (ICC), allowing us to highlight that the construct can be used reliably in samples with characteristics similar to the one collected in this dissertation.

By way of addition, based on the ICC, factorialization was evaluated in the same psychometric direction, in three different samples, for which it assumed the same patterns of factor analysis performed with the sample of 198 workers (namely: For security in decision making in the choice of factors, the criterion referring to the quantity of eigenvalues was adopted) equal to or greater than 1 (Kaiser's criterion), the graphical distribution of eigenvalues, taking as reference the point from which no other factor contributes considerably to the structure (Cattell's criterion) and the parallel analysis).

In the sample of bank employees, the one-factor existence of EPSO was observed with the following indicators: AIF ranging from 0.69 to 0.82, h2 from 0.42 to 0.51, explained % from 45.21 and alpha from 0.81; **In the sample of teachers**, the unifactoriality of EPSO was also observed, with very similar statistical indicators: AIF of 0.64 to 0.78, h2 of 0.38 to 0.47, explained % of 41.56 and alpha of 0.79; finally, in the **sample of health professionals**, EPSO was unifactorial with indicators very similar to the previous ones (AIF ranging from 0.70 to 0.86, H2 from 0.51 to 0.63, explained % from 47.25 and alpha from 0.85.

In the context of the evaluation presented, it not only corroborated the factorial organization of EPSO based on the ICC, but also that unifactoriality occurs regardless of the sample. However, despite the psychometric quality presented, the exploratory analysis is a calculation that presents randomness and its factorial organization does not allow theorizing about an adequate model that sustains the structure of the measure in terms of theoretical and empirical permanence; thus, we sought to perform a confirmatory factor analysis of EPSO presented below.

In this stage, 201 workers, men and women, from public and private organizations participated. To carry out the analysis, the AMOS GRAFICS statistical package was used, intended for confirmatory factor analysis for which the unifactorial model, already observed by the authors, was hypothesized (cf. Eisenberger et al., 1986; Siqueira, 1995; Formiga, Fleury & Souza, 2014) and based on the findings of the exploratory analysis of study 2; From this information, it is expected that the item-factor organization will confirm a similar association already observed.

In the Confirmatory Factor Analysis (CFA), it was decided to leave the covariances free (phi, φ), revealing indicators of goodness of fit for the proposed model close to the recommendations

presented in the literature (Byrne, 1989; Van De Vijver, & Leung, 1997). In these results, the intended model (adjusted one-factor model) presented statistical indicators that justify the consistency of the factor structure of EPSO in workers, confirming, in a more robust way, the proposal of the aforementioned authors.

In addition to observing that the statistical indicators were in accordance with the statistical requirements, these were close and even better than those observed in the study by Siqueira (2014) and Formiga, Fleury and Souza (2014), especially when it was verified, both the same indicators used by the authors, as well as others, which would contribute to maintaining the original proposal.

Thus, the results expressed in Table 4 showed that the adjusted one-factor model is the one that best represents the factorial proposal of the EPSO construct. This presented statistical indicators that justify not only the validity, but also the consistency of the factor structure.

Table 4**:** Psychometric indicators from the comparison of the factor structure of the EPSO scale

Models	Absolute fit measures				Incremental adjustment measures			Measures of parsimony	
	χ^2/gl	**RMR**	**GFI**	**AGFI**	**CFI**	**TLI**	**RMSEA**	**CAIC**	**ECVI**
One-factor without adjustment	12,25	0,19	0,82	0,79	0,86	0,82	0,19	385,09	1,86
Adjusted Unifatorial	2,56	0,04	0,99	0,98	0,99	0,99	0,03	224,63	0,86

It was observed that all saturations (Lambdas, λ) were within the expected range |0 - 1|, with no problems with the proposed IBACO estimation (see Table 4); in addition, they were statistically different from zero ($t > 1.96$, $p < 0.05$) proving the existence of the one-factor model, revealing a positive and strong association between the factor items (see Table 5).

Regarding the validity of this construct, the calculation of composite reliability (WC) and extracted mean variance (EMV) were performed; in the first indicator, the score level is required to be above 0.70, while in the second indicator, a level above 0.50 is required (Hair; Tatham; Anderson & Black, 2005; Campara, Tavares & Silva, 2009). Table 5 shows WC and VME, which were above the required in the literature, respectively 0.89 and 0.56. These results show the reliability and convergent validity of the evaluated construct, which is adequate in the proposed factorial structure.

Table 5: Factorial structure of the measure of organizational support in workers (n = 201).

ξ (construct)	X	L	ε (errors)	CC	VME	alpha
EPSO	**1**. This company ignores any complaint on my part	0,61	0,25	0,85	0,59	0,86
	2. This company does not consider my interests when it makes decisions that affect me	0,65	0,28			
	3. Is it possible to get help from this company when I have a problem	0,81	0,57			
	4. This company really cares about my well-being	0,80	0,49			
	5. This company would be willing to enlarge its facilities to help me utilize my best skills in the performance of my work	0,79	0,56			
	6. This company is ready to help me when I need a special favor.	0,87	0,54			
	7. This company cares about my job satisfaction	0,73	0,34			
	8. This company cares more about your profits than me	0,72	0,38			
	9. This company try to make my work as interesting as possible	0,75	0,32			

Notes: λ = Factor scores of the structure; ε (errors) = Errors in the measurement of the structure; χ = variables (items); ξ = psychological construct. VME = Extracted Mean Variance. CC = Composite Reliability.

The above results were confirmed when the prediction estimates were observed, based on the regression analysis; this revealed for the model in question, from the identification of the variables, a criterion ratio that, in addition to being within what is statistically required ($t > 1.96$, $p < 0.05$) and that were significant.

Regarding the addition of information, it was sought to prove that there is no multicollinearity in such results; this condition was observed in the VIF (defined in Portuguese as: Factor Variance Inflation - IVF), having as an evaluation the tolerance factor between the variables, for which it suggests that the VIF scores are not ≥ 5, which would imply the low quality of the estimated model (Hair; Tatham; Anderson & Black, 2005; Marôco, 2010); it was observed that the VIF ranged from 3.16 to 2.34 ($p < 0.01$), a result that supports the estimation of the hypothesized structural model.

Based on these results, the invariance between the parameters of the items was evaluated as a function of the adjusted one-factor structure. The TLI and CFI indicators of the corroborated model were compared, reflecting three sample sets (sample of the first collection, second collection and third collection) as well as the sample of health, bank and education workers. (Damásio, 2013; Sass, 2011; Moroco, 2010; Hair, Anderson, Tatham, & Black, 2005).

Thus, the following results were observed: based on the reductions in the CFI value (which is expected to be $\Delta < 0.01$, to ensure the two-factor structure in the specified groups), it is noteworthy that in all samples, the CFI corresponded to what is indicated in the literature (namely: CFIcurrent sample = 0.99, Samplefirst collection = 0.99 and CFIsecond collection = 0.99; CFIhealth sample = 0.98, CFIeducation sample = 0.98 and CFIbanking sample = 0.98; WED to the $_{\text{current sample}}$ = 0.99, TLIfirst collection = 0.99, TLIsecond collection = 0.99; TLIhealth sample = 0.99, TLIeducation

sample = 0.98 and TLIbanking sample = 0.98. Thus, it is possible to highlight that these indicators prove that the one-factor model, based on the appropriate psychometric scores, does not vary even if the samples compared are separated separately.

Having assured that EPSO was reliable, corroborating the one-factor structure already provided by national and international authors on the subject; It sought to verify the convergent validity by associating the construct of positive psychological capital and divergent associated with intention and turnover at work. It should be noted that the main interest in these constructs refers to the professional's motivational capacity both from a personal perspective (i.e., the emotional investment that the professional makes for himself or herself in order not to get sick, developing a positive psychological capital) and organizational (this refers to the behavior that a professional may present in the sense of voluntarily wanting to disconnecting from the organization to which he works – which, approached as an intention to turnover).

In order to respond to this objective, a Pearson correlation was performed between the variables, for which he hypothesized a positive and significant relationship between EPSO and positive psychological capital and negative relationship with turnover intention. Thus, when performing this calculation, what was expected was confirmed: the EPSO (total score) was positively and significantly related to positive psychological capital ($r = 0.48$; $p < 0.01$) and, negatively, to turnover intention (IRT) ($r = -0.36$, $p < 0.01$).

In this stage of the dissertation results, the level of EPSO in percentage was evaluated based on the distribution of tertiles. For this, a descriptive analysis was carried out, establishing the cutoff point in three levels (low, moderate and high). Table 6 shows that the highest frequency was found for the moderate level of organizational support.

Table 6: Percentile scores of EPSO levels

EPSO level	Frequency	%	Variation (points)
BAIXO	189	31	11 a 27
MODERATE	213	36	28 a 38
HIGH	197	32	39 a 62
Total	599	100,0	11 a 62

From these scores, the criterion evaluation was carried out, which considered the characteristics of each sample (bank employees, teachers, health), length of service and type of organization. Table 7 highlights that the highest percentage was for the participants in education, who indicated that they had observed low organizational support.

In the gender criterion, men had higher percentages in the moderate EPSO; However, it stands out that women, even with a lower percentage, remained in the recognition of the perception of being from moderate to high organizational support. When the age criterion was highlighted, younger workers (23 to 37 years old) had higher percentages in the high perception of organizational support. And as for the professional, bank employees were the ones with the highest scores.

Table 7: Frequency association between type of organisation and level of EPSO

Sampling characteristic	EPSO level			Statistics	
	Baixo	Moderate	High	χ^2/gl	p-value
Bank	8%	56%	36%	458,76/4	0,01
Health	0	37%	63%		
Education	**86%**	14%	0		
Sex	Baixo	Moderate	High		
Male	35%	**40%**	25%	30,89/2	0,05
Female	30%	35%	35%		
Age	Baixo	Moderate	High		
23 to 37 years old	0	43%	**57%**	4,57/4	0,05
38 to 44 years old	7%	48%	45%		
45 to 68 years old	3%	48%	49%		

Table 7 shows that the criterion validity followed very comprehensive directions, with the working man perceiving that the organization presented him with moderate support; a condition that can be understandable, because, although the decrease in the (dis)valuation of women in the world of work is justifiable and that they have a much more direct insertion in professional terms than ten years ago, in this supposed equality (Formiga, 2007), there are some differences, for example: in the study by Mesquita Filho et. al. (2018), he observed the existence of prejudice against women among Primary Health Care workers and that benevolent sexism presented higher percentages; there is a practically equal distribution between EPSO's average scores, but men still perceive themselves to be more valued, even if moderately.

Another curiosity of this result is the greater the appreciation of younger workers; It is possible that due to initiation or little experience in the world of work, they will develop a still idealizing perception about work and interpersonal relationships in the workplace, but, considering this measure, in terms of psychological assessment, this age group could be a good opportunity for training and developing a functional and organizational identity.

The main objective of this chapter was to address the lack of studies that replicated and evaluated EPSO in post-social isolation workers, based on psychometric indicators. This instrument, based on a theoretical perspective on the perception that the worker has with regard to the appreciation and support that the organization offers him, considered both the conceptual and empirical dimensions of the internal dynamics of contemporary organizations.

In addition, based on Brazilian research on EPSO (cf. Siqueira, 2014; Formiga, Fleury & Souza, 2014), this study proposes a solid and reliable psychometric evidence to assess the problems of the relationship between organization and worker, as well as the valuation of the latter in the labor system, in the field of organizational and work psychology.

In this sense, highlighting the importance of the perception of organizational support through the worker's perspective reflects the theoretical perspective of this construct, centered on the theory of reciprocity. This leads us to reflect on how the worker-organization relationship is not built in a labor vacuum. It is crucial to emphasize the participation of both dimensions in the world of work. Organization and worker do not act in isolation and are not only promoters of healthy and profitable productivity (see Formiga, Freire & Fernandes, 2019).

Another important condition for the development of this dissertation refers to the lack of studies in the databases of Brazilian and South American scientific production that address EPSO as a proposal for psychological testing based on empirical evidence. Only studies that conducted exploratory, confirmatory and predictive statistical analyses were identified, considering EPSO as a determining factor of productive dynamics and quality of life at work (Siqueira, 1995; Formiga, Fleury & Souza, 2014; Formiga, Freire, Azevedo & Faria, 2020; Teixeira, 2020; Paula et al., 2021; Nogueira & Oliveira, 2022).

Considering the psychometric indicators, specifically, when verifying the statistical analyses of the Classical Theory of Tests (TCT) regarding the quality of the EPSO items, it was observed that the discrimination and representativeness indices guaranteed the proposal of factorialization of EPSO (see Pasquali, 2011; Hutz, Bandeira & Trentini, 2015; Piton-Gonçalves & Almeida, 2018; Gomes, 2020). This analysis revealed that no item was excluded from the scale, suggesting that the participants were able to recognize the importance of the measure in their respective work environment, which reinforces the theoretical-empirical perspective.

In the exploratory factor analysis, this approach was based on the IRT, and factor scores above 0.50 and internal consistency indicators (evaluated from Cronbach's alpha) were observed that supported the quality and reliability of the measure. All items presented alpha values ≥ 0.70, highlighting that the measure evaluated the construct proposed by the aforementioned authors, maintaining the original factorial structure adapted in Brazil (cf. Siqueira, 1995) and corroborating the indicators of confirmatory analyses with Brazilian samples (cf. Formiga, Fleury & Souza, 2014; Formiga, Freire & Fernandes, 2019).

In the confirmatory evaluation, the theoretically suggested item-factor direction was maintained and confirmed in unifactorial form, which provided theoretical and empirical security in the samples of workers surveyed. Therefore, it is possible to highlight the correspondence between the definition and factorialization of the construct used in this study when comparing it with the

studies mentioned. These analyses ensured the psychological evaluation of the variables in relation to the experience of these professionals and their identification with the employment relationship offered by the organization, which can influence the system and work environment experienced by them.

The reflection presented above has its evaluative guarantee when the convergence and divergence of the constructs was verified through the psychometric indicators of EPSO. This suggests that, when considering the worker's bond and involvement in the organization, as highlighted by Formiga, Fernandes *et al*. (2021; cf. Formiga, Pereira, & Estevam, 2020; Formiga, Nascimento *et al*., 2021), it is likely that the employee will become more motivated, developing a sense of appreciation and sensitivity towards the organization.

In other words, when the worker perceives that there is organizational support, he not only assimilates and develops emotional potentialities applied to his work dynamics (positive psychological capital), but also has less intention of turnover, either in terms of thoughts or desire to leave (in the case of private organizations) or to request a change of function or work sector (in the case of public organizations) in his work environment. A more valued organizational dynamic, focusing on the factor of functional reciprocity, when well implemented, becomes important for the discovery and maintenance of organizational talents and to increase their productivity.

Despite these findings, it is necessary to consider a very significant piece of information in the evaluation of EPSO in this dissertation and that was not evaluated in the other studies: by identifying in the confirmatory analysis the empirical criterion for comparing the differences in the statistical indicators CFI and TLI, for which the literature establishes a difference of 0.01 (Hair, Tatham, Anderson & Black, 2005; Marôco, 2010); It was noted that this condition was confirmed. This allows us to infer that, regardless of the time of collection and the sample of workers, even with similar characteristics throughout Brazil, the evaluation of the factorial structure revealed a remarkable approximation between the psychometric scores for the construct.

The factor distribution was very close to those observed in samples with other types of workers in Brazilian studies mentioned in the previous sections of this dissertation. Therefore, the theoretical proposal addressed and the existence of a psychological assessment standard, based on the definition of the perception of organizational support applied to the work environment of the study participants, ensure that the theory and the measure can be applied to workers.

Finally, in relation to the evaluation of criteria, it was possible to verify how well EPSO is able to measure professional characteristics, gender and age. This contribution would be relevant to a specific stage regarding the training and functional development of workers in relation to organizational perception and its application in the productive functional process and functional identity in the organization.

FINAL CONSIDERATIONS

Based on the results of this dissertation, it can be stated that the main ones were achieved, especially in relation to the quality of the objectives of the measure used. Thus, this dissertation offers an evaluative solution that, although not unique, is considered an important response in the composition of studies and proposals for intervention in the quality of life at work and of the worker.

The results suggest that the quality of work is not limited only to a good economic structure and comfort in the work environment (although these aspects are also important). The focus of this dissertation is to highlight the valorization of the worker as a human being and to recognize that his qualification is closely linked to the organizational dynamics.

In this sense, the importance of this dissertation lies in the reflection on the need for a humanized organization and engaged workers, along with the concern of managers to develop work practices that contribute to a healthy and productive environment.

Although these results have shown similarity and confirmed the hypothesis raised, some considerations for future studies should be made: 1) to verify the relationship of these same variables when involving professionals in different countries; 2) to propose a theoretical model that evaluates the association of this construct with organizational culture and talent retention, in order to investigate whether, in fact, by perceiving that the organization values and promotes the functional bond, the worker will remain healthy and/or continue in the organization.

REFERENCES

1. Akgunduz, Y., Alkan, C., & Gok, O. (2018). Perceived organizational support, employee creativity and proactive personality: The mediating effect of meaning of work. *Journal of Hospitality and Tourism Management, 34*, 105-114.

2. Al-Hussami, M., Hammad, S., & Alsoleihat, F. (2018). The influence of leadership behavior, organizational commitment, organizational support, subjective career success on organizational readiness for change in healthcare organizations. *Leadership in Health Services*.

3. Almeida, F. D. M. (2019). As relações de trabalho na modalidade homeoffice em empresas de bens de consumo. (Dissertação de Mestrado, Pontifícia Universidade Católica de São Paulo). Disponível em: https://tede2.pucsp.br/handle/handle/22050.

4. Almeida, L. A. L., Formiga, N. S., Junior, J. I. A., & Sousa, P. M. de. (2020). Quanto mais se sabe, mais segurança tem! A importância da gestão do conhecimento na condução dos resíduos sólidos de quimioterapia. *Psicologia e Saúde em Debate, 6*(2), 430–442. https://doi.org/10.22289/2446-922X.V6N2A28.

5. Aselage, J., & Eisenberger, R. (2008). Perceived organizational support and psychological contracts: A theoretical integration. *Journal of Organizational Behavior, 24*, 491-509.

6. Assaf Neto, A. (2005). Custo de Capital e Criação de Valor. In A. Assaf Neto, *Finanças Corporativas e Valor* (2ª ed.). São Paulo: Atlas.

7. Associação Nacional de Pesquisa e Pós-graduação em Psicologia – ANPEPP. (2011). Contribuições para a discussão das Resoluções CNS nº. 196/96 e CFP nº 016/2000. Recuperado em 02 de setembro de 2011, de http://www.anpepp.org.br/XIISimposio/Rel_ComissaoEticasobre_Res_CNS_e_CFP.pdf2000.

8. Aube, C., Rousseau, V., & Morin, E. M. (2007). Perceived organizational support and organizational commitment: The moderating effect of locus of control and work autonomy. *Journal of Managerial Psychology, 22*(5), 479-495.

9. Barros, V. V., Kozase, E. H., Souza, I. C. W., & Ronzani, T. M. (2014). Validity evidence of the Brazilian version of the five-facet mindfulness questionnaire (FFMQ). *Psicologia: Teoria e Pesquisa, 30*(3), 317-327.

10. Bilich, F., Silva, R., & Ramos, P. (2006). Análise de flexibilidade em economia da informação: Modelagem de equações estruturais. *Revista de Gestão da Tecnologia e Sistemas de Informação, 3*(2), 93-122.

11. Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11*(3), 230-241.

12. Byrne, B. M. (1989). *A primer of LISREL: Basic applications and programming for confirmatory factor analytic models*. Springer-Verlag.

13. Byrne, Z. S., & Hochwarter, W. A. (2008). Perceived organizational support and performance: Relationships across levels of organizational cynicism. *Journal of Managerial Psychology, 23*(1), 54-72.

14. Caesens, G., Stinglhamber, F., & Ohana, M. (2016). Perceived organizational support and well-being: A weekly study. *Journal of Managerial Psychology, 31*(7), 1214-1230.

15. Chong, H., White, R. E., & Prybutok, V. (2001). Relationship among organizational support, JIT implementation, and performance. *Industrial Management & Data Systems, 101*(6), 273-280.

16. Conselho Nacional de Saúde – CNS. (1996). Diretrizes e normas regulamentadoras de pesquisas envolvendo seres humanos. Recuperado em 02 de setembro de 2011, de http://conselho.saude.gov.br/resolucoes/reso_96.htm.

17. Creswell, J. W., & Clark, V. L. P. (2013). *Pesquisa de métodos mistos* (M. F. Lopes, Trad.; D. da Silva, Rev. téc.; 2ª ed.). Porto Alegre: Penso.

18. Cunha, S. E. (1994). *A noção de validade de testes psicológicos*. CEPA.

19. Dawley, D. D., Andrews, M. C., & Bucklew, N. S. (2008). Mentoring, supervisor support, and perceived organizational support: What matters most? *Leadership & Organization Development Journal, 29*(3), 235-247.

20. Diógenes, L. C., Paschoal, T., Neiva, E. R., & Meneses, P. P. M. (2016). Intenção de rotatividade e percepção de suporte organizacional em um órgão público federal. *Revista do Serviço Público, 67*(2), 147-172.

21. Dweck, C. S. (2017). *Mindset: A nova psicologia do sucesso*. Editora Padrão.

22. Eisenberger, R., Huntington, R., Hutchison, S., & Sowa, D. (1986). Perceived organizational support. *Journal of Applied Psychology, 71*(3), 500-507. http://classweb.uh.edu/eisenberger/perceived-organizational-support/

23. Estivalete, V., Andrade, T., Faller, L., Stefanan, A., & Souza, D. (2016). Suporte social e suporte organizacional como antecedentes do bem-estar no trabalho: A perspectiva de colaboradores de uma empresa de logística ferroviária. *Revista de Administração da UNIMEP, 14*(2). https://doi.org/10.15600/1679-5350/rau.v14n2p31-56

24. Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191.

25. Fleury, L. F. D. O., et al. (2017). Escala de Percepção de Suporte Organizacional: Evidência da estrutura fatorial em trabalhadores brasileiros. *Psicologia em Pesquisa, 11*(1), 1-2. https://doi.org/10.24879/201700110010033

26. Flick, U. (2013). *Introdução à metodologia de pesquisa: Um guia para iniciantes*. Porto Alegre: Penso.

27. Formiga, N. S., Nascimento, F. S. da, Franco, J. B. M., Oliveira, H. C. C., Valin, C. G. P., Prochazka, G. L., Lima, R. O. de O., Beserra, T. K. P., & Lima, E. A. de S. A. (2021). Verificação empírica da escala de intenção de rotatividade: Validade de construto, estrutura fatorial e invariância fatorial em trabalhadores. *Pesquisa, Sociedade e Desenvolvimento, 10*(3), e9910313084. https://doi.org/10.33448/rsd-v10i3.3084

28. Formiga, N. S. (2015). Inventário de sexismo ambivalente: Um estudo a partir da modelagem de equação estrutural. *Revista de Psicologia, 2*(1), 104-116. Recuperado de

http://www.periodicos.ufc.br/psicologiaufc/article/view/79

29. Formiga, N. S., et al. (2021). Apoio organizacional, capital social e atitudes inovadoras: Um estudo correlacional entre trabalhadores da cidade de Natal-RN. *Pesquisa, Sociedade e Desenvolvimento, 10*(3), e55710313753. https://doi.org/10.33448/rsd-v10i3.13753

30. Formiga, N. S., et al. (2021). Invariância fatorial, sensibilidade e diferenças da medida de ansiedade, estresse e depressão em trabalhadores brasileiros. *Pesquisa, Sociedade e Desenvolvimento, 10*(7), e26910715572. https://doi.org/10.33448/rsd-v10i7.15572

31. Formiga, N. S., et al. (2021). Suporte organizacional e assédio moral no trabalho: Correlatos e diferenças entre funcionários da área de saúde e educação de um município do Estado da Paraíba, Brasil. *Psicologia e Saúde em Debate, 7*(1), 54–76. https://doi.org/10.22289/2446-922X.V7N1A5

32. Formiga, N. S., Franco, J. B. M., Neto, A. D. de S., Guimarães, W. N. C., Oliveira, M. A. P., Pereira, G. A., & Estavam, I. D. (2019). A medida de capital psicológico positivo: Evidência da invariância fatorial em trabalhadores de distintas profissões em João Pessoa-PB e Natal-RN. *Psicologia e Saúde em Debate, 5*(1), 19–36. https://doi.org/10.22289/2446-922X.V5N1A3

33. Formiga, N. S., Freire, B. G. de O., Azevedo, I. M., & Faria, S. de S. (2020). Correlatos entre o suporte organizacional, capital psicológico no trabalho e expectativa de futuro: Um estudo com trabalhadores brasileiros. *Research, Society and Development, 9*(6), e155963486. https://doi.org/10.33448/rsd-v9i6.3486

34. Formiga, N. S., Freire, B. G. O., & Fernandes, A. (2019). Evidência métrica de construto e invariância fatorial da escala de percepção de suporte organizacional em trabalhadores brasileiros. *Revista de Gestão e Secretariado, 10*(2), 194-221.

35. Formiga, N. S., Pereira, G. A., & Estevam, I. D. (2020). Proposta de modelo mediacional entre suporte organizacional, capital psicológico e saúde geral em enfermeiros de um hospital público. *Psicologia Revista, 29*(2), 375–403. https://doi.org/10.23925/2594-3871.2020v29i2p375-403

36. Formiga, N. S., Pereira, G. A., & Estevam, I. D. (2020). Proposta de modelo mediacional entre suporte organizacional, capital psicológico e saúde geral em enfermeiros de um hospital público. *Psicologia Revista, 29*(2), 375–403. https://doi.org/10.23925/2594-3871.2020v29i2p375-403

37. Formiga, N. S., Andrade Junior, I. I. D., & Almeida, L. A. L. (2022). Cultura organizacional e gestão do conhecimento em trabalhadores de organizações públicas e privadas. In R. P. Silveira (Org.), *Temáticas Contemporâneas da Sociedade, seus Aspectos e Realidades* (pp. 64-89). Formiga - MG: Editora Union.

38. Formiga, N. S., Franco, J. B. M., Prochazka, G. L., & Beserra, T. K. P. (2021). Quando as crenças influenciam a estabilidade e manutenção emocional no ambiente de trabalho? Proposta de um modelo teórico entre cultura organizacional, capital psicológico positivo e transtorno emocional em trabalhadores. In M. C. Zago (Org.), *Saúde mental no Século XXI: Indivíduo e coletivo pandêmico: Volume 2* (pp. 97-111). Guarujá - SP: Editora Científica Digital.

39. Formiga, N., Freire, B. G. O., Estevam, I. D., Fleury, L. F. O., & Souza, M. A. (2018). A influência do suporte organizacional no autoconceito profissional em trabalhadores de organizações públicas e privadas. *Eureka: Revista de Psicologia, 15*(1), 78-95.

40. Formiga, N. S., et al. (2019). Suporte organizacional, engajamento e espiritualidade no trabalho:

Verificação empírica de um modelo teórico concorrente em organizações brasileiras. *Boletim - Academia Paulista de Psicologia, 39*(97), 247-259. Recuperado em 28 de maio de 2023, de http://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S1415-711X2019000200010&lng=pt&tlng=pt

41. Formiga, N., Fleury, L. F. de O., & Souza, M. A. de. (2014). Evidências de validade da escala de percepção de suporte organizacional em funcionários de empresa pública e privada. *Estudos Interdisciplinares em Psicologia, 5*(2), 60-76. https://dx.doi.org/10.5433/2236-6407.2014v5n2p34

42. Formiga, N. S., Fernandes, A. J., Freire, B. G. O., Franco, J. B. M., Oliveira, H. C. C., Prochazka, G. L., Valin, C. G. P., Grangeiro, S. R. A., & Estevam, I. D. (2021). Apoio organizacional, capital social e atitudes inovadoras: Um estudo correlacional entre trabalhadores da cidade de Natal-RN. *Pesquisa, Sociedade e Desenvolvimento, 10*(3), e55710313753. https://doi.org/10.33448/rsd-v10i3.13753

43. Garcia, S. (2021). *Gestão 4.0: Disrupção e pandemia*. São Paulo: Blucher.

44. Germer, C. K., Siegel, R. D., & Fulton, P. R. (2015). *Mindfulness e psicoterapia*. Artmed Editora.

45. Gomes, S. C. (2020). *Desempenho de cotistas e não-cotistas em prova de vestibular: Uma análise psicométrica*. Dissertação (Mestrado em Modelagem Computacional do Conhecimento) – Universidade Federal de Alagoas. Instituto de Computação.

46. Hair, J. F., Tatham, R. L., Anderson, R. E., & Black, W. (2005). *Análise multivariada de dados*. Porto Alegre: Bookman.

47. Habtoor, N. (2016). Influence of human factors on organisational performance: Quality improvement practices as a mediator variable. *International Journal of Productivity and Performance Management, 65*(4), 460-484.

48. Hirayama, M. S., Milani, D., Rodrigues, R. C. M., Barros, N. F. D., & Alexandre, N. M. C. (2014). A percepção de comportamentos relacionados à atenção plena e a versão brasileira do Freiburg Mindfulness Inventory. *Ciência & Saúde Coletiva, 19*, 3899-3914.

49. Husman, J., & Lens, W. (1999). The role of the future in student motivation. *Educational Psychologist, 34*(2), 113-125.

50. Hutz, C. S., Bandeira, D. R., & Trentini, C. M. (2015). *Psicometria*. Artmed Editora.

51. Hutz, C. S., Bandeira, D., Trentini, C., & Vazquez, A. C. S. (2019). *Avaliação no contexto organizacional e do trabalho*. Porto Alegre: Artmed.

52. Jain, A. K., Giga, S. I., & Cooper, C. L. (2013). Perceived organizational support as a moderator in the relationship between organizational stressors and organizational citizenship behaviors. *International Journal of Organizational Analysis, 21*(3), 313-334.

53. Jawahar, I. M., & Hemmasi, P. (2006). Perceived organizational support for women's advancement and turnover intentions: The mediating role of job and employer satisfaction. *Women in Management Review, 21*(8), 643-661.

54. Jöreskog, K. G., & Sörbom, D. (1989). *LISREL 7 user's reference guide*. Chicago: SPSS.

55. Kabat-Zinn, J., & Hanh, T. N. (2009). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness*. New York: Dell Publishing.

56. Kanaane, R. (2011). *Comportamento humano nas organizações: O homem rumo ao século XXI*. São Paulo: Atlas. (2ª ed.)

57. Kelloway, E. K. (1998). *Using LISREL for structural equation modeling: A researcher's guide*. Thousand Oaks, CA: Sage Publications.

58. Kogut, B., & Zander, U. (1996). What firms do? Coordination, identity, and learning. *Organization Science, 7*(5), 502-518.

59. Kurtessis, J., Eisenberger, R., Ford, M., Buffardi, L., Louis, C., Stewart, K., & Adis, C. (2017). Perceived organizational support: A meta-analytic evaluation of organizational support theory. *Journal of Management, 43*(6), 1854-1884.

60. Limongi-França, A. C., & Rodrigues, A. L. (2009). *Stress e trabalho: Uma abordagem psicossomática* (4ª ed.). São Paulo: Atlas.

61. Melo Neto, F. P. (2008). *História do pensamento administrativo* (2ª ed.). Rio de Janeiro: Fundação CECIERJ.

62. Mesquita Filho, M., Marques, T. F., Rocha, A. B. C., Oliveira, S. R. de, Brito, M. B., & Pereira, C. C. Q. (2018). O preconceito contra a mulher entre trabalhadores da Atenção Primária em Saúde. *Ciência & Saúde Coletiva, 23*(11), 3491–3504. https://doi.org/10.1590/1413-812320182311.00132017

63. Nogueira, A. P. S., & Oliveira, Á. de F. (2022). Impacto da percepção de suporte organizacional e capital psicológico no bem-estar no trabalho. *Psicologia: Ciência e Profissão, 42*, e238418. https://doi.org/10.1590/1982-3703003238418

64. Oliveira, H. C. C., et al. (2021). Estudo correlacional entre suporte organizacional, danos relacionados ao trabalho e qualidade de vida em trabalhadores brasileiros. *Pesquisa, Sociedade e Desenvolvimento, 10*(8), e36810817380. https://doi.org/10.33448/rsd-v10i8.17380

65. Oliveira-Castro, G. A., Pilati, R., & Borges-Andrade, J. E. (1999). Percepção de suporte organizacional: Desenvolvimento e validação de um questionário. *Revista de Administração Contemporânea, 3*(2), 29-51. https://doi.org/10.1590/S1415-65551999000200003

66. Paschoal, T. (2008). *Bem-estar no trabalho: Relações com suporte organizacional, prioridades axiológicas e oportunidades de alcance de valores pessoais no trabalho* (Tese de Doutorado). Universidade de Brasília, Brasília, Distrito Federal, Brasil.

67. Pasquali, L. (1996). *Teorias e métodos de medida em ciências do comportamento*. Brasília: INEP.

68. Pasquali, L. (2011). *Psicometria: Teoria dos testes na psicologia e na educação*. Petrópolis: Vozes.

69. Paula, N. H. M. M. de, Formiga, N. S., Silva, A. K. L. da, Franco, J. B. M., Oliveira, H. C. C., Prochazka, G. L., Nascimento, R. L., Grangeiro, S. R. A., Valin, C. G. P., Beserra, T. K. P., & Almeida, L. A. L. (2021). The better bond I have with my organization, the healthier I am! Correlates between organizational support and work-related injuries. *Research, Society and

Development, 10*(6), e15710615323. https://doi.org/10.33448/rsd-v10i6.15323

70. Piton-Gonçalves, J., & Almeida, A. M. (2018). Análise da dificuldade e da discriminação de itens de Matemática do ENEM. *REMAT: Revista Eletrônica da Matemática, 4*(2), 38–53. https://doi.org/10.35819/remat2018v4i2id3060

71. Puente-Palacios, K., & Martins, M. C. F. (2013). Gestão do clima organizacional. In L. O. Borges & L. Mourão (Orgs.), *O trabalho e a organização: Atuações a partir da psicologia* (pp. 253-278). Porto Alegre: Artmed.

72. Randeree, K., & Al Youha, H. (2009). Strategic management of performance: An examination of public sector organizations in the United Arab Emirates. *International Journal of Knowledge, Culture and Change Management, 9*(4), 123-134.

73. Richardson, H. A., Yang, J., Vanderberg, R. J., Dejoy, D. M., & Wilson, M. G. (2008). Perceived organizational support's role in stressor-strain relationships. *Journal of Managerial Psychology, 23*(7), 789-810.

74. Silva, R. S., Cappellozza, A., & Costa, L. V. (2015). O impacto do suporte organizacional e do comprometimento afetivo sobre a rotatividade. *Revista de Administração IMED, 4*(3), 314-329.

75. Silveira, R. P. (Ed.). (2022). *Temáticas contemporâneas da sociedade, seus aspectos e realidades* (Vol. 2). Formiga: Editora Union.

76. Siqueira, M. M. M. (1995). Antecedentes de comportamentos de cidadania organizacional: A análise de um modelo pós-cognitivo. (Tese de Doutorado). Universidade de Brasília, Brasília.

77. Siqueira, M. M. M. (2003). Proposição e análise de um modelo para comportamentos de cidadania organizacional. *Revista de Administração Contemporânea, 7*(SPE), 165-184. https://doi.org/10.1590/S1415-65552003000500009

78. Siqueira, M. M. M. (2009). *Medidas do comportamento organizacional: Ferramentas de diagnóstico e de gestão*. Porto Alegre: Artmed Editora.

79. Siqueira, M. M. M., et al. (2008). *Medidas do comportamento organizacional*. Porto Alegre: Artmed.

80. Spector, P. (2002). *Psicologia nas organizações*. São Paulo: Saraiva.

81. Tabachnick, B. G., & Fidell, L. S. (1996). *Using multivariate statistics*. Needham Heights, MA: Allyn & Bacon.

82. Tamayo, N., & Abbad, G. S. (2006). Autoconceito profissional e suporte à transferência e impacto do treinamento no trabalho. *Revista de Administração Contemporânea, 10*(3), 09-28.

83. Teixeira, L. F. C. (2022). *A influência do suporte organizacional e do capital social organizacional no trabalho remoto em tempos de pandemia* (Tese de Mestrado). Instituto Superior de Contabilidade e Administração do Porto, Portugal.

84. Tsai, C.-Y., Horng, J.-S., Liu, C.-H., & Hu, D.-C. (2015). Work environment and atmosphere: The role of organizational support in the creativity performance of tourism and hospitality

organizations. *International Journal of Hospitality Management, 46*, 26-35. https://doi.org/10.1016/j.ijhm.2015.01.009

85. Van De Vijver, F., & Leung, K. (1997). *Methods and data analysis for cross-cultural research*. Thousand Oaks, CA: Sage Publications.

86. Wagner III, J. A., & Hollenbeck, J. R. (2000). *Comportamento organizacional*. São Paulo: Saraiva.

87. Zanelli, J. C., & Bastos, A. V. B. (2004). Inserção profissional do psicólogo em organizações e no trabalho. In J. C. Zanelli, J. E. Borges-Andrade, & A. V. B. Bastos (Orgs.), *Psicologia, Organizações e Trabalho no Brasil* (pp. 466-491). Porto Alegre: Artmed.

Abiotic factors and the growth of cyanobacteria in surface water reservoirs in the state of Pernambuco

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ABSTRACT

Objective: Analyze the relationship between physical-chemical and climatic abiotic factors in relation to the occurrence of cyanobacteria genera in surface water reservoirs used for public supply in the state of Pernambuco.

Literature Review: Information is presented on cyanobacteria and the consequences of the release of untreated effluents on the eutrophication of surface waters with effects on the growih of cyanobacteria and consequences for aquatic organisms and humans and the climate in regions of Pernambuco where water reservoirs are located,

Method: Quali-quantitative descriptive and exploratory approach to the analysis of abiotic variables (pH, CE., Turbidity, Color, Calcium, Magnesium, Chlorides, Sulfate, Nitrogen, Phosphate, Alkalinity, Hardness, Iron, Manganese, Aluminum and rainfall) and biotic (Cyanobacteria density), collected from the Pernambuco Sanitation Company — COMPESA. The samples were from eutrophic freshwater reservoirs in Pernambuco collected between 2010 and 2020.

Results and Discussion: The most frequent genus of cyanobacteria was Raphidiopsis/Cylindrospermopsis, found abundantly in all reservoirs, where the increase in color, turbidity and pH were positively correlated with the presence of Microcystis and Raphidiopsis/Cylindrospermopsis, and negatively with the increase in toughness. A positive correlation was also observed between hardness and the increase in Planktorhrix density.

Research Implications: Generate guidelines for drinking water supply presenting tools for understanding abiotic conditions that influence the growth of cyanobacteria, in order to outline control or services, ‘mitigation strategies in ETAs.

Originality/Value: Generate useful information in the evaluation of abiotic parameters and cyanobacteria density, observed over a long period (10 years), showing positive/negative correlations in surface waters used for human consumption.

Keywords: Phytoplankton, Limnology, Water quality, Dam.

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INTRODUCTION

Water, a finite and increasingly limited resource, has suffered increasing stress due to high demand, climate change and pollution (Li & Wu, 2024). Anthropogenic activities that play an role in the exaggerated proliferation of toxic cyanobacteria include the construction of dams, river diversions and deforestation (Igwaran et. al., 2024) and those caused by the discharge of domestic and industrial effluents (Memamalini er a/ ., 2017). High biomass of cyanobacteria in fresh waters occurs due to abiotic factors such as excessive amounts of nutrients, including phosphorus and nitrogen, high temperatures, light intensity, and low depth of water beds, associated with biotic factors (Vanderley er al ., 2021).

Effluents released without treatment or with deficient treatment have a high content of organic compounds and combined with the high temperatures in Brazilian territory. they encourage the proliferation of cyanobacteria in water reservoirs used for public supply. In high concentrations, cyanobacteria impart flavor and odor to water, and their presence in treatment systems leads to lower decantation efficiency and increased filter overload (Bittencourt- Oliveira & Molica , 2003). The situation is made worse by the potential of cyanobacteria to produce metabolites that are toxic to aquatic beings and humans, called cyanotoxins (Carmichael ez al ., 2001, Yuan & Yoon , 2021)

Reservoirs located close to large urban centers are generally more prone to eutrophication, constituting favorable ecosystems for the expansion of algal and cyanobacterial blooms. According to Paerl & Paul (2012), these environments are the most appropriate for the growth of cyanobacteria, which are normally found in neutral alkaline waters (pH of 6.0 to 9.0), at temperatures between 15°C and 30°C and with high concentrations of nutrients, particularly nitrogen and phosphorus. However, other factors, such as the volume of water in reservoirs and the availability of light (transparency and turbidity) in the water column, significantly influence the structure and dynamics of the cyanobacteria community and its toxins in an aquatic ecosystem (Santos Silva et. al. , 2020).

Thus, the present work focused on the frequent episodes of blooms that occurred in four surface water reservoirs used for public supply in the State of Pernambuco, using historical monitoring data from the Quality Control of the Companhia Pernambucana de Saneamento (COMPESA), and rainfall. from the Pernambuco Agronomic Institute (IPA, 2024), in order to enable a better understanding of the interactions between the cyanobacteria community and abiotic physical, chemical/physical-chemical water and rainfall climatic variables, enabling a better understanding of the precursor factors of blooms that can serve as a basis for preventive actions.

LITERATURE REVIEW

Cyanobacteria are oxygen-producing photosynthetic bacteria that account for much of aquatic productivity. However, some freshwater cyanobacteria can produce various toxins, potentially toxic

to humans and other animals (Yuan & Yonn , 2021). The poisoning of wild animals, domestic animals and fish by cyanotoxins is a corcern during blooms, and the toxins may be neurotoxic , hepatotoxic or paralyzing shellfish. The most emblematic human case occurred in Brazil, in the city of Caruaru-PE in 1996, when an outbreak of acute liver failure in a to hemodialysis center was reported in 116 patients, of whom 76 died, with 52 deaths attributed a syndrome known worldwide as “Caruaru Syndrome”. Subsequent phytoplankton samples from the city's water supply reservoir demonstrated that toxigenic cyanobacteria were the main phytoplankton group , representing 99% of the total phytoplankton density (Carmichael er al ., 2001; Azevedo et al , 2002).

The production of cyanotoxins by cyanobacteria is affected by changes in abiotic factors, such as nutrients, light and water temperature (Ferrandes ef al. , 2009; Vanderley er al .. 2021). Although in some conditions the number of cyanobacteria is considered safe, there may be potentially toxic blooms, whose scientific gap needs to be filled, with the understanding of what are the “triggers” that can lead to the producticn of cyanotoxins , as well as the indication of which conditions environmental conditions are the most conducive to blooms in reservoirs. According to Glibert & Burkholder (2011), many potentially toxic blooms are associated with increased eutrophication. However, not all species respond equally to changes in to the environment. This is the great challenge to actually determine which blooms are related eutrophication, and to try to understand why some species proliferate under specific nutrient conditions and abiotic variables.

According to Vanderley er al . (2021) the drivers of persistent blooms are less understood when conditions such as light, temperature and nutrients favor year-round cyanobacteria growth, especially in regions with recurring periods of drought. Reports from the Minas Gerais Sanitation Company (COPASA) showed toxic and non-toxic blooms between 2005 and 2012, with a predominance of toxic strains fron: October 2005 onwards (Jardim ez al, 2014).

Regarding climatic conditions, the state of Pernambuco is located in the Intertropical Zone, with a predominance of high temperatures whose climate varies due to the interference of the relief and air masses. Three major rainfall regimes are observed depending on the region. In Zona da Mata and the Metropolitan Region of Recife, where the cities of Lagoa do Carro and São Lourengo da Mata are located, respectively, the autumn-winter rainy season (February to July) is predominant, with periods of drought and marked maritime influence. ; In the Agreste region, where the cities of Belo Jardim and Garanhuns are located, climates and precipitation can be seen that vary depending on the relief; and, in the Sertao, there is a shortage of rainfall, which is concentrated in a short period of three months, from January to March (Lucena, 2023).

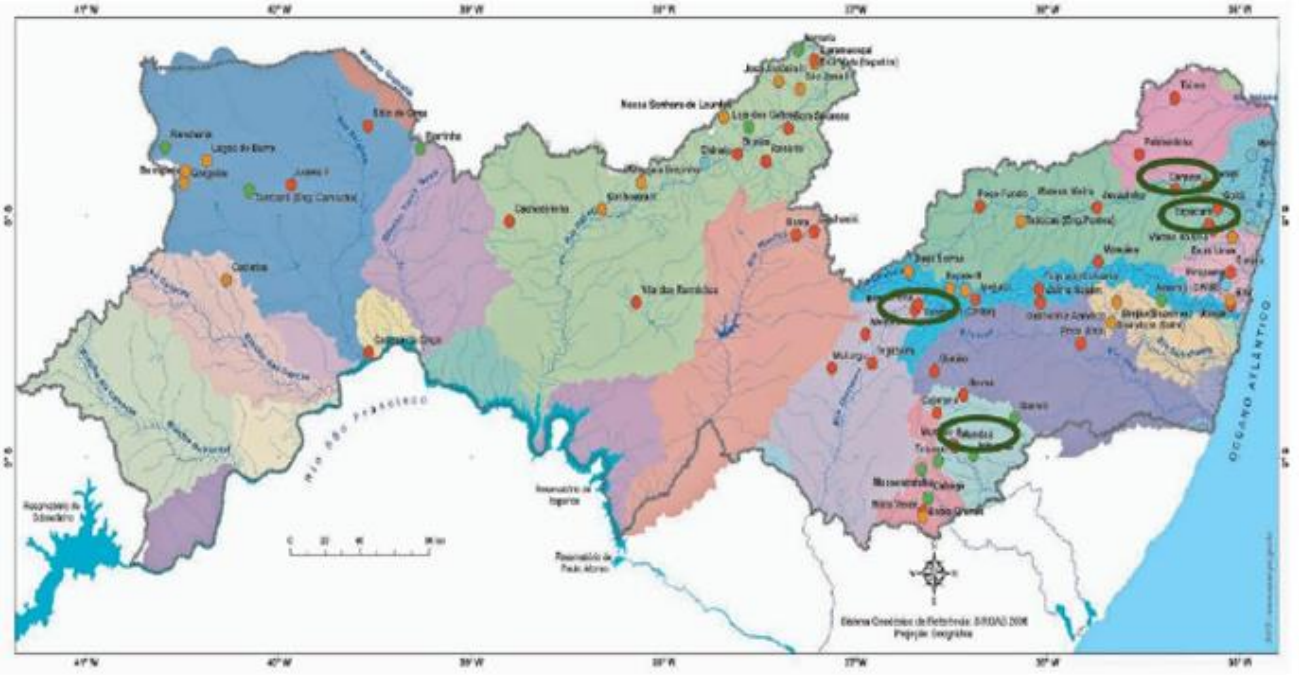
METHODOLOGY

This is a quali -quantitative, descriptive and exploratory approach with the analysis of data on abiotic variables (pH, Electrical conductivity, Turbidity, Color, Calcium, Magnesium, Chlorides, Sulfate, Nitrogen, Phosphate, Alkalinity, Hardness, Iron, Manganese , Aluminum and rainfall indices) and biotics (Cyanobacteria density). The physical-chemical parameters were collected from the Treatment and Laboratories Coordination of the Sanitation Company of the State of Pernambuco — COMPESA and the rainfall indices from the Pernambuco Agronomic Institute - IPA (2024).

STUDY AREA

Eutrophic freshwater reservoirs in the state of Pernambuco (Northeastern Brazil). The reservoirs have a history of cyanobacteria above 10,000 cells / mL , with genera potentially producing eyanotoxins . The reservoirs studied were: Tapacurá Dam , São Lourenço da Mata (8°3121"S 35°11'14"W, Capibaribe River basin, volume of 104,871 10 *m*) , Carpina Dam, Lagoa do Carro (7 °53'28"S 35°21'45"W, Capibaribe River basin, volume 270,000 10 * m *), Mundaú Dam, Garanhuns (8°58'59"S 36°28'27"W, Rio basin Mundaú, volume 19.283 10 *m *) and Pedro Moura Júnior Dam, Belo Jardim (8º20'43.6"S 36º22'29.2"W, Ipojuca River basin , volume 29.336 10 m?) (APAC. 2020).

Figure 1 Map of the state of Pernambuco with the area of the Tapacurá , Carpina, Pedro Moura Júnior and Mundaú reservoirs circled in green.



PHYSICAL. CHEMICAL AND BIOLOGICAL VARIABLES EVALUATED

Monitoring was carried out by COMPESA followiag the Sampling Plan based on the legislation then in force, Consolidation Ordinance n. 05, Annex XX, of the Ministry of Health

(BRASIL, 2017), updated by Ordinance No. 888/2021 (BRASIL, 2021). The historical period defined was 10 years, being correlated with periods of scasonality, as well as the identification of the main genera of cyanobacteria potentially producing cyanotoxins . The parameters analyzed in this study are listed in Table 1.

Physicochemical analyzes as well as the identification of the main genera of cyanobacteria potentially producing cyanotoxins were cerried out at COMPESA's Central Laboratory. The parameters analyzed were alkalinity. aluminum, calcium, chlorides, electrical conductivity, color, hardness. iron, total phosphorus, magaesium, manganese. total nitrogen. PH, sulfate, turbidity, identification and cyanobacteria count. All parameters were analyzed according to the APHA normative reference.

STATISTICAL TREATMENT OF RESULTS

The data were checked for ourliers and each situation was analyzed individually, as they could reflect measurement errors, as well as being incicative of a characteristic of the population analyzed. The caleulation of the Relative Abundance of cyanobacteria was adapted from Lobo & Leighton (1986), and the genera of cyanobacteria fell into the following categories: dominant (density of cyanobacteria >50% of the total density of the samples) and abundant (density greater than the average density, depending on the total number of cyanobacteria present in the sample). The normality of the variables was checked using the Shapiro Wilk test performed in R software (version 4.0.2). Generalized Linear Model (GLM) analysis, a non-parametric test of Multiple Linear Regression, was used to point out the joint correlation between abiotic variables in relation to cyanobacteria density. The correlation is established based on the coefficients generated for each variable. The correlation is significant when $P < 0.05$. Multivariate analyzes were performed to verify the influence of abiotic variables on cyanobacterial genera. For this, matrices of biotic and abiotic variables were constructed. A biotic matrix was constructed with cyanobacteria density data. Only genera that represented at least 5% of the total density in relation to the total density of cyanobacteria in each reservoir were considered. Biotic variables were log (x+1) transformed and all abiotic data were standardized using the range funcrion of the R software (version 4.0.2). The influence of abiotic variables on cyanobacteria densities was determined using redundancy analysis (RDA). This assay was chosen due to the smaller distribution of these data, calculated from the axis length provided by detrended correspondence analysis (DCA). In DCA, the various data from multiple variables are ordered, aiming to reduce the dimensionality of the data and analyze which are the main genera involved with the abiotic variables. Redundancy analysis (RDA) is the canonical form of principal component analysis (PCA), which selects the linear combination of environmental variables that gives the smallest sum of the total residuals from fitting table data to cyanobacterial

genera. The ordistep function was used to select the variables, except those that presented inflation values greater than 20%, to avoid collinearity between the variables. All statistical analyzes were performed using R software (version 4.0.2, vegan package).

RESULTS AND DISCUSSIONS

The reservoirs have a history of potentially toxic with concentrations higher than the “trigger” (20,000 cells/ mL) determined for weekly monitoring of cyanobacteria counts and cyanotoxin analysis , as established in Ordinance No. 888/2021 (Brasil, 2021). Table 1 presents the average results and standard deviations for each parameter analyzed from 2010 to 2020. The results in Figures 2 a, b , c and c relate the period in which the samples were collected, with the rainfall index and cyanobacteria density.

Tapacurá , Pedro Moura Jinior and Mundaú reservoirs showed peaks in cyanobacteria density (cel / mL) during periods of low rainfall for most of the monitored period. According to Chaves eral. (2013) and Brasil et. al. (2016), tropical ecosystems can be eutrophicated during the dry period, due to the concentration of organic matter, favoring the bloom of cyanobacteria. There are still studies that state that periods of greater rainfall have increased the bloom of results cyanobacteria and the concentration of nutrients due to the mixing process, causing the re- suspension of these nutrients (Meng et al. , 2016; Zhou et a!. , 2016). These studies corroborate the found in the Carpina reservoir, whose results fluctuated, presenting peaks of cyanobacteria in some periods of greater rainfall.

Other studies carried out in this same reservoir also confirmed the increase in counts associated with high rainfall (Oliveira ez al. , 2015; eral.,2012). Teixeirade Oliveira et. al. , 2011 and Dantas et al., 2012).

Figure 3 shows the classification according to the calculation of the Relative Abundance of cyanobacteria, according to the classification proposed by Lobo & Leighton (1986). It was observed that no genus was dominant, while the genera Raphidiopsis / Cylindrospermopsis . Planktothrix and Microcystis were abundant in at least one of the reservoirs analyzed. Raphidiopsis / Cylindrospermopsis was abundant in all ecosystems, while Planktothrix was abundant in the Pedro Moura Júnior and Carpina reservoirs, and the genus Microcystis abundant in Tapacura and Munda,

According to Vieira et al. (2020) the presence of :he genus Cylindrospermopsis in a reservoir in the semiarid region of Ceará was abundant during the monitoring period, occurring throughout the sampled period and present at all study points. Cyiindrospermopsis and Planktothrix were also reported in a reservoir in Rio Grande do Norte (Oliveira et. al. , 2019). Tn the state of Paraiba Vasconcelos et. al. (2011) observed the frequency of the genera Cylindrospermopsis , Planktothrix and Microcystis in reservoirs, while Vanderley eral . (2021), evaluating abiotic factors in reservoirs

in the semi-arid region of northeastern Brazil, also found Microcystis as abundant and dominant genera and Raphidiopsis.

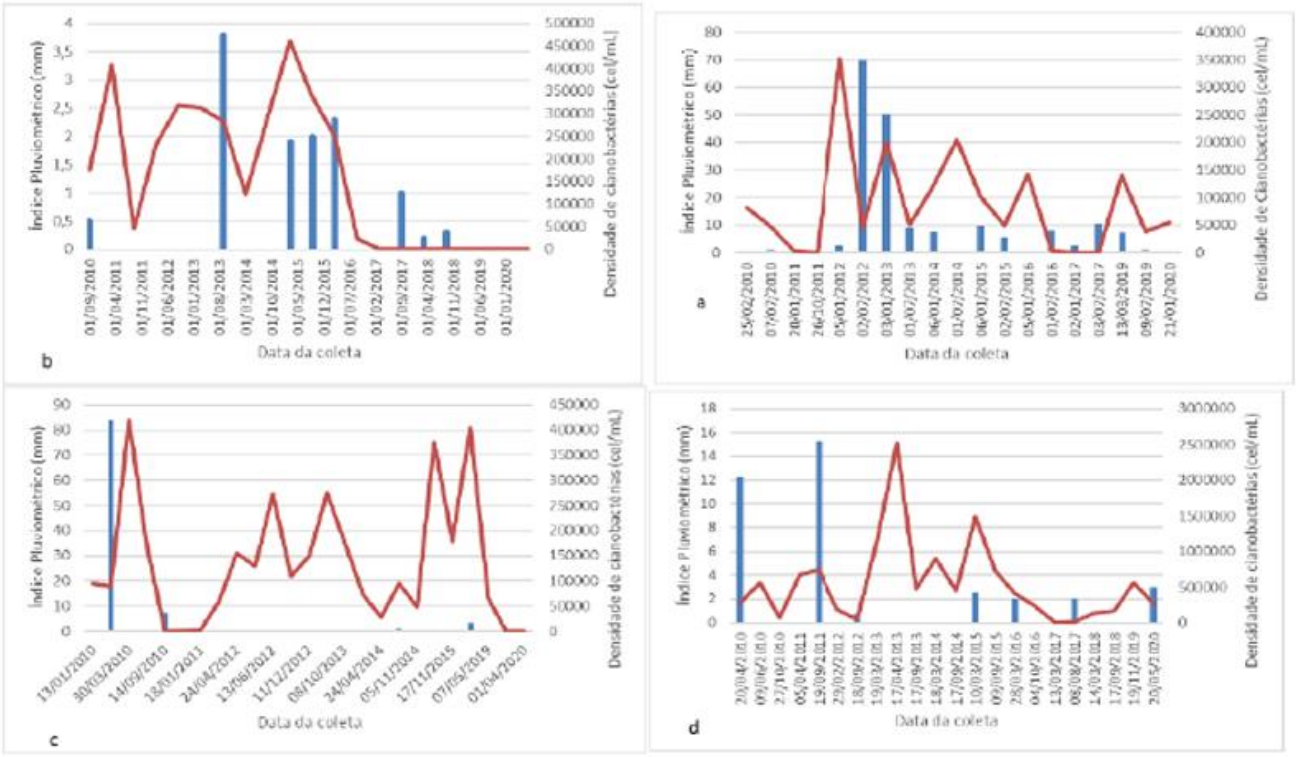
Table 1 biotic and biotic parameters of the Tapacurá , Pedro Moura Jinior, Carpina and Mundai reservoirs, in Pernambuco monitored from 2010 to 2020.

Reservoir	pH	CE	UT	Color (Hz)	Here (mg/L)	mg (mg/L)	CL (mg/L)	OS ₄ (mg/L)	N Total (mg/L)	OP ₄ (mg/L)	Alkaline . (mg/L)	Toughness (mg/L)	Faith (mg/L)	Mn (mg/L)	Al (mg/L)	IP	Cyanobacteria Density (cel / mL)
Tapacurá	**7.52**	**448**	**15**	**123**	**12**	**8**	**83**	**12**	**1.14**	**0.47**	**82**	**61**	**0.3**	**0.1**	**0.4**	**10**	**86188**
DP	0.35	65	11	69	3	two	15	10	1.12	0.25	13	12	0.3	0.0	0.3	18	88739
Pedro Moura Junior	**7.40**	**2086**	**9**	**112**	**62**	**93**	**714**	**42**	**1.75**	**0.13**	**114**	**536**	**0.6**	**0.6**	**0.4**	**4**	**134733**
DP	0.72	1637	8	68	44	81	639	51	2.23	0.10	105	430	0.6	1.2	0.6	16	123994
Carpina	**8.12**	**2124**	**9**	**116**	**29**	**83**	**715**	**47**	**1.61**	**0.24**	**204**	**415**	**0.2**	**0.2**	**0.4**	**1**	**114577**
DP	0.32	492	5	63	10	18	149	13	0.99	0.10	55	60	0.1	0.1	0.2	1	156690
Mundaú	**8.38**	**681**	**30**	**260**	**21**	**12**	**134**	**3**	**1.80**	**0.19**	**137**	**100**	**0.4**	**0.1**	**0.4**	**two**	**546233**
DP	0.71	96	15	119	5	3	45	6	1.42	0.10	34	23	0.6	0.0	0.7	4	567709

Source: The authors. EC= Electrical conducivity (uS/Cm at 20ºC); UT= Turbidity unit; Alkaline. =Alkalinity; IP= Average monthly rainfall (mm).

Cyanobacteria are potentially toxin producers, with some genera producing more than one type of toxin in a single bloom (EPA, 2024). The dominant genera identified, Raphidiopsis / Cylindrospermopsis . Planktothrix and Microcystis , are among the taxa producing diverse toxins. Rhaphidiopsis usually produces cylindrospermopsin whose primary toxic action oceurs in the liver and kidneys. It can also cause damage to DNA and bioaccumulate in invertebrate and vertebrate aquatic beings (EPA, 2024). The Microcysris genera and Planktothrix are associated with the production of neurotoxins such as anatoxin-a , capable of affecting the central nervous system by binding to neuronal receptors.

Figure 2 Cyanobacteria Density x Rainfall Index in reservoirs — a) Tapacurá ; b) Carpina; c) Pedro Moura Júnior and d) Mundaí. The red line indicates the rainfall index (mm) on the collection date and the blue column indicates the temporal variation m cyanobacteria density.



The genus Microcystis it is also potentially a producer of microcystins , the most common toxins, with microcystin -LR being hepatotoxic and the most studied form. Microcystins can be found intracellularly or dissolved in water and can bioaccumulate in invertebrates and vertebrates (EPA, 2024). It is worth mentioning that the most serious case of human poisoning with cyanotoxins occurred in the city of Caruaru-PE, where microcystins and eylindrospermopsin were found in the materials used to treat water used in hemodialysis (Azevedo et. al. , 2002).

The cyanobacteria cell count is a clear example of values that present a gap, that is, high standard deviation values (Table 1). However, they should not be excluded, as, taking into account the large possible variation in environmental analyses, it was decided to keep all data, since the outlier values found may be a reflection of the real situation of the environment. As expected, as these were environmental data, the distribution of some variables did not follow a normal distribution, therefore non-parametric tests of the variables were used.

After Generalized Linear Models (GLM) analysis, all abiotic variables showed a significant correlation with cyanobacteria density ($p < 0.05$) in all reservoirs studied. The abiotic variable Total Nitrogen showed an indirect correlation in all reservoirs. The influence of abiotic variables on the density of cyanobacterial genera is shown in the RDA present in Figure 4. The model generated explained 24.52% of the variation in the density of cyanobacterial genera involved in blooms in the studied reservoirs. Both axes were significant ($p < 0.05$) and explained 56.24% (axis 1) and 33.75% (axis 2) of the total percentage of the model.

Figure 3 Classification of the Relative Abundance of cyanobacteria in the Tapacurá , Pedro Moura Júnior, Carpina and Mundaú reservoirs in Pernambuco from 2010 to 2020.

Genres/Reservoirs	Tapacurá	Pedro Moura Junior	Carpina	Mundaú
Raphidiopsis / Cylindrospermopsis sp.	Abundant	Abundant	Abundant	Abundant
Planktothrix sp.	Rare	Abundant	Abundant	Rare
Geitlerinema sp.	Rara	Rara	Rara	Rara
Merismopedia sp.	Rara	Rara	Rara	Rara
Planktolyngbya sp.	Rara	Rara	Rara	Rara
Anabaenopsis sp.	Rara	Rara	Rara	Rara
Coelomoron sp.	Rara	Rara	Rara	Rara
Dolichospermum sp.	Rare	Rare	Rare	Rare
Microcystis sp.	Abundant	Rare	Rare	Abundant
Romeria sp.	Rare	Rare	Rare	Rare
Oscillatoria sp.	Rare	Rare	Rare	Rare
Radiocystis sp.	Rare	Rare	Rare	Rare
Aphanocapsa sp.	Rare	Rare	Rare	Rare
Pseudanabaena sp.	Rare	Rare	Rare	Rare
Cuspidothrix sp.	Rare	Rare	Rare	Rare
Chroococcus sp.	Rare	Rare	Rare	Rare
Sphaerospermopsis sp.	Rare	Rare	Rare	Rare

Source: The authors.

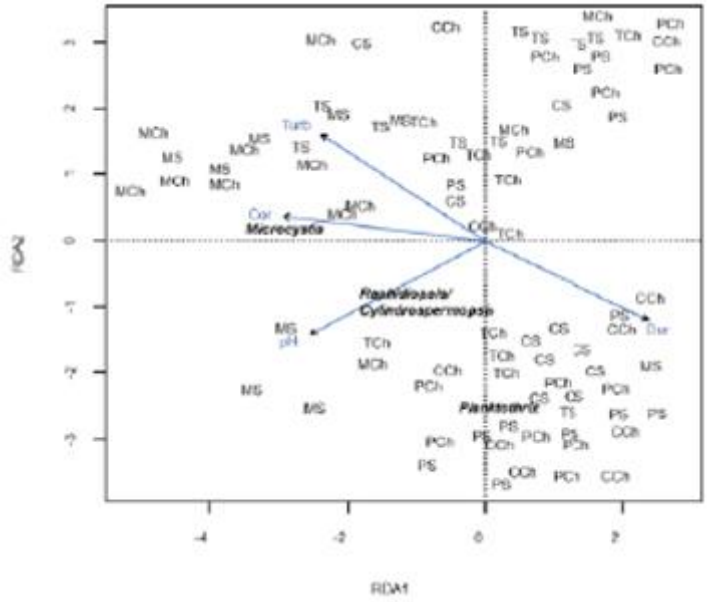
Axis 1 of the RDA separated the samples from the Mundaú reservoir, which were negatively correlated with the axis, while the other samples had a positive relationship. Although present on the positive side of axis 1, the samples from the Carpina reservoir were predominantly distributed on the negative side of axis 2, while the samples from Tapacurá and Pedro Moura Júnior were mostly plotted on the positive side of this. As for abiotic variables, 7). turbidity (-0.61) and PH (-0.65) were negatively associated with this axis. Analyzing the biotic variables, the density hardness (0.61) was positively associated with axis 1, while color (- of Microcystis (-2.61) and Raphidiopsis / Cylindrospermopsis (-1.18) are negativeiy related to axis 1, while Planktothrix densities (-2.41) were negatively related to axis 2.

Although no climate variable alone showed a significant correlation with the samples, it was possible to observe that sets were formed depending on seasonality. In this way, it was observed that higher values of color, turbidity and pH. and lower concentrations of hardness favored the growth of Microcystis and Raphidiopsis / Cylindrospermopsis . Laboratory studies (Patifio et. al. , 2023) showed that low concentrations of calcium stimulate the single-cell growth of Microcvstis aeruginosa , as well as the presence of magnesium, acting interactively. Growth Reducing Effects of Cylindrospermopsis raciborskii in high caleium concentration were reported by Carneiro et. al. (2011), which may partially corroborate the effect of hardness on metabolism. On the other hand, increasing hardness and pH favored the growth of Planktothrix.

It was observed that the Mundaú reservoir had flowerings characterized mainly by species of the genus Microcysris , while the Carpina reservoir had its flowerings characterized mainly by the genus Planktothrix . The Tapacurá and Pedro Moura Júnior reservoirs showed temporal alternation in the genera that make up the flowerings.

The pH in the reservoirs studied presented values ranging from neutral-alkaline to alkaline (Table 1), which is corroborated in several other studies (Moura et al ., 200 al,, 2014; Câmara ef al, 2015; Tardim ef al ., 2014), in studies of eutrophic reservoirs in the States of Pernambuco, Rio Grande do Norte and Minas Gerais. According to Esteves (2011), algae can interfere with the pH value through the assimilation of CO > because during the photosynthetic process they can raise the pH of the environment, especially where blooms oceur, which can justify pH values above neutrality.

Figure 4 Redundaney Analysis (RDA) diagram showing the variation in the density of cvanobacterial genera involved in blooms in relation to abiotic variables in the Carpina, Mundaú, Pedro Moura Júnior and Tapacurá reservoirs in the period from 2010 to 2020, in Pernambuco.



TS — Tapacurd Reservoir , dry period: TCh - Tapacurd Reservoir , ra.ny season ; MS - Mundaú Reservoir, dry period; MCh - Mundaú Reservoir, rainy season; PS - Pedro Moura Jinior Reservoir, dry period: PCh — Pedro Moura Túnior Reservoir, rainy season; CS - Carpina Reservoir, dry period: Dur = hardness: Turb = turbidity

Regarding turbidity, studies have shown a negative correlation of this variable with the density of cyanobacteria, possibly due to the interception of solar rays, compromising the photosynthetic process (Dantas et al ., 2012; Jardim er al ., 2014; Oliveira; Fonseca; Lopes, 2019; Santos Silva et. al. , 2020). However, the results of this work showed that the genus Microcvstis its growth was favored by murkier waters. Tkis behavior can be justified by the fact that representatives of this species have aerotopes in their cells, which allow them to move vertically in the water column. During periods of greater solar radiation, the species migrates the epilimnion of the reservoirs to carry out photosynthesis and this allows its growth. The excessive development of these organisms creates a shading effect in the reservoir, preventing solar rays from reaching the lower layers, where other genera of cyanobacteria are located. This competition did not show inhibition, however, of species of the genus Raphidiopsis / Cylindrospermopsis environments. In which, according to Reynolds er al (2002) tolerates low light this way, it could be inferred that the increase

in turbidity does not directly favor the growth of Microcystis , but rather that the growth of these bacteria creates a condition that inhibits the growth of others (interspecific competition) and, as a result, their density increases. This same reasoning can be used to explain the effect of color on the growth of Microcysiis

The presence of divalent cations such as calcium and magnesium, measured by water The 'hardness, participate in photosynthetic reactions and help in the aggregation of colony-forming species (CARNEIRO et. al., 2013). Calcium and magnesium also act on the balance between nitrogen and carbon in filamentous species. such as the genus Planktothrix (WALTER et al , 2016). results presented in the RDA (Figure 4) show a positive correlation between hardness and the increase in Planktothrix densitv , despite the vector showing greater representation on axis 1.

Although some studies indicate that phosphorus and nitrogen are the limiting nutrients for primary production, these were not significantly correlated with cyanobacteria density in this study, a similar result was also observed by Sonobe er al . (2019) when studying the growth of cyanobacteria in reservoirs in the state of São Paulo. It is known how important these elements are for the development and maintenance of cyanobacteria species in eutrophic environments , however, when the number of parameters is expanded, the weight of other variables is revealed, highlighting the importance of the synergistic action between the several biotic and abiotic variables for the ecology of cyanobacteria.

CONCLUSION

Data analysis allowed us to observe that the reservoirs studied presented, over a ten- year history, cyanobacteria density results above 20,000 cells / mL in the studied period from 2010 to 2020. The cyanobacteria most frequently identified in episodes with density above 20,000 cells , / mL belonged to the potentially foxigenic genus Raphidiopsis Cylindrospermopsis , which were found in all reservoirs in abundant condition. Abundance of Planktothrix and Microcystis , potentially toxigenic . were also observed in the Pedro Moura/Carpina and Tapacurá /Mundaú reservoirs , respectively, demonstrating the potential risk of abstracting water for treatment and human consumption. According to the Redundancy Analysis (RDA), itis possible to state that the increase in color, turbidity and pH were positively correlated with the presence of the genera Microcystis and Raphidiopsis / Cylindrospermopsis and negatively correlated with the increase in hardness; as well as a positive correlation was observed between hardness (caleium and magnesium) and the increase in density of the genus Planktothrix , even though the vector has a greater correlation with axis 1. The inhibition of growth (density) of many genera of cyanobacteria, observed by relative abundance, could not be attributed to the concentration of total phosphorus, even though

it was present in high concentrations throughout the evaluated period, and was not even significantly correlated in the RDA analysis.

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REFERENCES

1. Azevedo, M. F. O., Carmichael, W. W., Jochimsen, E. M., et al. (2002). Human intoxication by microcystins during renal dialysis treatment in Caruaru, Brazil. *Toxicology*, 181/182.

2. Bittencourt-Oliveira, M., & Molica, R. (2003). Cianobactéria invasora. *Revista Biotecnologia Ciência e Desenvolvimento*, (30).

3. Brasil, Ministério da Saúde. (2017). Anexo XX da Portaria de Consolidação GM/MS nº 5, de 28 de setembro de 2017.

4. Brasil, Ministério da Saúde, Gabinete do Ministro. (2021). Portaria nº 888, de 04 de maio de 2021.

5. Brasil, J., Attayde, J. L., Vasconcelos, F. R., et al. (2016). Drought-induced water-level reduction favors cyanobacteria blooms in tropical shallow lakes. *Hydrobiologia*, 770(1). https://doi.org/10.1007/s10750-015-2578-5

6. Câmara, F. R. A., Rocha, O., & Pessoa, E. K. R., et al. (2015). Alterações morfofuncionais da comunidade fitoplanctônica durante anomalia pluvial em um reservatório tropical. *Brazilian Journal of Biology*, 75(3). https://doi.org/10.1590/1519-6984.19513

7. Carmichael, W. W., Azevedo, S. M. F. O., An, J. S., Molica, R. J. R., et al. (2001). Human fatalities from cyanobacteria. *Chemical Perspectives*, 109(7).

8. Carneiro, R. L., Alípio, A. C. N., & Bisch, P. M. (2011). Evidence for cyanotoxins: The inhibitory effect of calcium on *Cylindrospermopsis raciborskii* (cyanobacteria) metabolism. *Brazilian Journal of Microbiology*, 42(4).

9. Chaves, F. L. B., Lima, P. F., Leitão, R. C., et al. (2013). Influence of rainfall on the trophic status of a Brazilian semiarid reservoir. *Acta Scientiarum - Biological Sciences*, 35(4). https://doi.org/10.4025/actascibiolsci.v35i4.18261

10. Dantas, E. W., Bittencourt-Oliveira, M. do C., & Moura, A. do N. (2012). Dynamics of phytoplankton associations in three reservoirs in northeastern Brazil assessed using Reynolds' theory. *Limnologica*, 42(1). https://doi.org/10.1016/j.limno.2011.09.002

11. EPA - United States Environmental Protection Agency. (2024). Species of cyanobacteria that produce. Retrieved from https://www.epa.gov/habs/learn-about-harmful-algae-cyanobacteria-and-cyanotoxins-overview

12. Esteves, F. A. (2011). *Fundamentos de limnologia* (3rd ed.). Interciência.

13. Fernandes, V. de O., Cavati, B., & de Oliveira, L. B., et al. (2009). Ecologia de cianobactérias: Fatores promotores e consequências das florações. *Oecologia Brasiliensis*, 13(2). https://doi.org/10.4257/0eco.2009.1302.03

14. Glibert, P. M., & Burkholder, J. A. M. (2011). Harmful algal blooms and eutrophication: Strategies for nutrient uptake and growth outside the Redfield comfort zone. *Chinese Journal of Oceanology and Limnology*, 29(4). https://doi.org/10.1007/s00343-011-0502-z

15. Hemamalini, J., Mudgal, B., & Sophia, I. D. (2017). Effects of domestic and industrial effluent discharges into the lake and their impact on the drinking water in Pandravedu village, Tamil Nadu, India. *Global NEST Journal*, 19(2).

16. Igwaran, A., Kayode, A. J., Moloantoa, K. M., et al. (2024). Cyanobacteria harmful algae blooms: Causes, impacts, and risk management. *Water, Air, Soil Pollution*, 235(71). https://doi.org/10.1007/s11270-023-06782-y

17. IPA. (2024). Sessão de índices pluviométricos. Recuperado de https://www.ipa.br/indice_pluv.php

18. Jardim, A., Sperling, E. V., & Jardim, B. F. M., et al. (2014). Fatores determinantes das florações. https://doi.org/10.1590/S1413-41522014019000001026

19. Lira, G., Moura, A., Vilar, M., et al. (2014). Vertical and temporal variation in phytoplankton assemblages correlated with environmental conditions in the Mundaú reservoir, semi-arid northeastern Brazil. *Brazilian Journal of Biology*, 74(3 Suppl 1). https://doi.org/10.1590/1519-6984.27612

20. Lobo, E., & Leighton, G. (1986). Estructuras comunitarias de la fitocenosis planctónicas de los sistemas de desembocaduras de ríos y esteros de la Zona Central de Chile. *Revista de Biología Marina*.

21. Lucena, R. T. L. (2023). Projeto de Lei do Plano Plurianual do Estado de Pernambuco - período 2024-2027. Recuperado de https://www.alepe.pe.gov.br/wp-content/uploads/2023/PL/PPA-2024-2027.pdf

22. Meng, P.-J., Tew, K. S., Hsieh, H.-L. Y., et al. (2017). Relationship between magnitude of phytoplankton blooms and rainfall in a hyper-eutrophic lagoon: A continuous monitoring approach. *Marine Pollution Bulletin*, 124(2). https://doi.org/10.1016/j.marpolbul.2016.12.040

23. Paerl, H. W., & Paul, V. J. (2012). Climate change: Links to global expansion of harmful cyanobacteria. *Water Research*, 46.

24. Patiño, R., Christensen, V. G., Graham, J. L., et al. (2023). Toxic algae in inland waters of conterminous United States. *Water*, 15(15). https://doi.org/10.3390/w15152808

25. Reynolds, C. S., Huszar, V., Kruk, C., et al. (2002). Towards a functional classification of the freshwater phytoplankton. *Journal of Plankton Research*, 24(5). https://doi.org/10.1093/plankt/24.5.417

26. Santos Silva, R. D., Severiano, I. S., Oliveira, D. A., et al. (2020). Spatio-temporal variation of cyanobacteria and cyanotoxins in public supply reservoirs of the semi-arid region of Brazil. *Journal of Limnology*, 79(1).

27. Sonobe, H. G., Lamparelli, M. C., Cunha, D. G. F. (2019). Spatial and temporal assessment of sanitary aspects of public water supply reservoirs in São Paulo, Brazil, with emphasis on cyanobacteria and cyanotoxins. *Engenharia Sanitária e Ambiental*, 24(5). https://doi.org/10.1590/S1413-41522019193351

28. Teixeira de Oliveira, M., Rocha, O., & Peret, A. (2011). Structure of the phytoplankton community in the Cachoeira Dourada reservoir (GO/MG), Brazil. *Brazilian Journal of Biology*, 71(3). https://doi.org/10.1590/1519-69842011000400003

29. Vanderley, R. F., Kemal, A. G., & Becker, V., et al. (2021). Abiotic factors driving cyanobacterial biomass and composition under perennial bloom conditions in tropical latitudes. *Hydrobiologia*, 848. https://doi.org/10.1007/s10750-020-04504-7

30. Vasconcelos, J. F., Barbosa, J. E. L., & Diniz, C. R., et al. (2011). Cianobactérias em reservatórios do Estado da Paraíba: Ocorrência, toxicidade e fatores reguladores. *Boletim da Sociedade Brasileira de Limnologia*, 39.

31. Vieira, R. de S., Oliveira, E. C. C., & Ricarte, E. M. F., et al. (2020). Dominância de cianobactérias na composição do fitoplâncton em reservatório de abastecimento no semiárido cearense. *Research, Society and Development*, 9(11). https://doi.org/10.33448/rsd-v9i11.9476

32. Walter, J., Lynch, F., & Battchikova, N., et al. (2016). Calcium impacts carbon and nitrogen balance in the filamentous cyanobacterium *Anabaena* sp. PCC 7120. *Journal of Experimental Botany*, 67(13). https://doi.org/10.1093/jxb/erw112

33. Yuan, Z., & Yoon, K. (2021). Overview of PCR methods applied for the identification of freshwater toxigenic cyanobacteria. In *Cyanobacteria: Advances in taxonomy and applications* (pp. 1–27). IntechOpen.

34. Zhou, J., Qin, B., & Casenave, C., et al. (2016). Effects of turbulence on alkaline phosphatase activity of phytoplankton and bacterioplankton in Lake Taihu. *Hydrobiologia*, 765(1). https://doi.org/10.1007/s10750-015-2413-2

Teaching of the theme "humanization of care" in undergraduate nursing courses at state universities in Paraná

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ABSTRACT

Introduction: The National Curriculum Guidelines for undergraduate nursing courses frequently propose reforms in the curricula of higher education institutions whenever changes are needed to create new demands and updates relevant to quality professional training. However, it seeks to break with the mere fulfillment of professional practice to incorporate teaching focused on the real needs of society and the world of work. Enabling the training of professionals with a holistic view of user care in accordance with the National Humanization Policy. Objective: To analyze how the theme "Humanization of Care" is proposed in the Pedagogical Course Projects (PPC) of the Undergraduate Nursing courses of the State Universities of Paraná. Methodology: A documentary analysis research was carried out, with the aim of constituting a satisfactory corpus, exhausting the clues capable of providing relevant information in relation to the theme. Document analysis is a set of intellectual operations that aims at the description and representation of documents in a unified and systematic way to facilitate their retrieval extracted from the original source, allowing the location, organization and evaluation of the information contained. Finally, the collected data were organized in Excel spreadsheets separated by tabs, in order to gather the most relevant data in a concise and objective way so that the findings and results pertinent to the research objective can be later discussed. Result: The Document Analysis allowed the deepening of the theme of Teaching Humanization due to its characteristic of constituting a satisfactory corpus, exhausting all clues capable of providing relevant information in relation to the theme. Thus, by effectively integrating politics as a basis for teaching, an environment is created that favors the development of a professional with a more humane, ethical and integrated vision with both the needs of patients and the health team. Conclusion: However, in order to have professionals with knowledge about the Humanization of Care and to be able to actually provide humanized care and assistance, it is essential that during their training they have come into contact with the theme in a theoretical-practical way, and that this contact happens throughout the undergraduate course. In this sense, contributing to the development and improvement of nursing education, and promoting reflections on the insertion of Humanization in the education of future nurses in a substantial way, is justified by the fact that humanized practice contemplates the individual in a holistic way, promoting prevention, promotion, and treatment.

Keywords: Nursing Education, Humanization of Care, Professional Training.

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INTRODUCTION

The National Curriculum Guidelines (DCN) for undergraduate nursing courses (Brasil, 2001) propose reforms in the curricula of Higher Education Institutions (HEIs), these changes that, in turn, emerge for new demands and updates pertinent to a new conjuncture of quality professional training and performance.

However, it seeks to break with the mere fulfillment of professional practice to incorporate teaching focused on the real needs of society and the world of work. Considering that nursing is the profession of care, it is expected that nurses acquire contextualized technical-scientific, ethical-political, and socio-educational skills, with the perspective of meeting the health-disease-care needs of users, with emphasis on the Unified Health System (SUS) to ensure quality, comprehensiveness, and humanized care (Rangel, 2020)

In this sense, the National Humanization Policy (NHP) aims to "include differences in the management and care processes", therefore, the transformations occur collectively, encompassing new teaching-learning methods and also theoretical-practical, expanding different ways of organizing humanized care to better serve the population (Brasil, 2013). The importance of promoting the implementation of humanized care throughout the context of SUS care is highlighted, however, undergraduate nursing courses have gaps in the offer of training consistent with the PNH, and attribute such difficulties to the fragmented view of the human being in health education (Morin, 2005).

According to Freire (1970), education is reinforced in the transformation of the being, simultaneously intervening in reality and being transformed by it. Awareness and the development of critical-scientific thinking in students should be promoted, making them active participants in the process of constructing their learning, thus contributing to the formation of qualified professionals permeated by the macro vision of humanized care.

Humanization in health has been an increasingly discussed and valued topic in recent years. In a context where technology and clinical efficiency are often prioritized to the detriment of care and empathy with the user. It is essential to emphasize the importance of humanization as a fundamental factor for the quality of health care. In addition to being a user's right, humanization is a key element for building a relationship of trust between health professionals and users, favoring treatment adherence and the well-being of the individuals involved (Villela; Ely, 2022).

Thus, discussing the importance of humanization in health, as well as the main strategies and challenges for its implementation in clinical practice, are fundamental for the training of future professionals (Villela; Ely, 2022).

Thus, it is necessary for HEIs to reformulate their Pedagogical Project of the Course (PPC) to adapt to the care model consistent with the health-disease-care needs of users, in order to

contemplate the new education and public health policies, in order to train trained and updated professionals to face the challenges presented by society, with competencies and skills that go beyond theory, to provide humanized and holistic care in which the disease does not occupy the center of care, but rather meets the human needs presented (Horta, 1974).

In this context, the present article aimed to analyze how the theme Humanization of Care is proposed in the PPC of undergraduate nursing courses at state universities in Paraná and how it is developed throughout professional training.

It is understood that the understanding of these documents is one of the essential elements for the implementation of the DCN proposal and the new reality of health-care of the population, and of the health professional expected to act in the dynamics of the care context in any and all health environments. To this end, it sought to answer the following guiding question: **"How is Humanization addressed in the Curricula of the Nursing course at the State Universities of Paraná?".**

OBJECTIVE

This study aims to analyze how the theme "Humanization of Care" is proposed in the Pedagogical Course Projects (PPC) of the Undergraduate Nursing courses of the State Universities of Paraná. The aim was to describe how the theme is presented and addressed in the disciplines of the PPCs, in addition to analyzing the potentialities and weaknesses related to the Humanization of Care, considering the competencies and skills expected of nursing students.

METHODOLOGY

A documentary analysis research was carried out, which aimed to constitute a satisfactory *corpus*, exhausting all clues capable of providing relevant information in relation to the theme (Cellard, 2008, p. 298).

According to Oliveira (2007), document analysis is a set of intellectual operations that aims at the description and representation of documents in a unified and systematic way to facilitate their recovery extracted from the original source, allowing the location, organization and evaluation of the information contained. The advantages of this method consist in the low cost and stability of the information because they are safe and reliable sources of data and because it is a technique that does not alter the environment or the subjects.

In this study, this method was chosen due to the possible authenticity of the information collected, since it is provided by the university itself, by enabling access to official documents, via formalized invitation letter and acceptance.

During the analysis of the documents to search for previously planned information, the form of visualization began to clarify findings that helped in the interpretation and location later, in the face of a screening by words and/or phrases. In order to have access to the certified documents of the universities, the PPC, first a letter was sent to the course coordinators explaining the objectives of the research, highlighting the relevance of the study with scientific support, in which authorization was requested to carry out the documentary analysis, after acceptance, the PPC in force at the IES was sent.

The investigations and data collection followed a few steps: Authorized access to the PPC of the undergraduate nursing courses of the State Universities of Paraná. In which they should be in accordance with some criteria: updated, and consistent with the creation and updating of the PNH, 2003 and 2013 respectively, and the implementation of the nursing course in universities by the year 2022, workloads and duration of the course consistent. Then, the data were collected with the support of a *previously constructed checklist* and a pilot test was carried out in a PPC that was not part of the sample, so that important findings could be evidenced, and that the possible necessary adjustments could be revealed to the researcher, meeting the objectives of the research.

The data analysis followed the method proposed by Bardin (2011) which consists of: 1. Pre-analysis Includes the hypotheses and objectives; size and directions of analysis; 2. Exploration of the material; 3. Treatment of results and interpretations - This is the synthesis and selection of results; 4. Inferences - The relationship between the objective of the research and the results obtained after analysis with a literary theoretical basis was covered and 5. Interpretation - It consists of an in-depth analysis, beyond the apparent perspective, seeking to extract as much information as possible that is camouflaged in the documents.

Finally, the collected data were organized in *Excel(R) spreadsheets* separated by tabs entitled: "name of the university", "disciplines and year of the curriculum", "application of the principles and guidelines of the PNH", "implicit and explicit contents in relation to the theoretical and practical teaching of Humanization of Care", among others, with the purpose of gathering the most relevant data in a concise and objective way to discuss the findings, and results relevant to research.

To elaborate the central question of the research, the PICo strategy was used, which is an acronym for Population or Problem, Intervention and Context of the study (Nishikawa-Pacher, 2022).

Table 1 - PiCo Strategy

COMPONENTE	DEFINIÇÃO	DESCRITORES DECS	SINÔNIMO
POPULAÇÃO (P)	GRADUAÇÃO EM ENFERMAGEM	EDUCAÇÃO EM ENFERMAGEM	ENSINO DE ENFERMAGEM FORMAÇÃO EM ENFERMAGEM
INTERVENÇÃO (I)	HUMANIZAÇÃO	HUMANIZAÇÃO DA ASSISTÊNCIA	CUIDADO HUMANIZADO
CONTEXTO (CO)	PROJETO PEDAGÓGICO DO CURSO (PPC)		

Source: The authors, 2024

RESULTS AND DISCUSSION

The Document Analysis allowed the deepening of the theme Teaching of Humanization due to its characteristic of constituting a satisfactory *corpus*, exhausting all clues capable of providing relevant information in relation to the theme, this particularity contributes to the training of nursing professionals who can deepen the knowledge of a specific theme, contributing to the humanized care of the patient.

Based on the criteria established for the study, the Pedagogical Course Projects (PPC) of six State Universities in Paraná were analyzed, since one of the institutions did not send the requested response, which was attempted twice. These criteria allowed for a detailed and systematic evaluation, identifying how each institution approaches the development of skills and competencies in line with the 2013 National Humanization Policy (NHP).

To ensure impartiality and avoid any type of identification or vision, the universities were arranged in alphabetical order, using letters (a, b, c, etc.). This ensured that the analysis was focused solely on the content of the PPC and the objectives of the research, with no external influences related to the recognition of HEIs. In the final sample, four characteristics of each University were selected, presented in the table below.

Table 2 - Categorization of Universities

UNIVERSIDADE	TOTAL DE DISCIPLINAS	EM QUANTAS DISCIPLINAS A PNH ESTÁ NAS REFERENCIAS	QUANTAS DISCIPLINAS ABORDAM A PNH *DIRETAMENTE*	QUANTAS DISCIPLINAS A PNH *INDIRETAMENTE*
A	30	0	0	3
B	25	0	1	9
C	64	0	1	7
D	34	0	3	9
E	34	0	1	4
F	24	0	1	5

Source: The authors, 2024

Chart 2 presents the data from the six universities (a, b, c,..) on the inclusion of the PNH in the disciplines of six universities, focusing on how the PNH theme is addressed directly or indirectly in the academic curriculum. The survey reveals how the traditional teaching model is still predominant, thus discouraging the promotion of dialogue, and the appreciation of the human being as a basis for planning and health care, making the teaching-learning processes static and not very reflective. This gap in the PNH in the references of the university disciplines analyzed reflects a lack of recognition of the importance of addressing this essential theoretical-practical content, which raises questions about this fragility and relevance to higher education (Debald, 2020).

The number of disciplines that address the PNH directly is extremely limited. University D stands out with 3 disciplines directly focused on the theme, while the other universities have, at most, a single discipline dealing explicitly with the theme. University A, for example, does not include the PNH in any of its disciplines. This scenario reinforces the idea that politics does not yet occupy a central role in the curricula, indicating that the theme is not addressed, and the humanization of care in the nursing curriculum is an approach that seeks to integrate the human, ethical and emotional dimension in the education of future health professionals.

This perspective emphasizes the importance of preparing nurses to care for users in a holistic way, considering not only the technical aspects, but also the emotional, psychological and social needs of the individuals. Comprehensive care, to value the subjective dimensions, in addition to being implicated in the health-disease-care process (Casate; Corrêa; 2012).

On the other hand, the indirect approach to the PNH is relatively more common, with significant differences between universities. University B and University D, for example, have 9 disciplines that indirectly discuss the theme, suggesting that the principles of the PNH can be

incorporated into broader discussions on humanization in health care, even if without explicit reference to the policy. Universities C and F also have a considerable number of disciplines that deal indirectly with the PNH, with 7 and 5 disciplines.

Table 3 - Transversality of the PNH by grade

UNIVERSIDADE	DURAÇÃO DO CURSO	SÉRIE DA GRADUAÇÃO COM ABORDAGEM DIRETA	DISCIPLINAS DE ABORDAGEM DIRETA	SÉRIE DA GRADUAÇÃO COM ABORDAGEM INDIRETA	DISCIPLINAS DE ABORDAGEM INDIRETA
A	5	Não aborda	Não aborda	1	Ciências sociais em saúde
		Não aborda	Não aborda	2	Enfermagem em saúde mental
		Não aborda	Não aborda	4	Práticas Supervisionadas de Alta complexidade
B	5	Não aborda	Não aborda	1	Processos saúde doença
		Não aborda	Não aborda	2	Práticas interdisciplinares e interação ensino, serviço e comunidade II; Organização dos Serviços de Saúde e Enfermagem
		3	Saúde do adulto	Não aborda	Não aborda
		Não aborda	Não aborda	4	Saúde da criança e Família; Saúde Mental II; Enfermagem no contexto infectologia
		Não aborda	Não aborda	5	Gestão dos serviços de enfermagem e saúde na atenção básica
C	5	2	Práticas Extensionistas II	2	Semiologia e Semiotécnica; Processos de enfermagem
		Não aborda	Não aborda	3	Estudos de eventos em saúde II; Práticas supervisionadas em enfermagem
		Não aborda	Não aborda	Optativas	Carreira, empreendedorismo e mercado de trabalho em enfermagem; Tópicos Especiais em saúde do idoso.

D	4	1	Fundamentos de Enfermagem I; Práticas Integrativas em saúde I;	1	Psicologia aplicada à enfermagem;
		2	Práticas Integrativas em Saúde II	2	Fundamentos em enfermagem II; enfermagem em saúde mental; enfermagem em saúde do idoso; farmacologia aplicada a enfermagem; enfermagem em saúde da mulher
		3	Práticas Integrativas III	3	Enfermagem em saúde do adulto I; Enfermagem no cuidado ao paciente crítico;
		Não aborda	Não aborda	Optativa	Tecnologias em saúde; Cuidados Paliativos
E	5	Não aborda	Não aborda	2	Ética e bioética
		3	Cuidados de enfermagem para pacientes em situações críticas	3	Saúde da Mulher e da Criança; Saúde do Adulto e do Idoso; Enfermagem em Saúde Mental e Psiquiátrica
F	5	Não Aborda	Não aborda	1	Fundamentos de filosofia aplicados à enfermagem; Enfermagem em saúde mental; Enfermagem fundamental I;
		3	Saúde Coletiva III	3	Sociologia
		Não Aborda	Não aborda	4	Enfermagem em puericultura, criança e adolescentes saios e crianças e adolescentes hospitalizados

Source: The authors, 2024

Chart 3 presents an analysis of the transversality of the PNH in undergraduate nursing in universities, highlighting that most courses last 5 years, except for University D, which offers a 4-year course. Universities C and D stand out for introducing disciplines with a direct approach to humanization at the beginning of the course from the first and second year, however, the inclusion of the content in the disciplines alone does not ensure significant changes in the training of undergraduate students in health, since this subject may remain restricted to the disciplines of the initial years, The other universities do not present this approach in the initial phases of graduation. In

these two universities, there is an emphasis on disciplines such as extension practices and nursing fundamentals, which seek to connect theory and practice right at the beginning of training.

At Universities A and B, the focus is on disciplines with an indirect approach in the first years, such as Social Sciences in Health and Health-Disease Processes, addressed from the first year onwards. The indirect disciplines focus on topics such as mental health, nursing in high complexity, adult health, child and family health, as well as nursing service management. These data indicate that, although the theme of humanization in health care is addressed in different contexts, this policy itself is not yet a central focus in the curricula of the universities analyzed.

Teaching is still predominant and commonly structured in a fragmented way, with separate disciplines that focus on specific areas of practice, such as anatomy, pharmacology, clinical procedures, among others, do not address in depth the principles and practices of humanization and when the contents about the policy are usually approached in a superficial way, without a constant dialogue with the daily practices of care (Morin, 2005).

The absence of this transversality in the curriculum makes it difficult for future nurses to internalize the principles of the policy, as they tend to associate humanization with specific aspects of care, instead of seeing it as an inseparable part of their entire professional performance (Câmara, 2022).

This reality reveals the need for greater integration and visibility of Humanization as a fundamental part of academic training in the areas of health, involving the construction of closer, more ethical and inclusive care relationships, but this dimension is often underestimated in the teaching-learning processes and even when students are exposed to these principles during their theoretical training, many face realities in internships that do not match the ideals of humanization and health education, disconnected from professional practice rooted in mechanical practices, focused only on the disease, generating consequences in the training of professionals that do not fully correspond to the needs of society (Silva, 2021).

According to Moran (2018), for there to be this articulation between theory and practice and for the teaching and learning processes to occur in the active perspective, it is necessary that the entire educational environment and its subjects are involved and focused on this perspective, promoting an atmosphere that stimulates participation, creativity, student protagonism and the teaching of humanization in the educational process.

The DCN (Brasil, 2001) emphasizes the need for teaching to be carried out in a transversal way, since it is recommended that there be the integration of fundamental themes and values within the undergraduate curriculum, addressed in all disciplines (Brasil, 1998). According to the Brazilian Nursing Association (ABEN), the transversality of teaching must be integrated by various

knowledge, practices and values in the context of education and in the practice of nursing, so that health professionals act in a holistic and humanized way (Brasil, 2018).

Among the aspects of transversality in Nursing, a set of actions that involve the integration of scientific, technological and humanistic knowledge stands out, so that knowledge is transmitted with sensitivity and empathy. In addition, interdisciplinary training aims to train the team to work together with other health professionals. Humanization and ethics are essential to provide dignified, respectful, and holistic care to the patient. Comprehensive health care seeks to promote health and prevent diseases, while continuing education and continuing education are essential to ensure that professionals are always up to date, practicing actions based on evidence, ethical and human values, with the aim of better serving the community (Lydines, 2019).

In view of the above, in order to train future health professionals capable of meeting the demands of society, it is essential that the student is prepared in a comprehensive and transversal way from the beginning, with topics addressed in various disciplines. The PNH provides a broader view of health care, improves the professional-patient relationship, values teamwork, promotes quality of life in the workplace, develops socio-emotional skills, and encourages more inclusive and equitable care, among other benefits (Lydines, 2019).

Thus, by effectively integrating politics as a basis for teaching, an environment is created that favors the development of a professional with a more humane, ethical and integrated vision with both the needs of patients and the health team.

FINAL CONSIDERATIONS

The assumptions are that the Humanization of Care is a topic of extreme relevance in the health area and has several justifications to be studied. Among them, it contributes directly to the user's well-being, as it places them at the center of the health process, considering their needs, desires and particularities. To this end, it seeks to provide more empathetic, respectful and welcoming care, thus contributing to the improvement of their experience in the health system.

By understanding and applying the principles of humanization, future health professionals are able to establish more effective communication, develop relationships of trust with users, provide individualized care, and allow a comprehensive approach, considering not only the physical, but also the emotional, social, and spiritual aspects. The humanization of care is also based on ethical principles and respect for human dignity. Embrace and value the autonomy and participation of users in decisions related to their health, in addition to recognizing the importance of respect for diversity, privacy and confidentiality.

However, the humanization of care is not limited only to users, but also extends to health professionals, with regard to the promotion of mental health, since it stimulates healthy interpersonal

relationships, reduces work-related stress and promotes well-being in the care environment. In view of the above, it is noteworthy that the Humanization of Care has been associated with the best impacts on health outcomes, including greater user satisfaction, treatment adherence, improved quality of life, and even reduced complications and readmissions.

Thus, it is possible to identify and implement practices that promote better health outcomes for users. In addition, the Humanization of Care also has the potential to transform the health system as a whole, promoting a more user-centered culture, with greater participation, providing greater transparency and quality in the services provided.

However, in order to have professionals with knowledge about the Humanization of Care and to be able to actually provide humanized care and assistance, it is essential that during their training they have come into contact with the theme in a theoretical-practical way, and that this contact happens throughout the undergraduate course.

In this sense, contributing to the development and improvement of nursing education, and promoting reflections on the insertion of Humanization in the education of future nurses in a substantial way, is justified by the fact that humanized practice contemplates the individual in a holistic way, promoting prevention, promotion, treatment, thus ensuring integrality and individuality in accordance with the PNH (Brazil, 2013). Thus, this research reaffirms the importance of inserting this policy in the undergraduate nursing curricula, in order to offer teaching that is related to the needs presented by society, and to train qualified professionals to provide humanized care in accordance with what is recommended by the guiding principles of the Unified Health System (SUS).

REFERENCES

1. Bardin, L. (2011). *Análise de conteúdo* (Rev. ed. ampliada). São Paulo: Edições 70. Disponível em: https://ia802902.us.archive.org/8/items/bardin-laurence-analise-de-conteudo/bardin-laurenceanalise-de-conteudo.pdf. Acesso em: 15 jun. 2024.

2. Brasil. Conselho Nacional de Educação. (2001). Institui Diretrizes Curriculares Nacionais do Curso de Graduação em Enfermagem. Resolução CNE/CES nº 3, de 7 de novembro de 2001. Seção 1, p. 37. Disponível em: [Link não fornecido]. Acesso em: 10 jun. 2024.

3. Brasil. Ministério da Saúde. (2013). *Política Nacional de Humanização - PNH*. Brasília: Ministério da Saúde. Disponível em: [Link não fornecido]. Acesso em: 09 jun. 2024.

4. Brasil. Secretaria de Educação Fundamental. (1998). *Parâmetros curriculares nacionais: terceiro e quarto ciclos: apresentação dos temas transversais*. Secretaria de Educação Fundamental. Brasília: MEC/SEF. Disponível em: http://portal.mec.gov.br/seb/arquivos/pdf/ttransversais.pdf. Acesso em: 09 set. 2024.

5. Casate, C. J., & Correa, A. K. (2012). Política Nacional de Humanização e formação dos profissionais de saúde: revisão integrativa. *Revista Esc Enferm USP*, 46(1), 219-226.

6. Câmara, A. G., Macêdo Júnior, A. M., Alcoforado, D. S. G., Souza, M. F. B., & Fonseca, M. C. (2022). A visão de estudantes de enfermagem acerca da humanização no processo de formação. *Scire Salutis, 12*(4), 88-103. https://doi.org/10.6008/CBPC2236-9600.2022.004.0009

7. Cellard, A. (2008). A análise documental. In J. Poupart et al. (Org.), *A pesquisa qualitativa: enfoques epistemológicos e metodológicos* (pp. 267-281). Petrópolis: Vozes.

8. Debald, B. (2020). Ensino superior e aprendizagem ativa: da reprodução à construção de conhecimentos. In B. Debald (Org.), *Metodologias ativas no Ensino Superior*. Porto Alegre: Penso.

9. Freire, P. (1970). *Pedagogia do oprimido* (17ª ed.). Rio de Janeiro: Paz e Terra. Disponível em: https://pibid.unespar.edu.br/noticias/paulo-freire-1970-pedagogia-do-oprimido.pdf/view. Acesso em: 08 jun. 2024.

10. Horta, W. A. (1974). Enfermagem: teoria, conceitos, princípios e processo. *Revista Escola Enfermagem USP, 8*, 7-15. Disponível em: [Link não fornecido]. Acesso em: 08 jun. 2024.

11. Lydines Martins Corsino, D., & Bonafé Sei, M. (2019). A Humanização nas Grades Curriculares de Cursos da Saúde de Universidades Públicas Paranaenses. *Revista Psicologia e Saúde, 11*(1), 43-52. https://doi.org/10.20435/pssa.v0i0.579. Disponível em: https://pssaucdb.emnuvens.com.br/pssa/article/view/579. Acesso em: 10 set. 2024.

12. Moran, J. (2018). Metodologias ativas para uma aprendizagem mais profunda. In L. Bacich & J. Moran (Orgs.), *Metodologias ativas para uma educação inovadora: uma abordagem teórico-prática*. Porto Alegre: Penso.

13. Morin, E. (2005). *Introdução ao pensamento complexo*. Porto Alegre: Ed. Meridional/Sulina. Disponível em: https://edisciplinas.usp.br/pluginfile.php/5566228/mod_resource/content/1/LIVRO%20Edgar%20Morin%20-%20Introduc%CC%A7a%CC%83o%20ao%20Pensamento%20Complexo.pdf. Acesso em: 11 jun. 2024.

14. Nishikawa-Pacher, A. (2022). Research Questions with PICO: A Universal Mnemonic. *Publications, 10*, 21. https://doi.org/10.3390/publications10030021. Acesso em: 08 jun. 2024.

15. Silva, A. C. de M., & Sei, M. B. (2021). A Humanização na Formação Acadêmica em Saúde: Perspectiva de Egressos de um Projeto de Extensão. *Revista Psicologia e Saúde, 13*(3), 3-18. https://doi.org/10.20435/pssa.v13i3.1269. Disponível em: https://pssa.ucdb.br/pssa/article/view/1269. Acesso em: 10 set. 2024.

16. Villela, M. S., & Ely, V. H. M. B. (2022). Humanização na ambiência de Práticas Integrativas e Complementares: significado de bem-estar na perspectiva dos usuários. *Ciência & Saúde Coletiva, 27*(5), 2011-2022. https://doi.org/10.1590/1413-81232022275.07702021. Acesso em: 11 jun. 2024.

17. Rangel, R. F., Paula, S. F., Zamberlan, C., Backes, D. S., Medeiros, A. C., & Siqueira, H. C. H. (2020). Comprehensive care from the perspective of nurses: an ecosystem approach. *Revista Brasileira de Enfermagem, 73*(Suppl 6), e20190781. https://doi.org/10.1590/0034-7167-2019-0781

Administrative Headquarters of the Forestry Foundation: A study of the design process, construction technique, structure and environment

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ABSTRACT

Studies with an environmental context are of great importance, such as the analysis of the Administrative Headquarters of the Forestry Foundation with the intention of the architects to contribute to the sustainability and regeneration of the surrounding areas, especially with the use of wood and the incorporation of CO_2. This is carried out during the growth of trees as it is a renewable material. The objective of the work is to study the design and construction process of this work. As a methodology is the case study and the form of analysis of the design process, construction, and structure through graphic analysis.

Keywords: Sustainability, Modularity, Glued Laminated Timber (CLM), Diagram.

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INTRODUCTION

Architecture and urbanism, in the context of the built environment, mirror cultural and social values through construction techniques, resulting from the convergence between humanity and its surroundings. The city is made up of buildings and public and private spaces, and is related to the behavioural and value systems of the inhabitants (Ghione, 2012).

The aspects of this relationship between the human being and the environment apply in several areas of knowledge. When these are fragmented, there is a greater professional difficulty in understanding multidisciplinarity. Consequently, such fragmentation diminishes the possibility of a broader and more integrated investigative process (Elali, 1997).

Based on the importance of multidisciplinarity and the relationship between man and city, this article aims to analyze the integration between architectural design, sustainability, construction technology, design processes, with the study of the Administrative Headquarters of the Forestry Foundation, of the Forestry Foundation of the State of São Paulo.

Brook; Masini (2014) study works that evaluate the design process with emphasis, what was analyzed, type of diagrams and the means of representation among the authors highlight the works of Francis Ching Architecture-Form, Space and Order (2002) Roger H. Clark, Michael Pause, Architecture: themes of Composición (1983), Peter Eisenman. Diez edficios canónicos 1950–2000 (2011) and his doctorate, Ana Maria Tagliari (2012), with the thesis entitled "The unbuilt residential projects of Vilanova Artigas in São Paulo".

The project of the Forestry Foundation will be discussed through graphic analyses, according to Tagliari (2009, p.1) this "comprises a set of items that allow the investigation of the organization of forms in space" and the analyses seek "formal and spatial aspects of the projects and their organization." The study investigates these "principles through diagrams of practical and clear understanding".

This type of analysis "can reveal hidden aspects in the drawings that we could hardly reach only by textual resources", so it is a relevant tool that can "be applied in the reading of works of architecture" to understand the formal aspects that "are part of the architectural proposal, whether of an aesthetic, constructive or conceptual nature" (TAGLIARI, 2008, p.4).

Tagliari; Florio; (2010) argue that this is a "means of a process of extraction and separation of attributes, diagrams facilitate the organization of ideas in a visual way." Researchers can "analyze, and graphically compare specific characteristics of the building or the architectural artistic artifact, detaching the parts from the whole", seeking to understand the design and construction process.

As a methodology, a single case study will be applied with emphasis on the Administrative Headquarters of the Floresta Foundation, applying the concept of diagrams by lines, contours and geometric figures. The authors Tagliari; Florio (2010) recommend the redesign of the

"axonometrics", based on executive projects associated with photographs. We reinforce the fundamental reference of the method in this study was discussed in Florio *et al*.(2002), as well as for the analysis of the case study, the parameters of the authors Roger Clark and Michael Pause, whose book title is "Precedents **in architecture:** Analytic diagrams, formative ideas and parts", published in 2012, will be adopted.

In the analysis, the context of the work, structure, natural light, section and plan, circulation and uses, repetition of forms, modulation, symmetry, addition and subtraction will be valued. In addition to the topics of graphic analysis, a survey of other aspects pertinent to the project will be made, with the decomposition of the work into form and structure, the description of the construction process, understanding of the materiality, the structural system, the fences, and the means of protection of the wooden structure.

CASE STUDY PROJECT: ADMINISTRATIVE HEADQUARTERS FUNDAÇÃO FLORESTAL 23 SUL ARQUITETOS YEAR: 2016

The context of the insertion of the project of the administrative headquarters of the Forestry Foundation takes place in the middle of an Atlantic Forest reserve near the coast in the city of Barra do Una in the state of São Paulo, the area "is part of the socio-environmental recovery program of the Serra do Mar and the Atlantic Forest Mosaic System" (23 SOUTH, 2019). The project was the subject of a public bidding in 2016, the architects of the São Paulo office 23 Sul were the winners to design the "Administrative Headquarters of the Mosaic of Conservation Units of Juréia-Itatins (MUCJI) and the Bases for Coexistence and Monitoring of Sustainable Use Reserves (RDS) and Ecological Parks (PE)" (23 SUL, 2019, p.1).

In the search for sustainability in order to expand the life cycle, "the entire process", ranging from design and construction to the operation of buildings, was designed "to generate the least possible environmental impact, considering the difficulty of access and the absence of drinking water, sewage and electrical network infrastructure" (23 SUL, 2019, p.1). The construction system was designed in light materials, both structure and fences, as an American system, seeking to "minimize waste in construction". The work was carried out by Rewood.

According to Green (2012), wood is a renewable material and constitutes a structural element with potential in relation to the impacts of climate change of anthropogenic action. In addition, sustainable development in architecture requires measures to reduce carbon and greenhouse gas emissions into the atmosphere.

A forest represents a large carbon reservoir, as it removes carbon dioxide (CO_2) from the atmosphere and stores carbon in vegetation and soil; when properly maintained (Green, 2012). When

wood is used in construction, the carbon dioxide, absorbed during the growth of the tree, remains stored for tens and hundreds of years (Müller, 2005).

The efficiency of removing carbon dioxide (CO_2) from the atmosphere and transforming it into oxygen (O_2) depends, from sustainable forestry, to the management of wood products at the end of the life cycle of the building (Green, 2012). Materials such as steel and concrete consume a lot of energy and emit high rates of carbon dioxide in manufacturing processes. Concrete corresponds to 5% to 8%, and steel corresponds to 4% of greenhouse gas emissions for the planet (Giorgi, 2020).

Therefore, the use of glued laminated wood (CLM) in the project of the Forestry Foundation Administrative Headquarters in the structure is due to the factors highlighted above and because it is a light, industrialized material, relieving the weight on the foundations". In the enclosures, architects applied "modular partitions in a self-supporting system, with standardized wooden frames, honeycomb polycarbonate and MDF enclosures, thermoacoustic tiles and Wall panel floors." (23SUL, 2019, p.1)

Glued Laminated Wood (CLM) is composed of wooden lamellae (boards), joined by gluing and arranged parallel to each other, that is, the fibers of these boards are positioned parallel to each other. It had its advance simultaneously with the efficiency of the glues, which are fundamental for the proper structural use of the material (Calil, 2011).

According to Ino and Silva (2008), the classification of construction systems based on the prefabrication method is an appropriate classification criterion for wooden structures.

Figure 1: Classification of construction systems based on the prefabrication method

Construção em entramado ou esqueleto	Formada por um esqueleto portante, contraventado por diagonais e fechamento em capa dupla ou maciça
Construção com painéis compostos	Paredes portantes formadas por painéis sanduíche ou placas compostas

Source: Ino e Silva (2008).

According to the table in figure 1, the classification of the project's construction systems by the prefabrication methodology would be construction in intersection or supporting skeleton; with MLC column and beam system.

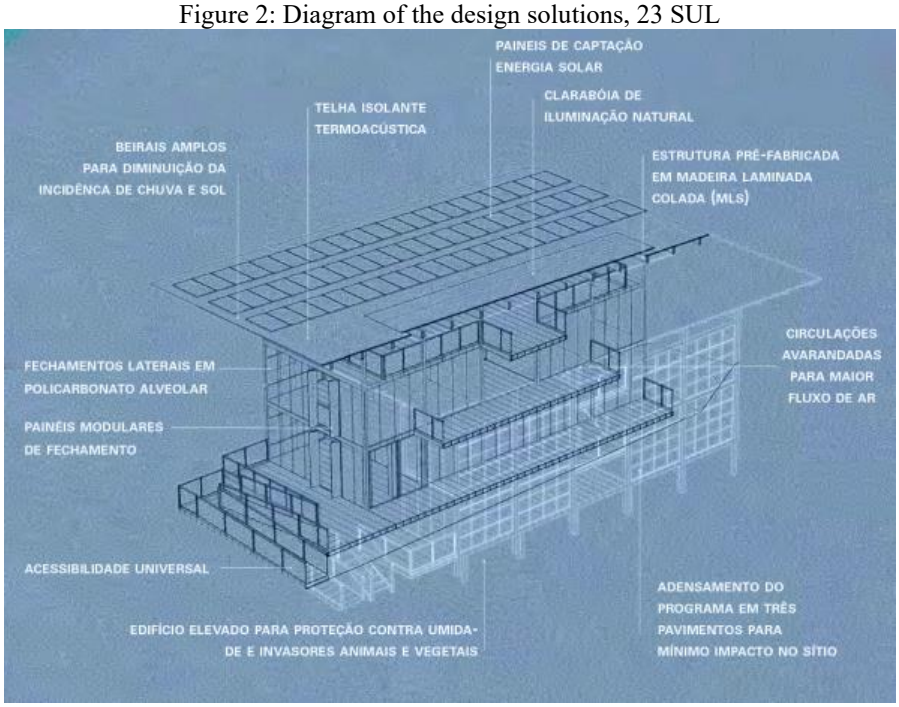
The project sought solutions of high energy efficiency and environmental comfort, in addition to "electrical self-sufficiency with photovoltaic panels, the reuse of rainwater, effluent treatment and waste control". The building raised from the ground due to "the tropical climate with prolonged rains" and for the protection of the wood, "a roof with large eaves, facades with thick honeycomb polycarbonate, natural cross ventilation and circulations and balconies" were planned.

In the center, the main uses are the "operational and legal" and this is "responsible for the management of the conservation units of the Mosaic, in addition to centralizing educational and

scientific research actions." This program was housed "on three floors, minimizing the impact on the terrain" (23SUL, 2019, p.1).

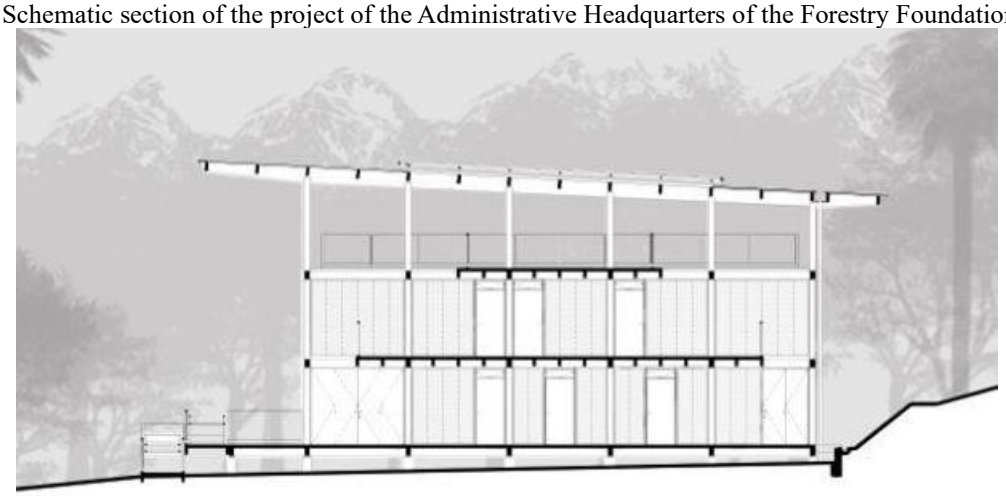
In this way, the proposed project presents itself as a social and sustainability reference equipment, especially for the "communities that historically inhabit Brazilian natural reserves" (23 SUL, 2019).

Figure 2: Diagram of the design solutions, 23 SUL



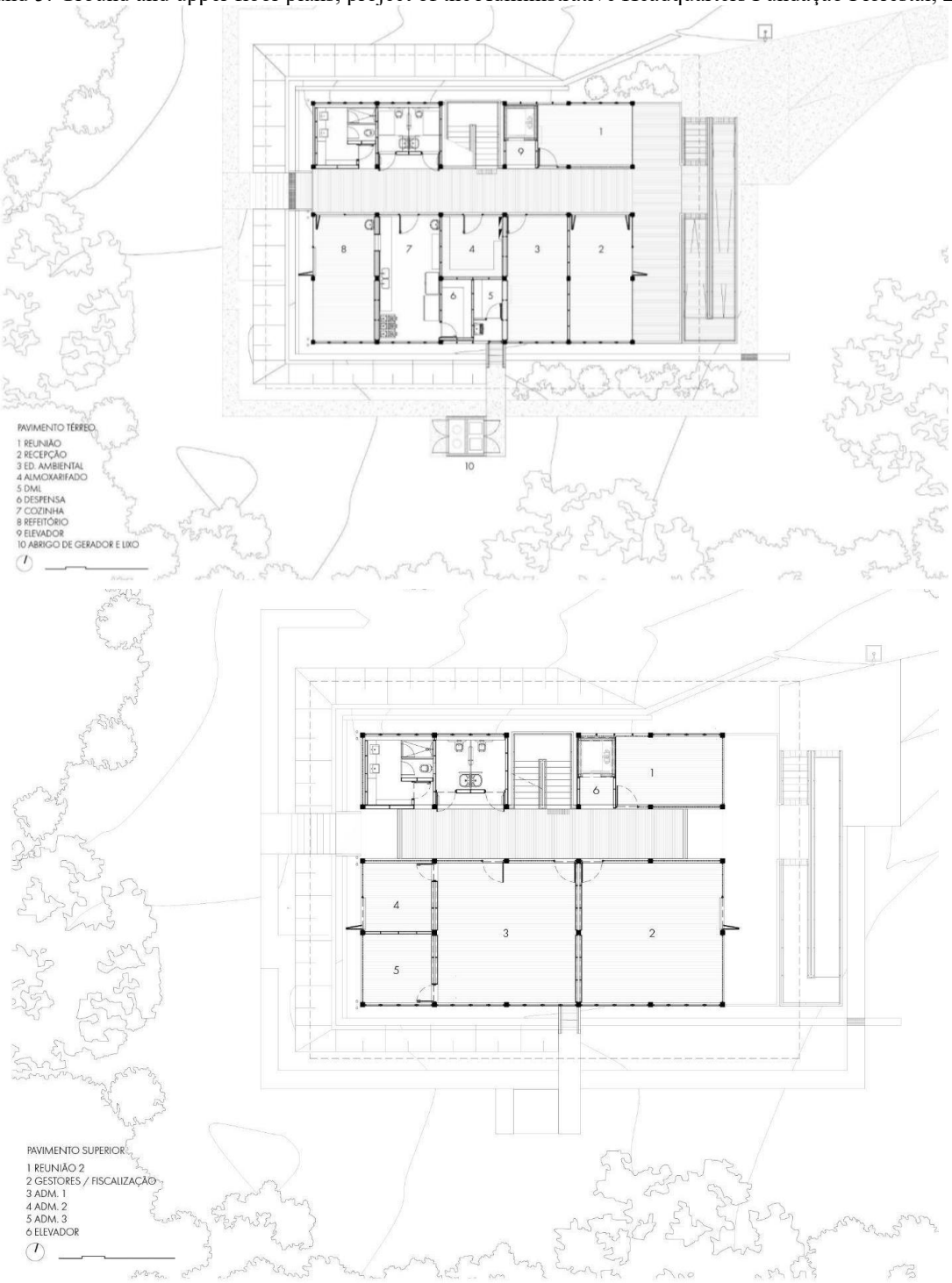
Source:https://www.archdaily.com.br/br/973978/sede-administrativa-fundacao-florestal-nil-jureia-itatins-23-sul-arquitetura

Figure 3: Schematic section of the project of the Administrative Headquarters of the Forestry Foundation, 23 SUL



Fonte: http://www.23sul.com.b

Figure 4 and 5: Ground and upper floor plans, project of the Administrative Headquarters Fundação Florestal, 23 SUL



Source:https://www.archdaily.com.br/br/973978/sede-administrativa-fundacao-florestal-nil-jureia-itatins-23-sul-arquitetur

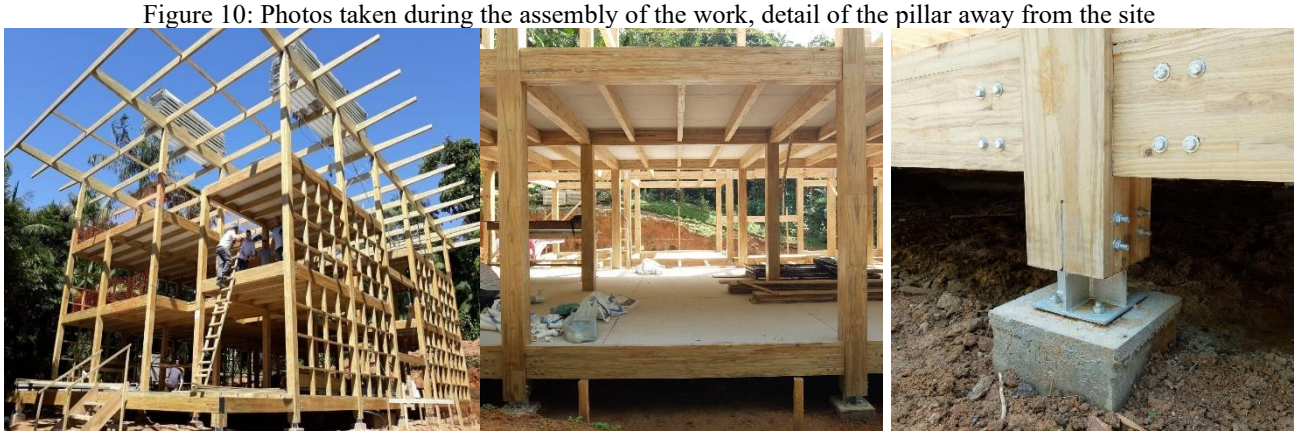
Figure 6: Photo of the side façade, Author: Pedro Kok, 2018

Fonte: http://www.23sul.com.br/

Figure 7: Photo of the internal and lateral façade, Author: Pedro Kok, 2018

Fonte: http://www.23sul.com.br/

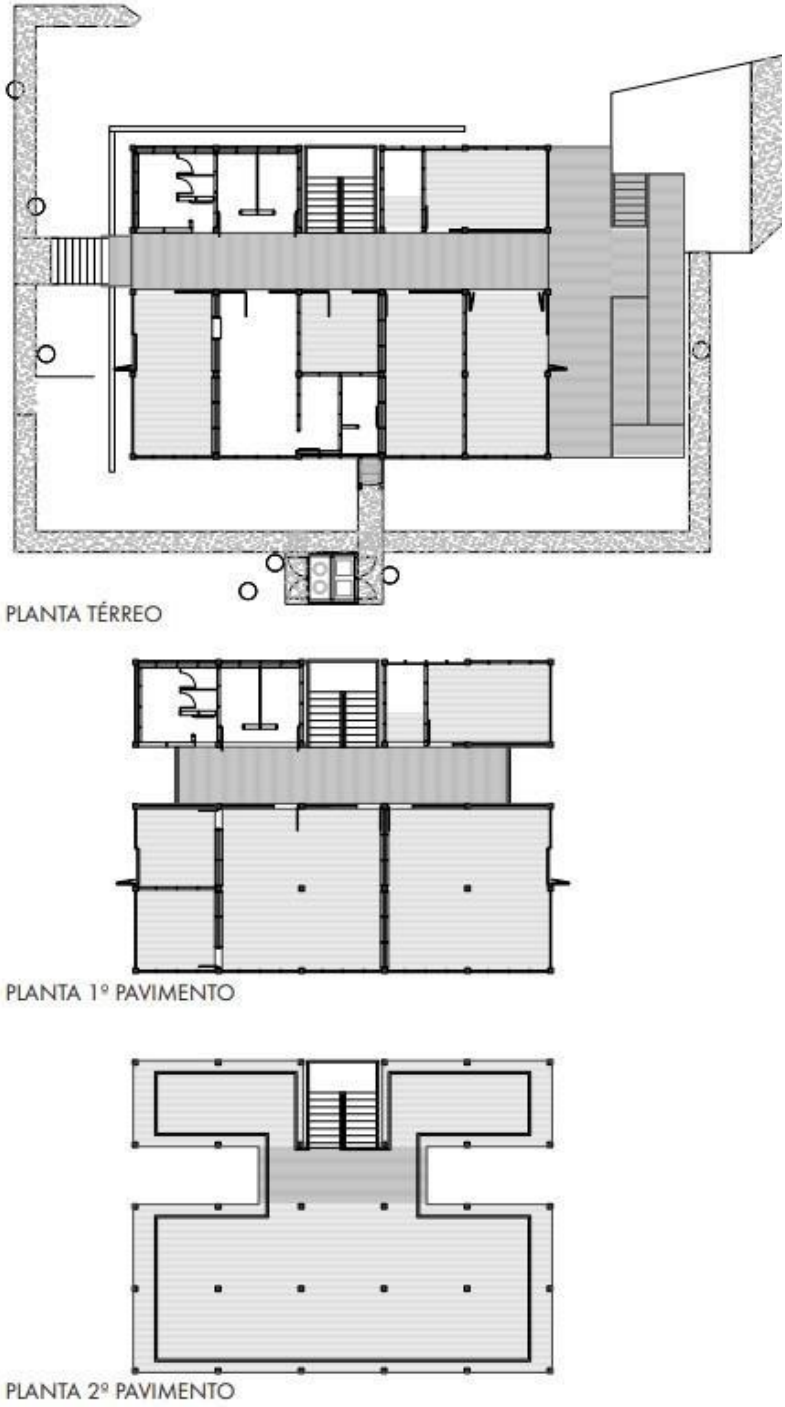
Figures 8 and 9: Photos taken during the assembly of the work, shows the grid structure of the MLC
Figure 10: Photos taken during the assembly of the work, detail of the pillar away from the site



Fonte: http://www.23sul.com.br/

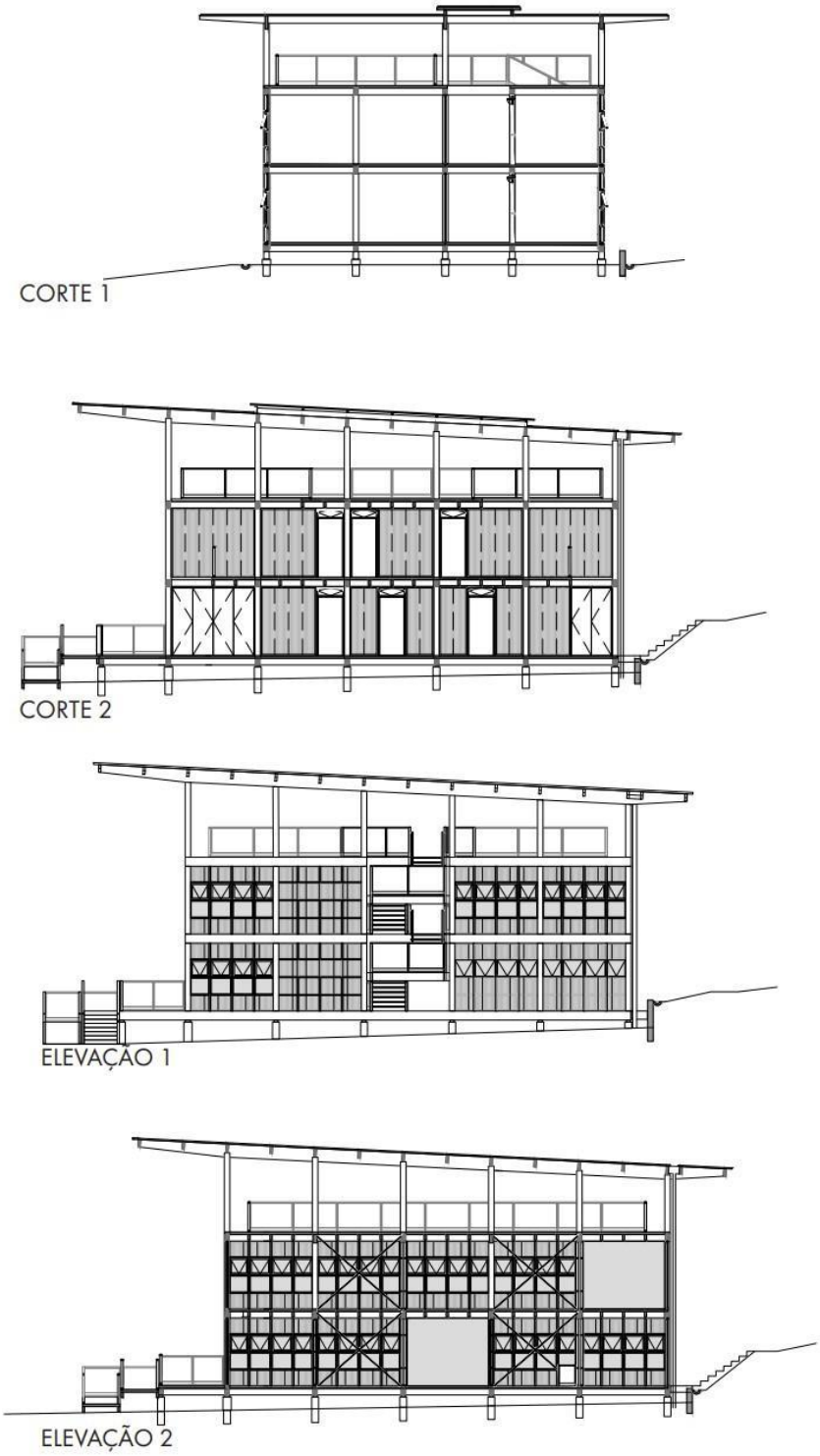
PROJECT: ADMINISTRATIVE HEADQUARTERS OF THE FORESTRY FOUNDATION, 2016

Figure 11: Redesign of pavement plans, Forestry Foundation project



Source: author

Figure 12: Complete redesign of the project in Archicad with plans, sections, and elevations

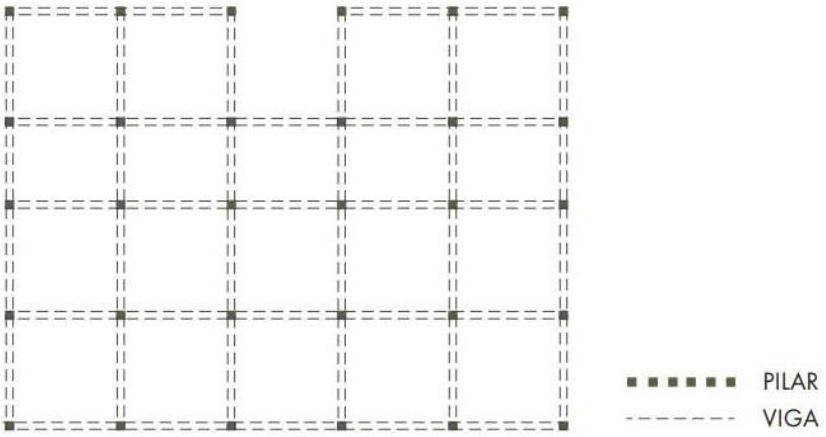


Source: the author

ANALYSIS DIAGRAMS

PROJECT: ADMINISTRATIVE HEADQUARTERS OF THE FORESTRY FOUNDATION, 2016

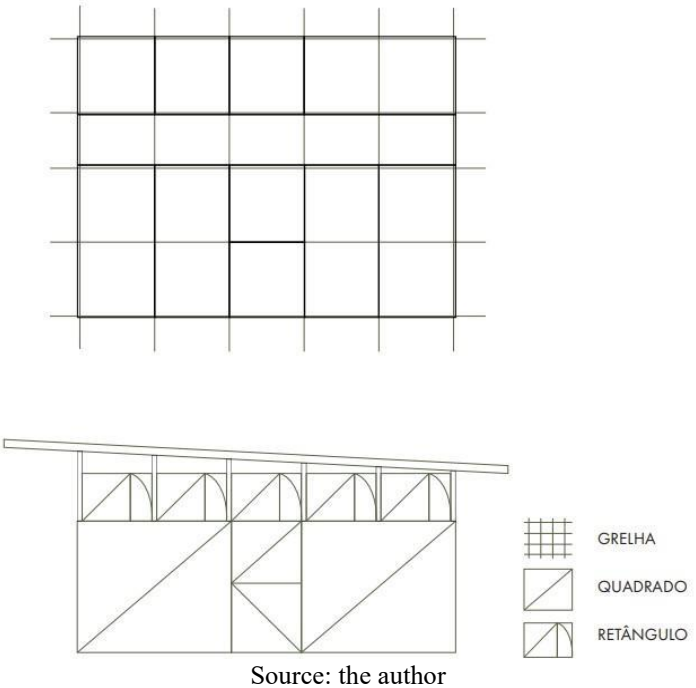
Figure 13: Structure diagram



Source: the author

The structure shows the modularity of MLC pillars and beams, with the formation of a grid and the square geometry in plan.

Figure 14: Geometry diagram

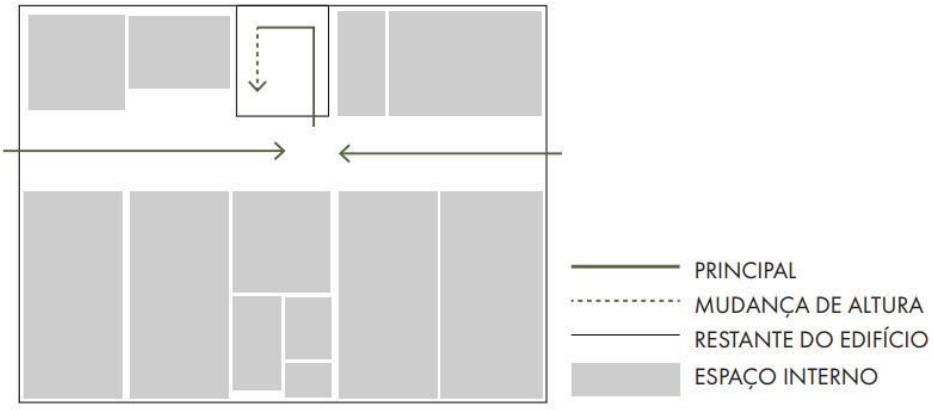


Source: the author

In the diagram of comparison between plan and section, the square geometry found in the plan is repeated in the modulation of the façade panels in larger proportions and rectangles are created between the structure and the roof.

In the analysis of the main circulation axes of the project, it is possible to notice in the plan a displacement of the main access in relation to the symmetry aspect of the building, which results or can be the former of internal spaces with varied dimensions to meet the uses of the program of needs.

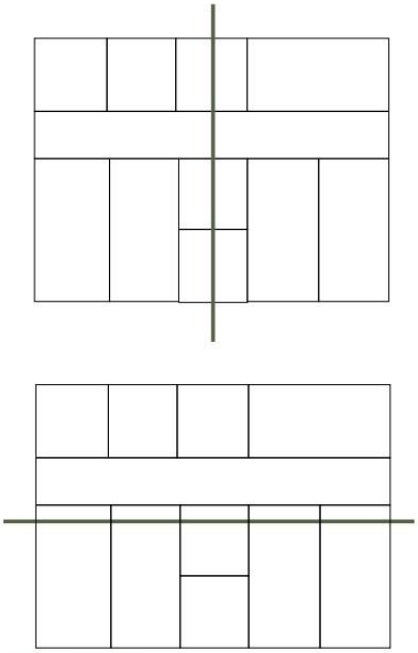
Figure 15: Circulation diagram



Source: the author

In the symmetry aspect, this displacement of the main circulation axis is clear in relation to the main façade, generating a certain imbalance in the plan, while the circulation axis on the side facades appears in perfect symmetry and balance.

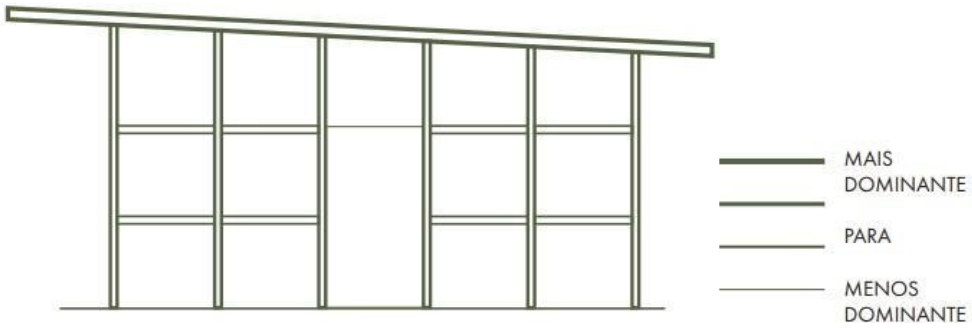
Figure 16: Symmetry and equilibrium diagram



Source: the author

The hierarchy was evaluated in view, where the roof stands out as the largest element of the building and for its distance from the main body brings greater notoriety in the context. The other dominant layer in the façade hierarchy are the pillars and beams, with their modularity and repetition, they have a certain dominance.

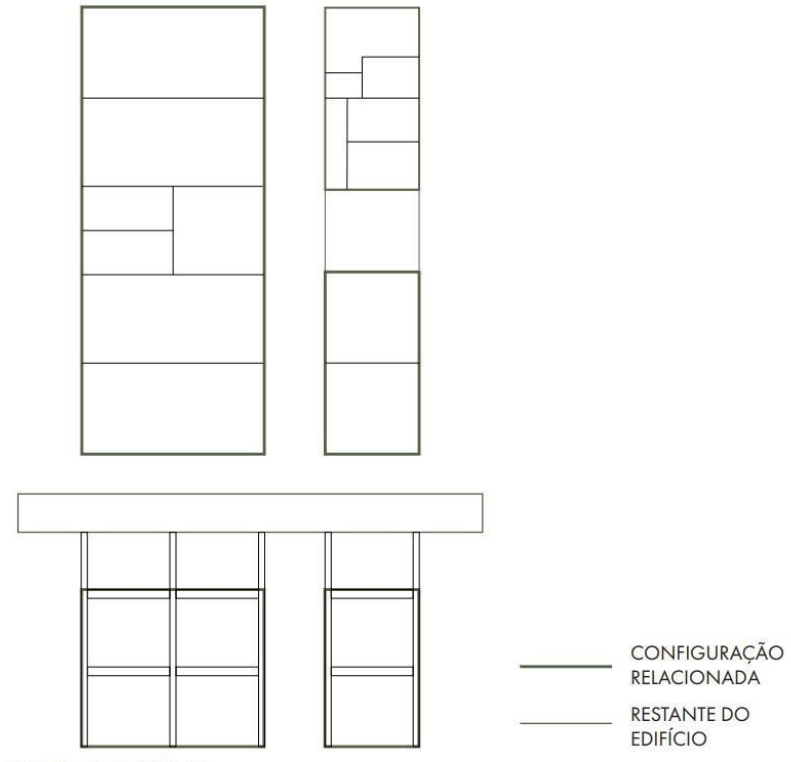
Figure 17: Hierarchy Diagram



Source: the author

In the configuration between plan and façade, the proportion of the internal environments in plan can be seen with the same dimension in relation to the modularity of the facades, this is due to the design of the structure of beams and pillars forming a grid.

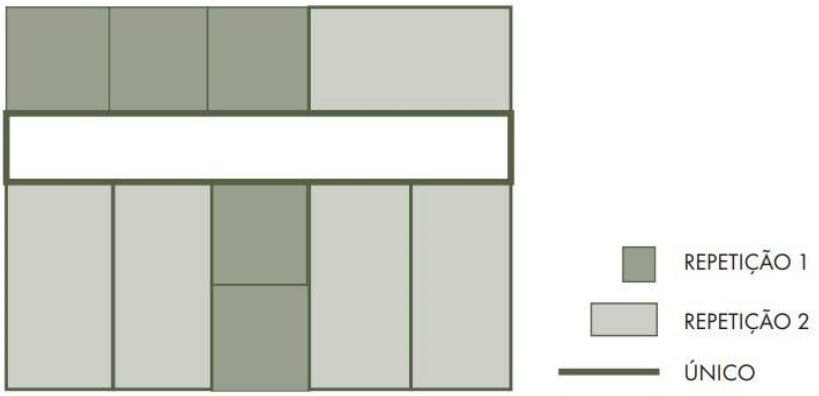
Figure 18: Diagram of Related Shapes



Source: the author

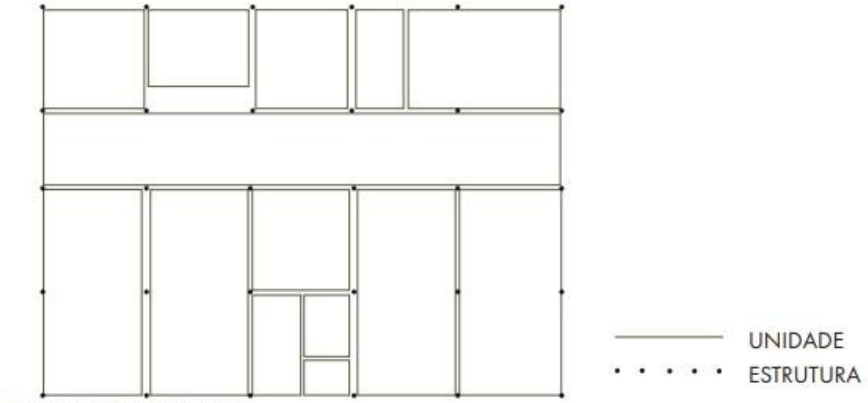
When evaluating the internal environments due to the modularity of the structure and the façade closing panels, room volumes and compartmentalization are created with great repetition and little variation. What appears as a divergent and unique element, circulation.

Figure 19: Repeat diagram



Source: the author

Figure 20: Whole and part diagram

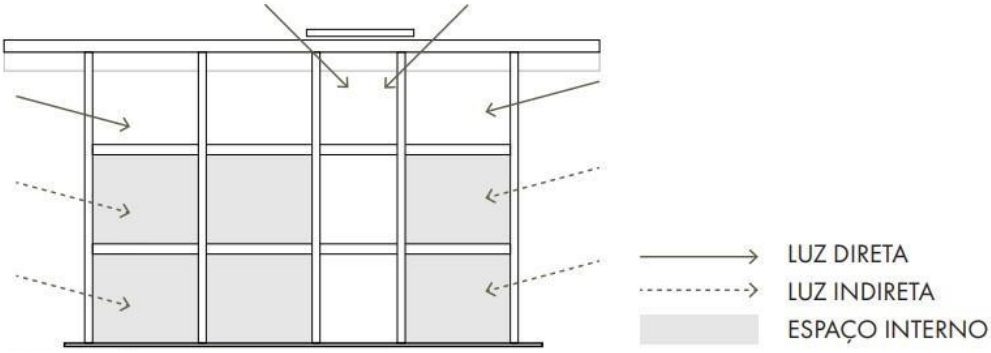


Source: the author

When evaluating the internal environments due to the modularity of the structure and the façade closing panels, room volumes and compartmentalization are created with great repetition and little variation. What appears as a divergent and unique element, circulation.

The natural lighting diagram indicates a potential for direct light falling on the entire circulation axis of the project given its balcony character, which adds to the distance from the roof and the creation of a patio that functions as a viewpoint on the top floor. Facades have different materials and opacities, influencing the passage of natural light to the internal space, when the use of polycarbonate filters direct sunlight and creates indirect light panels internally.

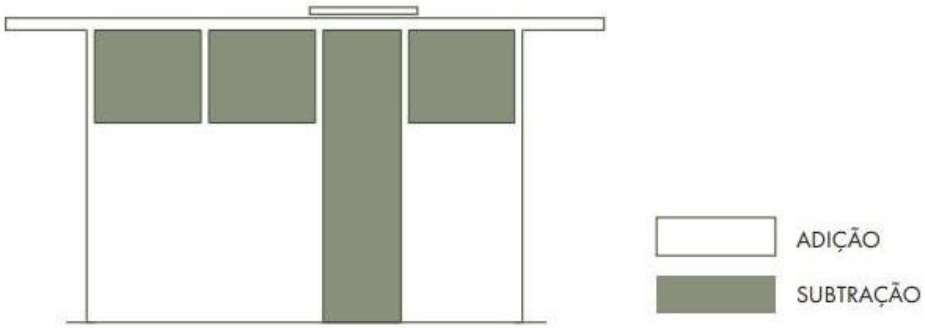
Figure 21: Daylighting diagram



Source: the author

Finally, the addition and subtraction diagram demonstrates the full and empty of the building. The removal of sealing elements in the horizontal and vertical circulations, in the stair block, is evident in the graphical analysis. Another notable subtraction is the large observation deck on the top floor where the roof seems to float under the volume of the building.

Figure 22: Addition and subtraction diagram



Source: the author

By analyzing the project graphically, it was possible to notice the strong influence of Gropius' and Bauhaus' thought by the modularity and uniformity of the solution, without ornamentation. The grid or grid structure created modulations in the facades, with linear pillars and beams in MLC and enclosures that function independently of the building structure.

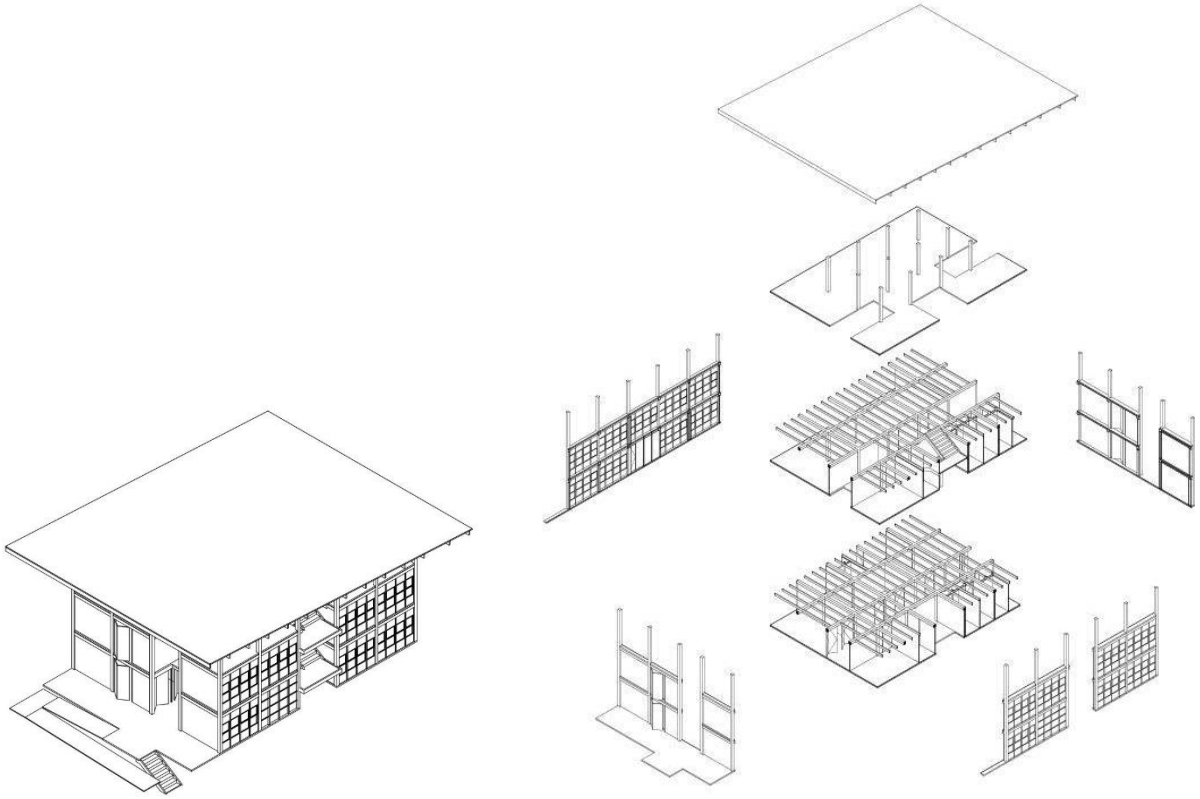
The roof with only 1 pitch in the hierarchy of the set stands out for its dimension as a single inclined element, however, despite its graphic weight in the design, the materiality chosen, thermoacoustic tile, makes it light and elegant, in addition to allowing air to circulate in the space, promoting the thermal comfort of the building.

The circulation axis connects with ventilation and natural lighting, the voids created in the volumetry represent the three common aspects and unified with the staircase and balconies that function as circulation of people, wind and natural light. Thermal comfort is guaranteed by these voids and by the roof suspended like a large parasol made with MLC beams and thermoacoustic tiles.

In terms of symmetry, the project makes a small shift in the circulation axis and this becomes visible on the main façade, while on the side facades it establishes perfect symmetry between the two sides with the exception of the slope of the roof.

In figure XXX below, it is possible to see the primary beams that receive the wall panel slabs and the secondary ones that distribute the load evenly on the supports.

Figure 23: Redrawn isometric perspective and exploded isometric perspective



Source: author

FINAL CONSIDERATION

The analysis of the work Administrative Headquarters of the Forestry Foundation, shows the strong relationship between the modular wooden project and the search for sustainability, in this context the work presents a lower environmental impact due to inferring in a few points of the soil, as well as a longer life cycle of the buildings seeking greater durability of the wooden work with large eaves and elevations in relation to the ground preventing the unit from rising, It uses large eaves that protect the wood and sealing, and the quality of the project defines thermal comfort, raising the roof and creating the possibility of cross ventilation. Analysis through diagrams makes it clear that design and construction can have a positive or negative impact, as they depend on multidisciplinary knowledge, from the local culture, the environment and design decisions.

REFERENCES

1. Aflalo, M., Dominique Gauzin-Müller, Martins, A., & Wisnik, G. (2005). *Madeira como estrutura: a história da Ita*. São Paulo: Paralaxe.

2. 23 UL Arquitetura. (2019). Sede Administrativa Fundação Florestal — Juréia-Itatins Peruíbe–SP. *Projetos*, Vitruvius. Disponível em: https://vitruvius.com.br/revistas/read/projetos/22.259/8558. Acesso em: 10 maio 2024.

3. Calil Neto, C. (2011). *Madeira Laminada Colada (MLC): controle de qualidade em combinações espécie-adesivo-tratamento preservativo* (Dissertação de Mestrado). Universidade de São Paulo, São Carlos.

4. Clark, R. H., & Pause, M. (1983). *Arquitectura: temas de composição*. Barcelona: Gustavo Gili.

5. Clark, R. H., & Pause, M. (2012). *Precedents in architecture: analytic diagrams, formative ideas, and parties*. John Wiley & Sons.

6. Ching, F. D. K. (2002). *Arquitetura: forma, espaço e ordem*. São Paulo: Martins Fontes. [Original publicado em 1996].

7. Eisenman, P. (2011). *Diez Edifícios Canónicos 1950-2000*. Barcelona: Gustavo Gili.

8. Florio, W., Gallo, H., Santana, S. S., & Magalhães, F. (2002). *Projeto residencial moderno e contemporâneo: análise gráfica dos princípios de forma, ordem e espaço de exemplares da produção arquitetônica residencial - residências internacionais* (Vol. 1). São Paulo: MackPesquisa.

9. Ghione, R. (2012). Que cidade estamos construindo? Metrópole e sociedade contemporânea. *Minha Cidade, 12*(143.01). Vitruvius. Disponível em: https://vitruvius.com.br/revistas/read/minhacidade/12.143/4369.

10. Green, M. C. (2012). *The case for tall wood buildings: How mass timber offers a safe, economical, and environmentally friendly alternative for tall building structures*. Canadá: Mgb Architecture + Design Equilibrium Consulting Lmdg Ltd Bty Group.

11. Giorgi, R. S. N. (2020). *Edifícios de múltiplos pavimentos em estrutura de madeira: Processos construtivos e diretrizes para projeto* (Dissertação de Mestrado). Universidade Presbiteriana Mackenzie, São Paulo.

12. Ino, A., & Silva, R. D. (2008). Habitação econômica em madeira no Brasil: estado da arte. In *XI EBRAMEM - Encontro Brasileiro em Madeira e Estruturas de Madeira* (pp. 1-14). Londrina: Ebramem.

13. Ribeiro, P. P. A., & Masini, D. F. (2014). Análise gráfica-síntese e conhecimento da arquitetura. In *Anais do III ENANPARQ-arquitetura, cidade e projeto: uma construção coletiva* (pp. 1-17).

14. Tagliari, A. (2008). *Os princípios orgânicos na obra de Frank Lloyd Wright: uma abordagem gráfica de exemplares residenciais* (Dissertação de Mestrado). Instituto de Artes da Universidade Estadual de Campinas, Campinas.

15. Tagliari, A. (2009). Análise de forma e espaço pelo método gráfico: Residências Usonian de Frank Lloyd Wright. In *IV Projetar. Projeto como Investigação: Ensino, Pesquisa e Prática*. São Paulo.

16. Tagliari, A., & Florio, W. (2010). Teoria e prática em análise gráfica de projetos de arquitetura. *Educação Gráfica*, 13, 211-227.

17. Tagliari, A. M. (2012). *Os projetos residenciais não-construídos de Vilanova Artigas em São Paulo* (Tese de Doutorado). FAUUSP, São Paulo.

Prevalence of periapical lesions in endodontically treated teeth at the FOP-UPE specialization clinic

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ABSTRACT

The aim of the present study is to determine the prevalence of periradicular lesions in permanent anterior teeth treated endodontically and in teeth with intraradicular retainers through the analysis of periapical radiographs. A survey of 1000 radiographs of patients treated endodontically in the dental clinics of the Faculty of Dentistry of Pernambuco – FOP/UPE was carried out, constituting a sample of 467 radiographs that fit the established criteria. In the analysis, the following data were collected: canal obturation limit, presence or absence of periapical lesion, homogeneity of the filling material characterized as without failure or with failure when presence of any radiotransparency in the root canal, presence or absence of the space between the intraradicular retainer and filling material and coronary sealing classified as adequate or inadequate. Through the data obtained, the highest frequencies corresponded to maxillary incisor teeth. It indicated that the filling

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limit characterized as beyond the apical foramen was the one with the highest rate of periapical lesion presence (66.7%), followed by the filling limit characterized as exact (32.4%).

Keywords: Endodontics, Quality of treatment, Periapical radiograph, Periapical lesion.

INTRODUCTION

Endodontics is the specialty of Dentistry that studies and treats changes in the dental pulp, periradicular tissues, and is dedicated to evaluating their morphology, physiology and pathology. The study and practice of this area involve basic and clinical sciences, including the biology of healthy pulp, the etiology, diagnosis, prevention and treatment of pulp diseases and injuries, associated or not, with periradicular alterations.

The pulp tissue is protected by its natural structure from external bacterial agents of the oral cavity, however, when factors such as caries, dental trauma, or restorations allow the integrity of the tissues that protect the pulp to be broken, they contribute to the emergence of infections in the dentin-pulp complex, possibly causing pulp and periapical disease.

As a treatment for these infections, endodontic treatment is performed, which has currently favored the increase in success rates thanks to new techniques, instruments, materials and, mainly, the awareness of professionals. However, this fact does not dispense with clinical and radiographic control of endodontic treatments after their completion.

"There are several methods to diagnose periradicular lesions, among them is the radiographic method. Among the possibilities of radiographic takes, periapical radiography is the one that makes it possible to observe the periradicular region, providing a detailed view of the root and surrounding structures. " (FREITAS, 1998).

"Longitudinal studies carried out in places where endodontic treatment is performed in controlled environments point to a 95% chance of success. " (STRINDBERG, 1956; SJÖGREN et al., 1997). "However, in studies where this controlled environment does not exist, or even when endodontic treatment is performed by general practitioners, the success rate can vary between 35% and 60%. " (ERIKSEN et al., 1995; SEGURA-EGEA et al., 2004).

Based on these premises, the objective of the present study is to determine the prevalence of periradicular lesions in permanent anterior teeth treated endodontically and in teeth with intraradicular retainers through the analysis of periapical radiographs.

LITERATURE REVIEW

PERIAPICAL LESION OF ENDODONTIC ORIGIN: BASIC CONCEPTS, DIAGNOSIS AND TREATMENT

The presence of bacteria in the root canal system is the primary etiological factor for the development of an AP. Radiolucidity is an important characteristic for its diagnosis (KAKEHASHI, STANLEY, FITZGERALD, 1965).

Inflammation of the periodontium is called apical periodontitis. Its etiology is related to the infection of the tissues of the root canal system and the surrounding dentin, in some cases, also of

tissues beyond the apical foramen. Typically, the lesion is located at the vertex of the root, but communications may exist along the root surface and the lesions may develop laterally or in the furcation region (HUUMONEN, ØRSTAVIK, 2002).

Inflammation and destruction of periradicular tissues caused by etiological agents of endodontic origin is called PA. In general, it is a sequelae of root canal infection seen as a dynamic interaction between microbial factors and host defense at the interface between the root pulp and the periodontal ligament. The name periapical lesion encompasses several histopathological categories of AP. The most frequent gateways for endodontic infections are the result of caries, clinical procedures, and traumas that induce cracks or fractures. The goal of endodontic treatment is to eliminate root canal infection and prevent reinfectionthrough filling. When treatment is done properly, BP cures with bone regeneration, which is characterized by the gradual decrease and disappearance of radiolucent on preservation radiographs. Most failures occur when treatment procedures, mainly of a technical nature, have not reached a satisfactory level for the control and elimination of infection (NAIR, 2004).

Apical periodontitis is a general term used to describe the inflammatory periapical process that occurs in response to the presence of microorganisms and other irritants within a tooth's root canal system. Although many patients may develop apical periodontitis without symptoms over a long period of time, it is very likely that acute exacerbation will occur at some point and then various signs and symptoms will become evident. However, there are other conditions that mimic BP, such as an advanced stage of pulpitis, periodontal disease, occlusal trauma, an accident that damages the periodontal ligament, and multiple tumors or cysts. Therefore, it is essential to understand the progressive nature of the periapical disease process, how and why the various stages occur, so that the pathology can be diagnosed and treated appropriately. Diagnosis will usually be based on the clinical and radiographic manifestations and the results of various tests that may be performed as part of a routine dental exam. Teeth with acute primary BP have very marked sensitivity to percussion and pain when pressure is applied. Radiographically, a slight thickening of the ligament space and some loss of the lamina dura around the apex of the tooth root may be found, or present in a normal manner. The dental element may have some mobility and the onset of pain is usually sudden and unexpected. The patient will experience considerable pain when biting and touching the tooth and possibly a sensation of pressure building up in the periapical region. Secondary acute BP presents with pain symptoms similar to those present in primary acute BP, but there will be more clinical and radiographic signs to aid in the diagnosis, since it is an acute exacerbation of a chronic BP. There may be a history of previous episodes of pain or discomfort, but many patients may not remember such details. Radiographically there will be a radiolucent around the root vertex of the involved tooth and loss of the hard lamina. The size of radiolucency, which can range from just a thickening of the

periodontal ligament space in early cases to a large radiolucent area, is time dependent. However, these lesions progress at varying rates so the size of the area is not necessarily indicative of the time it has been present. Chronic BP varies in its clinical presentation, since this general term represents different histological conditions of the periapical disease process. Patients are usually unaware of any symptoms associated with these lesions, which are often only indicated as findings on routine radiographic examination. The pulp may be necrotic and infected, or the canal pulped and infected, or the canal may be treated and infected in the meantime. There will be no response to sensitivity tests and radiographically it will present a periapical radiolucent area. The tooth will show mild pain on percussion or palpation and will present slight mobility (ABBOTT, 2004).

Periapical granuloma and periapical cyst (true and bay) have exactly the same clinical and radiographic appearance. Although some authors state that clinical and radiographic diagnosis is based on periapical radiolucency or scathing of the periodontal ligament, the appearance of the radiolucency margins cannot be used as a diagnostic criterion to distinguish these conditions. It is now recognized that a well-defined margin indicates only a long-standing lesion that is slowly increasing in size, whereas a diffuse border probably indicates a rapid expansion of the lesion. The size of the radiolucent is also irrelevant for diagnosis, since small or large lesions can be granulomas, abscesses, or cysts. Therefore, the accurate diagnosis can only be conceived through histopathological examination. Since cysts and root granulomas are difficult to distinguish and their treatments are identical, they can be classified clinically with the general term of "apical periodontitis". These pathological processes are dynamic and the pathological entities are interchangeable, thus this more generalized diagnostic term is more valuable for clinical use (ABBOTT, 2004).

Lateral periodontal cysts, odontogenic keratocysts, dentigerous cysts, developmental cysts, central giant cell granuloma, traumatic bone cyst, and some forms of ameloblastoma must somehow be differentiated from apical periodontitis (COTTI, 2010).

Most apical periodontitis is found associated with endodontically treated teeth. The quality of this treatment is of fundamental importance for the favorable prognosis of healing the lesion (ECKERBOM, FLYGARE, MAGNUSSON, 2007). Scar tissue may develop after conventional endodontic treatment, causing complications in the diagnosis of periapical lesions (HUUMONEN, ØRSTAVIK, 2002).

Adequate endodontic treatment consists of completely filling the root canal and, if possible, the accessory canals, eliminating and preventing the re-entry of the aggressive agents. In patients with periapical lesions, endodontic treatment is successful when the lesion regression is radiographically observed over a few months. On the other hand, failure, in well-performed

treatments, should be associated with local factors, such as the great variability of apical morphology (CONSOLARO, 2008).

In vitro studies have shown that bacteria and their products penetrate filled channels after a certain period of exposure to artificial saliva or bacterial culture. Ricucci, Gröndahl and Bergenholtz (2000) conducted a retrospective cohort study of 55 patients who had teeth with an obturated canal, exposed to the oral environment due to caries or absent restorations to evaluate this infiltration. The cases were combined one by one with regard to the initial pulp and periapical diagnosis, time elapsed after the end of endodontic treatment, type of teeth, patient's age, and technical quality of the filling. Only cases with a follow-up period of three years or more were included. The last observation radiography was submitted to a blinded evaluation.A total of 14 osteolytic lesions were observed. In 43 of the 55 pairs combined (78%), the periapical conditions remained identical. In 9 pairs, a periapical lesion was present in the "open tooth" category (P>0.10), while in 3 pairs, a periapical lesion was observed exclusively in the "intact tooth" group. The authors concluded that the data suggest that the problem of coronary infiltration may not be of as great clinical importance as demonstrated by numerous in vitro studies, provided that instrumentation and root filling are carefully performed.

According to Wu, Wesselink and Walton (2000), the apical limit of endodontic treatment is considered an important factor in the success of the treatment. The exact impact of this threshold is somewhat uncertain, and most publications on this topic are based on retrospective results. In vital teeth, the best success rate has been reported when procedures ended 2 to 3 mm short of the radiographic apex. With pulp necrosis, bacteria and their derivatives, as well as debris from the infected dentin, can remain in the most apical portion of the canal, compromising apical healing. In these cases, the best success rate was achieved when the procedures ended between 0 and 2 mm below the radiographic apex. When this measurement was greater than 2 mm or exceeded the radiographic apex, the success rate for infected channels was about 20% lower than when the limit was between 0 and 2 mm. Clinical determination of the anatomy of the apical canal is difficult and apical constriction is often absent. In accordance with the biological basis and clinical principles, instrumentation and filling should not extend beyond the apical foramen.

In order to evaluate the success rate of endodontic treatment in patients from the School of Dentistry of the University of Pernambuco, Brazil, Travassos, Caldas Júnior, Albuquerque (2003) conducted a retrospective cohort study using dental records from the sample composed of all patients treated in 1998 and 1999. Statistical analysis was performed using the Chi-square test and Fisher's exact test. Logistic regression models were used to confirm the effect of some variables on endodontic therapy. A total of 311 (75.9%) patients were women and 99 (21.1%) were men. Most cases (82.9%) were considered successful. Success was less frequent in patients with incomplete

primary education (55.6%) than in those with a higher level of education (89.7%). The vital condition of the pulp showed a statistically significant relationship with the success of endodontic therapy ($p < 0.05$). The authors concluded that it is possible to achieve high success rates when the causes of endodontic treatment failure are well controlled.

In order to identify and describe the individual factors associated with the incidence or persistence of apical periodontitis in a population, Kirkevang et al. (2007) randomly selected 616 individuals in 1997 to obtain a complete periapical record. In 2003, 77% of these patients retook the exams. All teeth were individually evaluated in the following items: caries, marginal bone level and dental restorations. Through logistic regressions, the authors tried to identify the risk factors for each individual and for each tooth to develop BP. Endodontic treatments, coronary restorations, primary caries lesions, and reduced marginal bone level have been associated with the incidence of BP in the individual. Regarding teeth, poor quality or absence of a coronary restoration, as well as the presence of an obturated root, primary caries lesions, reduced marginal bone level, and molar teeth increased the risk of developing BP. The quality of the endodontic filling was not associated with the incidence of BP, but the results suggest an association between the quality of the filling and the cure of BP.

The working length and filling of endodontic treatments is a controversial topic. For this reason, Moura et al. (2009) set out to determine the influence of root canal filling length on apical periodontitis detected by periapical radiography and cone beam computed tomography (CBCT). A total of 503 filled canals were evaluated. The distances from the radiographic apex to the tip of the filling material were measured and classified. The analysis of periapical radiographs showed that the fillings were between 1 and 2 mm from the apex in 88% of the anterior teeth, 89.3% of the premolars, and 95% of the molars. CBCT images showed that the fillings had the same length in 70% of the anterior teeth, 73.7% of the premolars, and 79% of the molars. The frequency of BP was significantly higher in molars than in the other groups of teeth, regardless of the method of diagnosis. BP was detected more frequently when CBCT was used and was present at all endodontic filling lengths.

CONSIDERATIONS ON RADIOGRAPHIC IMAGES

Radiography is an invaluable tool for the diagnosis, treatment guidance and preservation of pathologies, in addition to assisting in clinical follow-up studies. However, radiological findings do not always accurately reflect the existence of normal or pathogenic conditions in the periapical region. Differences in radiographic images of bones or other mineralized tissues depend on the thickness of the hard structure, the homogeneous composition of the tissue, and the angle at which the X-rays pass through the object. In addition, the transformation of the object that is three-

dimensional into a bidimensional image should be considered, which leads to the overlapping of anatomical structures. The radiographic visualization of lesions is influenced by the location of the lesions in different types of bone. Visualization is easier when the lesion is in or very close to the cortex, and more complicated when it is located in the endosteal region, and even less likely to be detected when it is in the region of spongy structure (BENDER, 1982).

Panoramic radiographic examinations may be sufficient for preliminary visualization of the patient's dentition as well as bone-related pathologies. These have become popular in dental diagnosis due to acceptable image quality, low radiation dose, and ease of obtainment. As it is an extra-oral method, it is more comfortable for the patient. However, this type of radiography may underestimate periapical lesions when compared with periapical radiographs (HUUMONEN, ØRSTAVIK, 2002).

Periapical radiographs are good aids in the diagnosis of endodontics, although they have limitations (COTTI et al., 1999). Taken in at least two different projections, these radiographs will allow a more specific visualization of the selected teeth, verify the presence and extent of caries, visualize the condition of the restorations, and diagnose a possible lesion (HUUMONEN, ØRSTAVIK, 2002).

The accuracy of periapical radiographs in detecting periapical bone defects is significantly higher than that of panoramic radiographs (ESTRELA et al., 2008a). However, no differences were observed when comparing digital and conventional periapical radiographs (STAVROPOULOS, WENZEL, 2007).

Changes in the mineralized tissue of the tooth and the bone structure adjacent to the site of inflammation form the radiographic basis for diagnostic procedures, detection and monitoring of chronic apical periodontitis (HUUMONEN, ØRSTAVIK, 2002).

Morphological variations of the apical region, bone density, x-ray angles, radiographic contrast and actual location of the periapical lesion influence the radiographic interpretation (ESTRELA et al. 2008a). However, when the signs of the disease are large and striking, interpretation problems are almost non-existent (HUUMONEN, ØRSTAVIK, 2002).

Conventional and digital radiographs enable the diagnosis of periapical diseases, but not their nature (GUNDAPPA, NG, WHAITES, 2006; RAGHAV et al., 2010).

One aspect to be considered is that, regardless of the method used to obtain the radiographic image, care must be taken to avoid misinterpretation, however, the use of conventional radiographic images for the detection of BP must be done with caution because of the high possibility of false-negative diagnosis. (ESTRELA et al, 2008b).

Frequent radiographic evaluation of healthy teeth for the sole purpose of detecting and monitoring the first signs of apical periodontitis is not usually indicated for radiation safety reasons (HUUMONEN, ØRSTAVIK, 2002).

Conventional radiography is, without a doubt, the most commonly used imaging modality to evaluate periapical lesions, because it is easy, inexpensive, and accessible. Digital radiography gained popularity as an alternative to conventional radiography because it gave the dentist the ability to perform the radiographic examination with reduced radiation exposure in addition to allowing the improvement of image quality through software (RAGHAV et al. 2010).

Digital radiography has several advantages and has become an indispensable diagnostic tool for many dentists in daily practice. The software of the X-ray machines allows immediate capture with less exposure to radiation and the improvement of images, favoring the diagnosis. However, inappropriate use of enhancement may adversely affect the diagnosis. On the other hand, digital information can be manipulated in order to alter the information contained in it (NAIR, NAIR, 2007).

Diagnostic, clinical and radiographic information will directly influence clinical decisions about the treatment of periapical bone lesions. An imaging system is effective when: (1) it can detect all lesions present in the jaws; (2) favors the anatomical location of lesions in the three spatial dimensions for diagnosis and treatment purposes (determine the shape and measurements of a lesion, determine the amount of cortical bone involved; visualize the relationship of a lesion with the tip of the root and the anatomical landmarks in the bones); (3) to guide a differential diagnosis of the lesions; and (4) to assist in the transoperative and postoperative periods. (COTTI, 2010)

Periapical radiographs were the reference standard for evaluating the healing of endodontic lesions. The Periapical Index (IAP) has been used as a classification system for the radiographic evaluation of BP. The PAI offers a visual reference scale (score related to reference radiographs and histological assessment of BP) and assigns a health status to the root, based on changes in bone mineral content in the periapical region. The score ranges from 1 (absence of pathologies) to 5 (propagation of the lesion within the bone) (ØRSTAVIK, HEREKES, ERIKSEN, 1986; COTTI, 2010)

To compare the information collected from periapical radiography and high-resolution computed tomography (CT) regarding the detection of periapcal lesions and their relationship with neighboring anatomical structures, Velvart, Hecker and Tillinger (2001) evaluated 50 patients with a periapical lesion. Patients with indication for perendodontic surgery were selected. The teeth involved were 6 mandibular premolars and 44 mandibular molars, totaling 80 roots. A computed tomography scan and a periapical radiography were requested for each case. All 78 lesions diagnosed during surgery were also visible with CT scans. In contrast, only 61 of the lesions were seen on

conventional radiographs. The mandibular canal can be identified radiographically in 31 cases, whereas on CT scan it can be observed in 100% of cases. The amount of cortical and trabecular bone and the thickness of the bone, as well as the three-dimensional extent of the lesion, can only be interpreted with computed tomography. The use of this exam provides additional information for planning and treatment in cases of surgery, which is beneficial not available on radiographs.

Gundappa, Ng and Whaites (2006) evaluated the efficacy of ultrasound, digital and conventional radiography in the differential diagnosis of periapical lesions. Fifteen patients aged between 13 and 40 years with periapical lesions associated with the upper or lower anterior teeth that required parendodontic surgery were selected. Conventional and digital periapical radiographs were obtained for the preoperative period. Provisional measures of the areas and diagnoses were made by three specialists (two dental radiologists and one endodontist) at three different times. Preoperative ultrasound examinations were performed and the images were evaluated by two specialists (sonographer and endodontist) for analysis of size, content, vascular supply, and a provisional diagnosis of cyst or granuloma. Parendodontic surgery was performed to allow histopathological investigation, which provided the gold standard diagnosis. All measures and results were compared and statistically analyzed. Both conventional and digital radiographs showed that periapical lesions were readily identified, but observers were unable to differentiate which type of lesion affected the patient. Dimensional measurements were subject to greater interobserver variation in digital radiography than in conventional radiography. Where the vestibular cortical bone had been resorbed the ultrasound was simple but underestimated the size of the lesions compared to the radiographs. In all 15 cases, the ultrasound diagnosis agreed with the histopathological gold standard. Thus, the authors concluded that the two methods of radiographs allow a diagnosis of the existence of periapical lesion, but not of its nature; While ultrasound underestimates the extent of the disease, but can provide accurate information about the pathological nature of the injury.

The accuracy of Cone Beam Computed Tomography (NewTom 3G) in detecting periapiacis bone defects was compared with intraoral periapical radiographs (Dixi2, Planmeca CCD sensor, and Insight film) by Stavropoulos and Wenzel (2007). Ten frozen pig mandibles had their soft tissues removed and were sectioned sagittitally to obtain three blocks on each side of the mandible containing the premolars and molars, with surrounding bone. All teeth were extracted with intact roots. Initially, 15 blocks were used to define the size of the bone defect and the exposure parameters, then the other 45 blocks were divided into three numerically identical groups. In one group, cylindrical defects of 1 x 1 mm were prepared beyond the limit of the apices of the cavities left by the extracted teeth; in the other group, defects of 2 × 2 mm were prepared in a similar way, while no defects were prepared in the last group. The teeth were reattached to their respective cavities and digital and conventional radiographs of all blocks were taken under reproducible

conditions. In addition, all blocks were submitted to CBCT with the same volumetric data and then reconstructed to provide sagittal and coronal sections in two dimensions. The evaluation of the images was performed by four calibrated examiners, classifying them as "present defect" or "no defect". Statistical analysis was performed with ANOVA, and the significance level was set at P <0.05. NewTom 3G was significantly better compared to digital and conventional radiographs. No difference was observed between the results of digital and conventional periapical radiosurgery.

In order to verify the accuracy of imaging methods for detecting apical periodontitis, Estrela et al. (2008a) obtained 888 imaging records from a consecutive sample of scans of patients with endodontic infection (1508 teeth), including cone beam computed tomography and panoramic and periapical radiographs. The sensitivity, specificity, predictive values, and accuracy of periapical and panoramic radiographs were calculated. The analysis of the characteristics of the operational receiver was performed to evaluate the diagnostic accuracy of the panoramic and periapical images. The prevalence of BP was significantly higher with CBCT. The overall sensitivity was higher in periapical radiographs compared to panoramic radiographs, 0.55 and 0.28 respectively. ROC curves, which measure the characteristics of the operating receptor, and area under the curve (AUC) with periapical radiography showed high accuracy for both periapical (AUC, 0.90) and panoramic (AUC, 0.84) radiographs, in cases of severe apical periodontitis in which there are exacerbated characteristics. Apical periodontitis was correctly identified with conventional methods when it showed an advanced stage. CBCT has been proven to be effective in identifying apical periodontitis.

In order to evaluate the efficacy of conventional radiography, digital radiography, and ultrasonography in the diagnosis of periapical lesions, Raghav et al. (2010) selected 21 patients aged between 15 and 45 years with well-defined periapical radiolucency associated with maxillary or mandibular anterior teeth that had an indication for parendodontic cirurgia or extraction. Three specialists examined the preoperative periapical radiographs and the digital images obtained by the parallelism technique using a charge-coupled device and gave their diagnosis. Then, ultrasound examination was performed and the images evaluated for size, content, and vascular supply by 3 sonographers. After surgery, the periapical tissues were analyzed for histopathological analysis, which is the gold standard for diagnosis. The data were statistically analyzed using SPSS, analysis of variance, and the k. The diagnostic accuracy of periapical lesions using conventional radiography was 47.6%, 55.6% with digital radiography and 95.2% ultrasound. The latter have the highest sensitivity and specificity: 0.95 and 1.00, respectively. Conventional and digital radiographs make it possible to diagnose periapical diseases, but not their nature, while ultrasound provides accurate information about the pathological nature of the lesions, which is of importance in prognosis. Therefore, ultrasound can be used as an adjunct to conventional or digital radiography in the diagnosis of periapical lesions.

Working length in endodontic treatments of deciduous teeth obtained through digital and conventional intraoral radiographs and electronic apical locator was compared by Ananthraj et al. (2011). An in vivo study was conducted on 30 deciduous teeth with pulpectomy idication in patients between 5 and 11 years of age. During pulpectomy, the working length was determined by digital radiography and apical locator. The measurements were then compared with the conventional method. Based on the results obtained, the authors found that the working length determined in deciduous molars using digital radiography and apical locator did not present a significant difference between the means of working length measurements, when compared with the conventional radiographic method. The apical locator is comparable to conventional radiography for the determination of the non-radiation working length in primary teeth. Intraoral digital radiography is the safest method to determine working length with significant reduction of radiation exposure. Thus, both techniques can be easily used as alternatives to conventional radiographic methods in determining the working length in primary teeth.

Digital radiographic imaging systems have undergone major improvements since their introduction. Its advantages over conventional radiographs include lower radiation doses, instant imaging, easier archiving and sharing of images, and manipulation of various properties that can aid in diagnosis. Tewary, Luzzo and Hartwel (2011) conducted a study where six observers evaluated 150 digital periapical radiographs of molars to determine which of the following conditions each dental element fit: normal periapical tissue, enlargement of the periodontal ligament, or presence of periapical radiolucency. The evaluators had full control over the radiography parameters through the Planmeca Dimaxis software. All images were viewed on the computer monitor in ideal viewing conditions. The same six observers re-evaluated the same 150 images three months later. The data were analyzed by comparing interobserver agreement, twice, and intraobserver agreement. Fleiss Kappa statistical analysis was used to measure the level of agreement between the evaluators. The kappa value for interobserver agreement for the first round of interpretation was 0.34 ($P < 0.001$), for the second round it was 0.35 ($P < 0.001$). The results indicate that the interpretation of a dental X-ray is subjective, regardless of whether conventional or digital radiographs are used. The factors that appear to have the greatest impact were the examiner's years of experience and the operator's familiarity with a particular digital system.

In a clinical study, Patel et al. (2012) compared the radiographic change in periapical status in roots determined using periapical digital radiographs compared with cone beam computed tomography (CBCT) 1 year after endodontic treatment. Periapical radiographs and CBCT of 123 teeth in 99 patients were evaluated one year after completion of endodontic treatment by a single operator and were compared with the diagnostic image. The presence or absence as well as the increase or decrease in the size of existing periapical radiolucent was evaluated by two examiners.

Paired comparison of the diagnostic results was performed using the McNemar or Stuart-Maxwell symmetry analysis tests. The rate of absence of periapical radiolucency for all roots was 92.% on periapical radiographs and 73.9% on CBCT. When this group was added to which the radiolucency size had decreased, the rates increased to 97.2% and 89.4%, respectively. A statistically significant difference in the result of the root diagnosis was found between radiography and CBCT in single-rooted teeth and buccal or mesiobuccal roots of multi-rooted teeth. Analysis by tooth revealed that the rate of "cured" was 87% through periapical radiographs and 62.5% using CBCT. This increased to 95.1% and 84.7%, respectively, when the group "cured". The results also demonstrated a statistically significant difference in diagnosis. Diagnosis using CBCT revealed a lower rate of "cure" and "cured" for root canal treatment when compared to periapical radiographs, especially in the roots of the molars. There was a 14-fold increase in failure rate when preoperative periapical radiolucency-free teeth were evaluated with CBCT compared to periapical radiographs at 1 year.

PREVALENCE STUDIES OF APICAL PERIODONTITIS IN POPULATIONS

The prevalence, quality of endodontic treatment and the occurrence of periapical lesions of a random sample of 967 individuals selected from the total population in a county in Sweden were evaluated by means of radiographs by Ödesjö et al. (1990). The relationship between the quality of endodontic treatment and the occurrence of periapical lesions was also analyzed. Of the selected individuals, 95% were examined. Of the 17430 teeth examined, 1492 (8.6%) underwent endodontic treatment. About 70% of the treated root canals were inadequately filled; 10% had overfilling. The prevalence of periapical lesions was 2.9%, and in teeth with a treated root canal it was 24.5%. There was no difference in the frequency of periapical lesions found in root canals with homogeneous filling at the correct limit compared to those improperly filled. Overfilling was related to a significantly higher frequency of periapical lesions.

With a random sample of about 3% of 50-year-old citizens of the city of Oslo, Eriksen and Bjertness (1991), through panoramic radiographs and periapical radiographs of all endodontically treated teeth evaluated the prevalence of apical periodontitis. The results showed the presence of lesions in 3.5% of all teeth present. Of the endodontically treated teeth, 44% had a radiolucent image detectable on periapical radiography. The authors demonstrated a statistically significant negative correlation between the quality of root fillings and the prevalence of apical periodontitis.

The objective of the study by Weiger et al. (1997) was to determine the periapex situation, the quality of root canal fillings and to estimate the endodontic treatment needs in a German population. Clinical and radiographic data and operational procedures performed in 1993 on 323 patients were evaluated. In 182 subjects, at least one tooth exhibited endodontic treatment performed, necrotic pulp, or irreversible pulpitis. Of the 7897 teeth examined, 215 (2.7%) underwent endodontic

treatment; of the teeth not treated endodontically, 122 (1.5%) did not respond to the sensitivity test and 53 were diagnosed with irreversible pulpitis. In the group of teeth with filled canals, 61% presented radiographic signs of periapical pathology. In teeth in which the pulp was not present, but which were not submitted to endodontic treatment, 88% presented an image suggestive of periapical lesion. Using the criterion for evaluating the limit and homogeneity of the filling material, the authors concluded that only 14% of the treatments were considered adequate. Regarding the total number of teeth that do not have a treated root canal, 2.3% require endodontic intervention. When the need for endodontic retreatment due to a deficient filling was taken into account, this percentage rose to 3.7%.

The epidemiological study by Marques, Moreira and Eriksen (1998) verified the prevalence of apical periodontitis and the quality of endodontic treatment, through the evaluation of 179 panoramic radiographs of residents of the city of Porto. The results indicated a prevalence of apical periodontitis in 27% of this population. The quality of 54% of the fillings observed was considered inadequate, but only 22% of the teeth treated endodontically had apical periodontitis.

To verify the prevalence of apical periodontitis as well as the technical standard of root canal treatment in Belgium, De Moor et al. (2000) examined 206 panoramic radiographs of adult patients at the University Hospital of Ghent verifying endodontic treatment, periapical conditions and coronal restorations. Of the 4617 teeth examined, 6.8% were treated endodontically. Periapical radiolucency was found in 6.6% of all teeth and in 40.4% of endodontically treated teeth. More than half of the fillings (56.7%) were classified as inadequate. The authors concluded that the need for endodontic treatment of this Belgian subpopulation was great and that the quality of the treatments performed was disappointing. Thus, they stated that there is still a need for improvements in the training and number of endodontists.

The prevalence and technical quality of root fillings, as well as the periapical status of endodontically treated teeth in a French subpopulation were verified by Boucher et al. (2002). Complete periapical charts of 208 patients were observed. Fillings are classified according to the density and dstance of the filling material termination and the radiographic apex. Periapical status was assessed using the Periapical Index. The type of coronary restoration and the presence of pins were also observed. At least one periapical lesion was observed in 63% of patients. Of the 8743 channels included in the survey, 23% were blocked. An acceptable standard of care was found in 21% of the roots, with 16% of the cases associated with signs of periapical disease. In the canals with unacceptable fillings, 27% had associated lesions. Pins were detected in 26% of the filled canals, with 29% of the cases associated with periapical injury. Intracoronary restoration was observed in 30% of the filled roots, of which 22% had periapical pathology. Extracoronal restoration was present in 60% of the endodontically treated roots, of which 24% showed radiographic signs of periapical

radiolucency. The remaining 10% of filled roots that did not have coronary restoration were associated with periapical pathology in 33% of cases. According to the authors, the results demonstrate a high prevalence of filled root canals with poor technical quality of treatment. Acceptable fillings were associated with a lower prevalence of periapical pathology. Pins were significantly associated with periapical pathology.

Lupi-Pegurier et al. (2002) determined the periapical status and quality of endodontic treatment of patients treated at the dental school of Nice, France, in 1998. Panoramic radiographs of patients seeking the Faculty of Dentistry for the first time were examined. The quality of the canal fillings and the periapical region of all teeth, except for the third molars, were evaluated. Statistical analyses were performed using the ANOVA, Chi-square, PLSD Fisher and Cohen Kappa tests. The research involved 344 patients: 180 women and 164 men. Male individuals had significantly fewer remaining natural teeth than females ($P<0.03$). Similarly, the mean number of filled teeth was lower for men ($P<0.01$). Non-endodontically treated teeth ($n = 6126$) had significantly fewer signs of periapical pathology than filled teeth ($n = 1429$) (1.7% vs 31.5%, $P<0.0001$). Most of the fillings were poorly executed. There was a significant correlation between the presence of periapical pathology and inadequate root canal fillings ($P<0.001$). The authors concluded that many root canal treatments were technically unsatisfactory in terms of quality and success of treatment, which leads to a need for endodontic re-treatment in the population examined.

The prevalence of apical periodontitis and the quality of endodontic fillings and restorations were determined in two Canadian populations by Dugas et al. (2003). Panoramic radiographs of 610 patients aged between 25 and 40 years were examined for the following items: missing teeth, presence of endodontically treated teeth, quality of these fillings, and presence of BP, according to the periapical index. Patients with treated root canaled teeth were invited for an interview and clinical examination so that the restorations could be inspected and reveal data such as the reason for extraction and what type of professional performed the root canal treatment. The association between the prevalence of BP in filled teeth and the quality of filling, restoration, and the person performing the treatment was examined using the chi-square test and the t-test. The prevalence of endodontically treated teeth was higher in Toronto (39%) than in Saskatoon (26%). The presence of PA in filled teeth was 44% in Toronto and 51% in Saskatoon, and was significantly associated with radiographs in which the filling material had low density, were below or beyond the working length. In relation to the type of professional who performed the treatment, there was no significant difference between general dentists and endodontists. The results also confirm that the quality of both the root filling and the restoration influence periapical health. The data clearly demonstrated the need for an improvement of filling and restoration patterns in order to improve the outcome and benefits associated with endodontic treatment.

To investigate the quality of root fillings and coronary restorations and their associations with periapical status in a Spanish adult population, Segura-Egea et al. (2004) examined 180 patients aged 37.1 ± 15.7 years. With the periapical radiographic chart complete, the periapical region of all endodontically treated teeth, excluding the third molars, were examined. The quality of the fillings was evaluated in terms of distance from the root vertex and the apical end of the filling material and lateral adaptation of this material in relation to the canal walls. Radiographic signs of restorations with excess or marginal infiltrations were also evaluated. Periapical status was assessed with the aid of the Periapical Index and statistical analyses were performed with the Cohen k test and logistic regression. Of the 93 teeth filled, 64.5% had apical periodontitis. This was associated with inadequate adaptation of the root canal filling, inadequate length of the filling material, and poor coronary restoration. Only 34.4% of the root fillings were adequate from a technical perspective. When endodontic filling and coronary restoration were adequate, the incidence of BP decreased to 31.3%. The authors concluded that the incidence of BP in filled teeth was high; in many cases, the filling of the canal was unsatisfactory; An adequate filling had a more significant impact on the outcome of the treatment than the quality of the coronary restoration.

Through panoramic radiographs, the quality of root fillings and the prevalence of apical periodontitis in an adult population of Ireland were evaluated by Loftus, Keating and McCartan (2005). A systematic sample of the clinical records and panoramic radiographs of 302 patients from Dublin Dental Hospital were examined by two unfamiliar examiners. The European Society of Endodontics guidelines were used to determine the quality of endodontic treatment. Of the 7427 teeth examined, 2% were filled. Apical periodontitis was evident in 1.6% of teeth without endodontic treatment, while 33.1% of individuals had at least one tooth with apical periodontitis. Of the filled teeth, 25% had apical periodontitis and 52.6% had fillings considered inadequate. There was a statistically significant ($P < 0.05$) and negative correlation between the quality of fillings and the prevalence of apical periodontitis. Posterior teeth treated endodontically had a higher prevalence of apical periodontitis compared to anterior teeth under the same conditions. The authors concluded that the quality of endodontic treatments in this Irish population was poor and the prevalence of apical periodontitis was high.

A cross-sectional study was conducted by Siqueira et al. (2005) to determine the prevalence of periradicular lesions in teeth that underwent root canal treatment in a Brazilian adult urban population. The quality of the fillings and coronary restorations and their associations with the periapical state of these teeth was also observed. The fillings of 2051 teeth, through periapical or panoramic radiographs, were classified as adequate or inadequate based on length and homogeneity. Coronary restorations of these same teeth were classified as adequate, inadequate or absent. Statistical results were obtained using the chi-square test. The overall success rate of root canal

treatments was 49.7%. Cases with adequate endodontic treatment and restoration had a success rate of 71%. When cases with proper treatment and inadequate restoration were evaluated, the success rate dropped to 65%. Cases with adequate treatment and absent restoration showed a success rate of 48%. Teeth with adequate treatment with inadequate restoration demonstrated a 38% success rate, whereas the combination of inadequate treatment and restoration resulted in a 25% success rate. Teeth with inadequate treatment and absent restoration showed the lowest success rate in this study (18%). The analysis of the data revealed that, when the filling of the root canal appeared to be adequate, the quality of the restoration did not significantly influence the results of the treatment. However, when a coronary restoration was absent, the success rate of properly treated canals was significantly reduced. The quality of the coronary restoration also significantly affected the outcome of teeth with inadequate filling. The results revealed a high prevalence of endodontically treated periradicular root lesions. In addition, the authors concluded that although coronary sealing had a significant impact on periradicular health, the quality of the canal system filling was the most important factor in ensuring the success of endodontic treatment.

To estimate the prevalence of teeth with apical periodontitis and technically defective fillings in an adult population of Belarus, Kabak and Abbott (2005) evaluated 1423 panoramic radiographs of patients over 15 years of age who did not seek urgent dental care and who were attending the School of Dentistry of the Medical University of Belarus for the first time during the period from January 1 to December 31, 2001. The quality of the fillings and the eryapical status of all teeth, except the third molars, were evaluated. The data were statistically analyzed using the chi-square test and odds ratio. In 20% of the teeth there was some matter inside the root canals. BP was more associated with molar teeth (23%) than premolars (14%), incisors (6%), and canines (4%). Bone injury was diagnosed in 45% of the filled teeth. Statistical analysis showed that the probability of radiological detection of BP in filled teeth was 25 times higher than when root canals had not been treated. Periapical radiolucency associated with a well-filled canal was significantly less frequent than in cases of deficient fillings. The authors concluded that the prevalence of BP in all age groups in Belarus was higher than in other populations. The probability of BP increased significantly after endodontic treatment and was closely related to the quality of the filling.

To determine the prevalence of periapical lesion and endodontic treatment in a Japanese adult population, Tsuneishi et al. (2005) examined, through periapical composite charts of 672 patients (16232 teeth), the periapical status and the length of endodontic fillings. Of the total number of patients, 87% had filled teeth and 70% had at least one periapical radiolucent image. Regarding the total number of teeth, 21% were endodontically treated. Of these, 40% were associated with apical periodontitis. The higher prevalence of periapical lesions was associated with overfilling and mandibular incisors. Compared to the results of other countries in Europe and America, the

prevalence of filled teeth was higher in this study. However, the presence of periapical lesions associated with endodontic treatment was equivalent.

To investigate the prevalence of filled teeth and apical periodontitis in a Greek population, Georgopoulou et al. (2005) selected 320 complete radiographic charts of patients aged between 16 and 77 years. A total of 7664 teeth were evaluated and the frequency of filled teeth and periapical status were noted. Two observers evaluated the radiographs under standardized conditions. BP was defined as periapical radiolucent or enlargement of the periodontal ligament space twice as large and as normal thickness. Statistical evaluation of the differences in proportions between groups was performed using logistic regression models. A total of 1,040 (13.6%) teeth had radiographic signs of BP and 680 (9.2%) teeth were filled. Of the filled teeth, 408 (60.0%) had BP. There was no difference in the number of filled teeth in relation to gender and observed that the prevalence of filled teeth increased with age. Molars (13.1%) and premolars (11.9%) were significantly more filled than anterior teeth (5.8%) ($P < 0.001$). The prevalence of BP was also significantly higher ($P < 0.001$) in molars (23.9%) and premolars (14.0%) than in anterior teeth (9.4%). The researchers concluded that the prevalence of BP and the frequency of filled teeth affected by BP in this Greek population were higher than those found in many other European countries. The frequency of filled teeth was comparable with the results of other epidemiological studies.

In a study that investigated the prevalence of apical periodontitis and its association with endodontically treated teeth in residents of the city of São Luís, MA, Brazil, Terças et al. (2006) examined 200 complete periapical records over a period of 10 years. The Periapical Index was used to assess the health of the periapex. Age group, gender, tooth groups, location, and association with endodontic treatment were also analyzed. At least one case of AP was found in 135 patients (67.5%). Of the total of 5008 teeth examined, 296 had BP (5.9%) and 553 (11%) had filled canals. Of the 553 endodontically treated teeth, 235 (42.5%) were associated with BP. The chi-square test showed a strong correlation between BP and root canal treatment. The highest prevalence was in the 40-year-old age group. There was no association between BP and gender. The maxillary incisors were the most affected teeth. The authors concluded that the prevalence of apical periodontitis and teeth treated endodontically with AP was high and similar to the results of studies conducted in other countries.

The prevalence of apical periodontitis as well as the quality of endodontic treatment was verified in a Turkish population by Sunay et al. (2007). On panoramic radiographs, the periapical status of 8863 teeth from 375 patients was evaluated by two precalibrated observers. The presence of apical periodontitis, the prevalence and quality of root fillings were noted. The relationship between the quality of fillings and apical periodontitis was obtained by the analysis of the chi-square test. A total of 470 teeth (5.3%) underwent root canal treatment. Forty-seven percent of all individuals had

at least one endodontically treated tooth. Periapical radiolucency was visible in 4.2% of the teeth examined, and 53.5% of the teeth with endodontic treatment had apical periodontitis. Of these, 90.8% had deficient fillings, i.e., there was a statistically significant correlation (P<0.05) between the presence of lesions and the quality of the filling. Thus, the authors concluded that there is a need to improve the standards of endodontic treatment in the population studied.

Eckerbom, Flygare and Magnusson (2007), reassessed a Swedish population in order to assess the prevalence of endodontically treated teeth and apical periodontitis, as well as the quality of these fillings after 20 years. From an initial population of 200 participants (2825 teeth), 115 (2461 teeth) were re-examined using a complete radiographic clinical record, with conventional radiographs. The frequency of endodontically treated teeth increased significantly (P<0.05), from 13.9% at the first observation to 17.7% after 20 years. There was also a statistically significant increase (P <0.05) in patients with apical periodontitis from 3.3% to 6.8%. This increase occurred tenate in teeth with root canals treated as in teeth without endodontic treatment. There was an improvement in the quality of root fillings, but there was no improvement in the apical status in endodontically treated teeth. Thus, the authors concluded that both the number of teeth with the treated canal system as well as apical periodontitis increased during the time period covered by the study, and that despite an improvement in the quality of endodontic treatment, no improvement in the periapical health of treated teeth was found.

To assess the prevalence and risk factors of apical periodontitis in endodontically treated teeth in a population of Brazilian adults, Estrela et al. (2008b) analyzed 1372 periapical radiographs of endodontically treated teeth, observing the quality of the filling, the status of the coronary restoration and the presence of apical periodontitis. The data were statistically analyzed using odds ratio, confidence interval and chi-square test. The prevalence of BP in patients with adequate endodontic treatment was low (16.5%). This percentage dropped to 12.1% in cases with adequate filling and coronary restoration. Patients with adequate endodontic treatment and deficient coronary restoration had a BP prevalence of 27.9%. BP increased to 71.7% in patients with defective endodontic treatment and coronary restoration. When inadequate endodontic treatment was combined with good coronary restoration, the prevalence of BP was 61.8%. The authors also observed that the presence of intraradicular pins did not influence the prevalence of BP.

To examine the prevalence and technical quality of endodontic treatments and the periapical status of filled teeth in a subpopulation of Dakar, Touré et al. (2008) evaluated complete radiographic clinical records of 208 patients who sought the university's dental service. The occurrence and technical quality of the fillings were evaluated according to the apical extension of the root fillings and their density. Periapical status was assessed using the Periapical Index. When this was greater than 2, it indicated the presence of disease. The presence of coronary restorations and pins were also

observed. Statistical analysis was performed with the chi-square test. Of the 6234 teeth examined, 2.6% had filled canals. Apical periodontitis was diagnosed in 56.1% of the treated teeth. Only 17.7% of the fillings were technically acceptable and 26.2% of them were associated with a PAI> 2. In roots with inadequate treatments, 62.5% had an IAP> 2. Poor endodontic treatments were associated with a higher prevalence of periapical disease (P <0.001). Pins were observed in 18.9% of teeth with root canal treatment and of those, 66.2% were associated with a PAI> 2. Filled teeth without coronary sealing had significantly more periapical disease compared to those with stauriated teeth. The authors concluded that in this study the results indicated a low prevalence of endodontically treated teeth and periapical lesions and a high prevalence of inadequate treatments.

Through panoramic radiographs, a cross-sectional study that evaluated the prevalence of endodontically treated teeth in 1401 adult patients was developed by Hollanda et al. (2008). Three endodontists independently evaluated the radiographic images in the following items: presence of endodontic treatment, defined as partially or completely filled, regardless of whether the filling material ended at the radiographic apex or not, with or without an intraradicular retentor, or even in association with apical periodontitis. Odds ratio, logistic regression and the chi-square test were used for statistical analyses. Of a total of 29467 teeth evaluated, 6313 (21.4%) were treated endodonally. Endodontic treatment was more frequent in maxillary premolars and molars, while mandibular incisors had a lower prevalence. Most of the endodontically treated teeth were found in people aged 46 to 60 years (47.6%, p <0.001) and the authors observed that the prevalence increases with age. Women had a higher prevalence of filled teeth (61.9%) than male patients. Compared to studies from other countries, the authors found a higher prevalence of endodontically treated teeth in Brazil.

In order to verify the frequency and distribution of endodontically treated teeth, as well as the prevalence of apical periodontitis in an adult population in Turkey, Gulsahi et al. (2008) evaluated digital panoramic radiographs of 1,000 patients. Patients who are elderly, younger than 15 years of age, and those with fewer than nine teeth in their mouths were excluded. The coronal and periapical status of all teeth, except for the third molars, was evaluated according to the criteria proposed by De Moor et al. (2000). Statistical analysis was performed using the Rao and Scott test adjusted with the chi-square test for the comparison of binary cluster data. In total, 24433 teeth were examined. A total of 346 teeth (1.4%) had radiographic signs of apical periodontitis, and 812 were filled (3.3%). Of the endodontically treated teeth, 148 (18.2%) were associated with apical periodontitis. Apical periodontitis was associated with 198 teeth (0.8%) without endodontic treatment. The number of filled canal teeth in males was significantly lower than in females (P <0.001), but the presence of apical periodontitis in males was significantly higher than in females (P <0.05). The prevalence of apical periodontitis and the frequency of teeth with filled canals and with apical periodontitis were

lower than in similar populations in other countries. The number of teeth treated endodontically was comparable to that found in other epidemiological studies.

In a cross-sectional study, Tavares et al. (2009) determined the prevalence of apical periodontitis in 1035 endodontically treated teeth from 213 adult patients in France. The influence of the quality of the filling and coronary sealing on the periapex status was also investigated. Through the analysis of periapical radiographs, the teeth were classified according to the periapical index score as healthy or sick. The prevalence of apical periodontitis in treated root canals was 33%. Only 19% of the teeth had endodontic treatments classified as adequate. The success rate for cases with adequate endodontic treatment was 91%, which was significantly higher when compared to teeth with inadequate treatment (61%). Adequate restoration significantly decreased the prevalence of BP compared to teeth without adequate coronary sealing from 41% to 29%. The combination of adequate endodontic treatment and adequate restorations provided the highest success rate (93.5%). The authors concluded that the quality of endodontic treatment was the most important factor for success, although the quality of coronary restoration also influenced the outcome of treatment.

The objective of the study by Wu, Shemesh, and Wesselink (2009) was to identify, through a systematic review of the literature, the limitations of the publications that evaluated the outcome of endodontic treatment. Traditionally, periapical radiography has been used to evaluate the outcome of root canal treatment, considering the absence of periapical radiolucent a confirmation of a healthy periapex. However, a high percentage of cases confirmed as healthy by radiographs revealed apical periodontitis when evaluated by Cone Beam Computed Tomography and histopathological examinations. In clinical studies, two additional factors may have contributed to the overestimation of successful outcomes after root canal treatment: extractions and re-treatments were rarely recorded as failures; and the rate of preservation was many times less than 50%. The periapical index, frequently used to determine success, was based on radiological and histopathological findings in the periapical region of the maxillary incisors. The validity of PAI use for all tooth positions may be questionable, as the thickness of the cortical bone and the position of the root end in relation to the cortex may vary according to the position of the teeth. In conclusion, the severe limitations of clinical longitudinal studies may restrict the correct interpretation of root canal treatment results. Therefore, for the authors, the results of a root canal treatment should be re-evaluated in long-term longitudinal studies using CBCT and more rigorous evaluation criteria.

The current prevalence of apical periodontitis related to endodontically treated teeth in an Amsterdam population was compared by Peters et al. (2011) with a similar study developed in 1988.The lack of teeth, restorations, quality of endodontic treatment and periapical radiolucidity were evaluated. A total of 178 radiographs were evaluated and 4594 teeth were examined. Of these, 7% had increased apical periodontal ligament or periapical radiolucency and 4.8% had undergone

endodontic treatment. Radiographic signs of apical periodontitis were present in 2.5% of the teeth. Of these lesions, 45.7% were linked to endodontically treated teeth, which corresponds to 24.1% of endodontically treated teeth. Inadequate endodontic fillings were present in 55.8% of the cases. Apical radiolucent was significantly higher in these patients than in patients with adequate treatment. The authors concluded that the periapical status of this population did not improve over almost 20 years.

In order to assess the prevalence and distribution of apical periodontitis and endodontic treatment in a group of people from Jordan, Al-Omari, Hazza and Haddad (2011) analyzed 294 digital panoramic radiographs. The coronal and periapical status of all visible teeth were evaluated according to the criteria proposed by de Moor et al. It was observed that 83.7% of the patients had apical periodontitis and 63.3% had endodontically treated teeth. Of the 7,390 teeth evaluated, 11.6% had apical periodontitis and 5.7% were endodontically treated. A correlation was detected between apical periodontal lesions and endodontically treated teeth. Endodontic treatment was inadequate in 72.4% of cases, of which 87.0% had apical periodontitis. No difference was found in the number of teeth treated endodontically or the presence of periodontitis in relation to gender. The results of this study indicated that there is a relatively higher prevalence of apical periodontitis compared to those in many other countries, and that the percentage of endodontically treated teeth associated with apical periodontitis indicates a poor quality of endodontic treatment.

A possible association between the presence of apical periodontitis and the quality of endodontic treatment and coronary restoration over a 14-year time period was examined by Tolias et al. (2012). Panoramic radiographs of 1781 cadet freshmen, taken between the years 1995 and 2008, were included in this study. Periapical status was assessed using the Periapical Index. The chi-square test and logistic regression analysis were used to examine the association between apical disease and the quality of root filling and coronary restoration. 62.3% of the teeth analyzed showed BP. The number of teeth treated endodontically and the prevalence of BP were higher in radiographs obtained between 1995 and 2001 than between 2002 and 2008. Both the quality of the coronary restoration and the quality of the root filling (length and lateral seal) have been observed to be correlated with the presence of PA. The authors noted that the quality of endodontic treatment in Greek adults has improved over the years; and that both the quality of endodontic treatment and coronary restoration appear to affect the periapical status of treated teeth. The factor that probably most determined periapical health was the quality of the coronary restoration.

López-López et al. (2012) determined the prevalence of apical periodontitis and the frequency of endodontic treatment in a sample of 397 Spanish adults of both sexes. Digital panoramic radiographs were used and the periapical status was classified according to the periapical index. The results were analyzed using the chi-square test and logistic regression. Radiographic images

suggestive of BP in one or more teeth were found in 135 patients (34%). The prevalence of BP was significantly higher in males (42.3%) than in females (26.1%). At least one filled tooth was found in 233 patients (59%). Twenty-six percent of individuals with endodontically treated teeth had at least one periapical lesion associated with a treated tooth. The prevalence of BP increased with age. Patients with filled root canals demonstrated a higher prevalence of BP (42%) compared to patients without root canal treatment (23%). The authors concluded that both the prevalence of BP and the frequency of endodontic treatments are high among Spanish adults; and that patients with one or more endodontically treated teeth are more likely to have BP.

The aim of the study by Kalender et al. (2013) was to evaluate the prevalence of periapical lesions in teeth with root canals treated in a Turkish population and to investigate the influence of the quality of fillings and coronary restorations on the prevalence of periapical lesions. The sample for this cross-sectional study consisted of 1006 patients, where 2200 radiographs of endodontically treated teeth were evaluated. The teeth were grouped according to the radiographic quality of the root canal filling and the coronary restoration. Periapical status was assessed using the periapical index. Of the 2200 teeth with canals treated, 1364 (62%) had apical periodontitis, compared to 5.5% of the total sample. Of the teeth classified as adequately filled, 26.6% had an eryapical lesion, while those classified as unsatisfactory filling were present in 87.7% of the cases. A higher quanity of well-treated teeth than inadequately treated teeth was observed. The results demonstrated a high prevalence of periapical pathology with or without endodontic treatment. Therefore, the authors suggest the need for better education for dentists so that they can perform better root canal treatments and coronal restorations.

OBJECTIVES

GENERAL OBJECTIVE

To evaluate the prevalence of periradicular lesions and intraradicular retainers in anterior permanent teeth treated endodontically on periapical radiographs.

SPECIFIC OBJECTIVES

Check:

- the prevalence of periapical lesions in permanent anterior teeth;
- the prevalence of the dental element with periradicular lesions;
- the prevalence of intraradicular retainers in permanent anterior teeth;
- the prevalence of the dental element with an intraradicular retainer;
- the influence of the intraradicular retainer in relation to the prevalence of lesions;
- the influence of the filling limit in relation to the prevalence of periapical lesions;

- the influence of the homogeneity of the filling material in relation to the prevalence of periapical lesions;

METHODOLOGY

ETHICAL CONSIDERATIONS

This study was approved by the Research Ethics Committee (REC) of the University of Pernambuco (UPE), according to Resolution No. 196/96 of the National Health Council, through protocol No. 235,176.

The patients did not need to undergo radiation for radiographic taking exclusively for the purposes of the research in question.

TYPE OF STUDY

This is a retrospective, observational, cross-sectional study with a quantitative approach.

LOCATION OF THE STUDY

This research was developed in a private dental radiology clinic located in the city of Recife, Pernambuco, Brazil.

SAMPLE SIZE

A total of 1318 digital periapical radiographic records were selected, which corresponded to 11186 maxillary and mandibular anterior teeth from the clinic's archives, following specific criteria for sample selection.

SAMPLE SELECTION

A total of 7908 digital periapical radiographs belonging to patients of both sexes, performed in the radiology clinic in the last 2 years, were selected.

The data obtained during the clinical examination and anamnesis were not known, as well as gender, age, name, and indication for the examination. This sample was obtained through the selection of radiographs, following inclusion and exclusion criteria.

Inclusion Criteria

Digital periapical radiographs of upper and lower permanent anterior teeth, with complete rhizogenesis, obtained in the orthoradial position, were selected. The dental arches could not be completely edentulous, that is, the patient had to have at least one tooth in the upper or lower anterior region.

Exclusion Criteria

Radiographs suggesting teeth submitted to apicoectomy surgery, radiographs of the posterior teeth (premolars and molars), teeth with incomplete rhizogenesis, presence of impacted teeth, and total edentulous teeth in the anterior region were excluded.

ACQUISITION OF DIGITAL PERIAPICAL RADIOGRAPHS

Digital periapical radiographs were obtained using a periapical X-ray device, Timex-70 C (Gnatus, Ribeirão Preto, SP, Brazil), by radiology technicians using Hanshin radiographic positioners (JON, Brazil), to keep the phosphor plate parallel to the X-ray beam, reducing distortions due to horizontal and vertical malpositioning, standardizing the radiographic method. The kilovoltage (kVp) and milliamperage (mA) were 60 and 10, respectively. The time of exposure to X-rays varied according to the biotype, age of the patient and the anatomy of the region. Replacing the periapical film, the digital phosphor storage system with a 30 x 40 mm optical plate, Digora (Soredex Orion Corporation, Helsinki, Finland), was used, which captures the image indirectly, i.e., this plate, after being sensitized by X-rays, is read by a laser scanner and the information is transferred to a computer, resulting in the digital image.

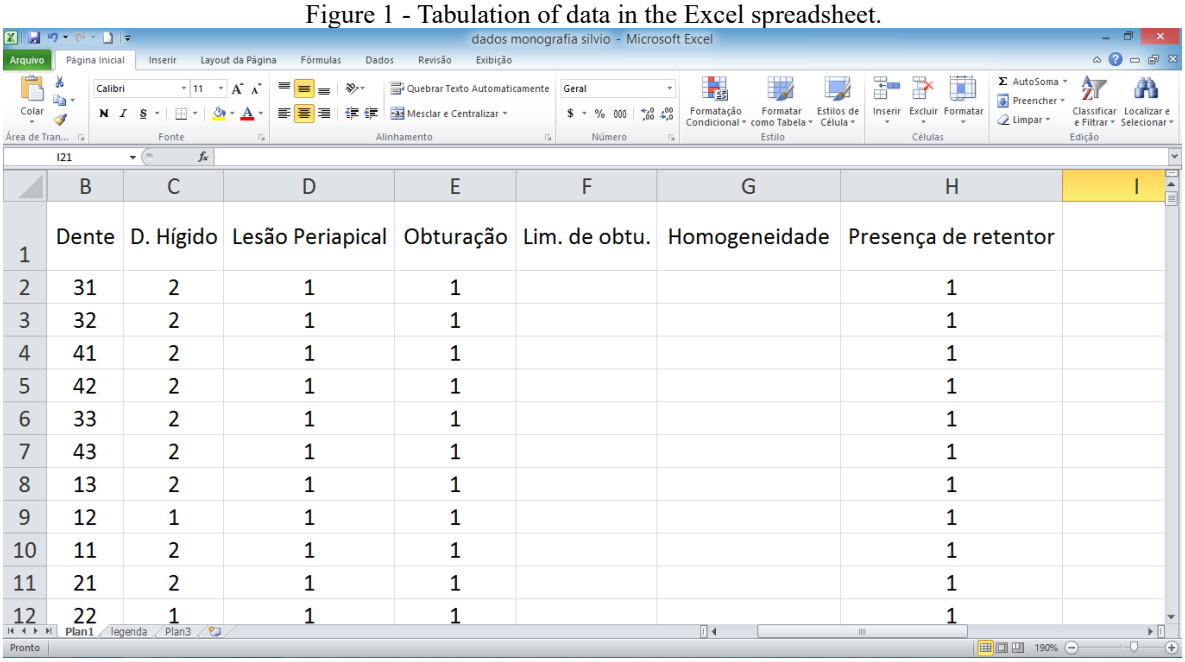
STORAGE OF RADIOGRAPHIC IMAGES

The images were stored in JPEG (Joint Photographic Experts Group) format with 150 dpi resolution. This format is commonly used to compress images as the degree of image reduction can be adjusted, which allows you to choose the storage size and your commitment to image quality.

RADIOGRAPHIC ANALYSIS

The images were viewed using the Paint program (Microsoft Windows, São Paulo, Brazil) version 6.0, on a 14-inch flat panel LCD monitor (Acer, Manaus, Brazil), with 1024 x 768 lines of resolution. Three evaluators, specialists in Endodontics, carried out the observation. After the first two evaluators examined the images, the conflicting results were confirmed by the third evaluator. To prevent a possible compromise of the analyses due to eye strain, the ambient light and the brightness of the monitor were reduced and the number of images was limited to 90 scans in sequence. The interpretation was conducted at different times of the day. Only manipulation of the brightness and contrast of the image was allowed. The notes were made in a Microsoft Excel spreadsheet, as shown in Figure 1.

Figure 1 - Tabulation of data in the Excel spreadsheet.



	B	C	D	E	F	G	H	I
1	Dente	D. Hígido	Lesão Periapical	Obturação	Lim. de obtu.	Homogeneidade	Presença de retentor	
2	31	2	1	1			1	
3	32	2	1	1			1	
4	41	2	1	1			1	
5	42	2	1	1			1	
6	33	2	1	1			1	
7	43	2	1	1			1	
8	13	2	1	1			1	
9	12	1	1	1			1	
10	11	2	1	1			1	
11	21	2	1	1			1	
12	22	1	1	1			1	

CRITERIA FOR RADIOGRAPHIC EVALUATION

Table 1 shows the criteria used to fill out the survey data sheet.

Treated root canals were those that contained radiopaque material in the pulp cavity or inside the root canal, disregarding those that suggested being part of the intraradicular retainer.

A radiolucent area connected to the root was classified as a periapical lesion. Slight enlargement of the periodontal ligament space with intact lamina dura or doubtful cases were recorded as absent pathology.

The longitudinal limit of the filling was considered underfilled when the end of the filled material was more than 2 mm away from the radiographic apex. Filling with adequate limit when this distance is between 2 and 0.5mm. Exactly, when this limit coincided with the apex. Overfilling occurred when the filling material exceeded the limit of the root vertex.

It was only observed whether the dental element had an intraradicular rentainer or not. The merits of type, quality and indication were not observed.

Table 1 – Criteria for radiographic evaluation

PERIAPICAL INJURY	1 – Absent 2 – Present
SHUTTER LIMIT	8 – Underfilled 9 – Satisfactory 10 – Exactly. 11 – Overfilled
HOMOGENEITY OF THE FILLING MATERIAL	1 - Failed 2 - No failure
PRESENCE OF INTRARADICULAR RETAINER	1 – Absent 2 – Present
TEETH	11 21 12 22 13 23 33 32 31 41 42 43

DATA TABULATION

Data were tabulated using a table from the SPSS (Statistical Package for the Social Sciences) to quantify periradicular lesions distributed by the number of dental elements and the presence or absence of an intraradicular retainer.

STATISTICAL ANALYSIS

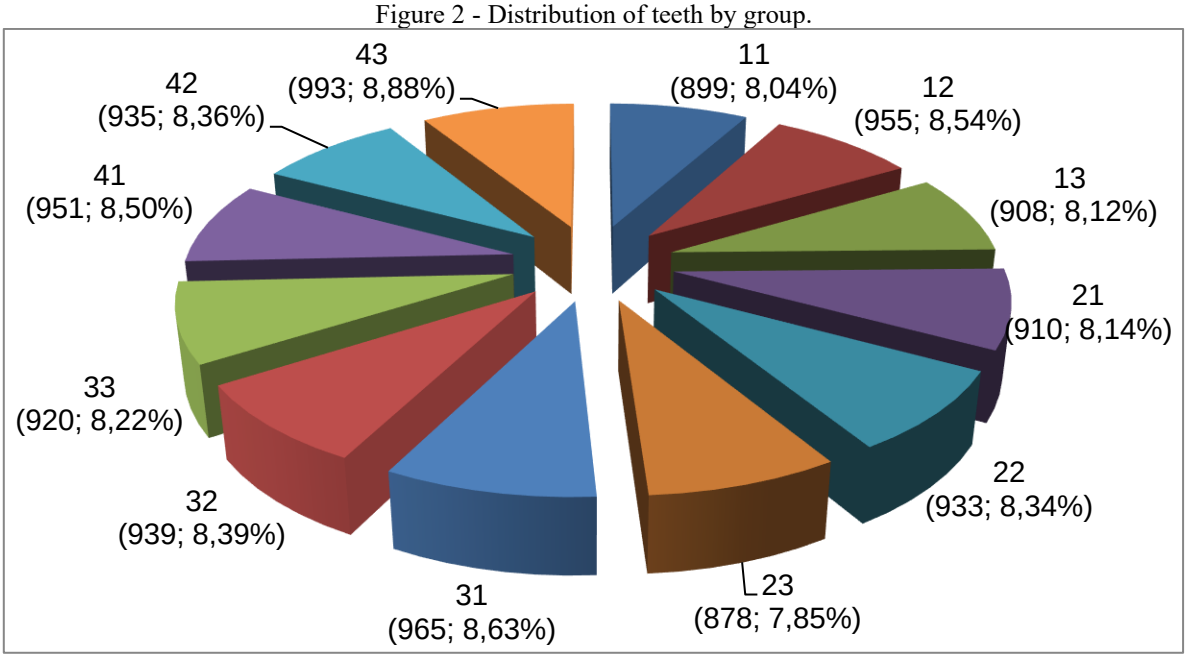
Absolute and percentage distributions and statistical measures were obtained: mean, median, standard deviation (descriptive statistical techniques) using Pearson's Chi-square statistical test (inferential statistics technique).

Statistical tests were performed with a margin of error of 5.0% using the SPSS software in version 15 for Windows.

RESULTS

After completing the analysis of the 1318 radiographic records, containing 6 radiographs each, a total of 11186 teeth were evaluated. Figure 2 shows the distribution, in absolute and percentage numbers, of the teeth in the corresponding groups.

Figure 2 - Distribution of teeth by group.



The distribution and presence of each dental group with and without periapical lesions, as well as the results of the entire sample, are shown in Table 2. Of the total number of teeth analyzed, 955 (8.5%) had apical periodontitis. The one with the highest percentage of lesions was the right upper lateral incisor, and the least susceptible was element 33, with less than 1% of the cases having BP. An interesting finding is the percentage of healthy teeth with periapical lesions: of the 7326 teeth with radiographically intact crowns, 101 teeth (1.4%) had periapical bone rarefaction.

Regarding endodontic treatment, 9.8% of the teeth had an obfilled canal. The right maxillary central incisor, with 19.4% of the cases filled, was the one with the highest prevalence. On the other hand, element 33 had the lowest prevalence, with only 2% of them treated, as can be seen in Table 3.

Table 2 - Distribution of the presence of apical periodontitis by group.

			Injury		
			Absent	**Present**	**Total**
Tooth	11	Quantity	776	123	899
		Percentage per tooth	86,3%	13,7%	100,0%
	12	**Quantity**	**800**	**155**	**955**
		Percentage per tooth	**83,8%**	**16,2%**	**100,0%**
	13	Quantity	796	112	908
		Percentage per tooth	87,7%	12,3%	100,0%
	21	**Quantity**	**798**	**112**	**910**
		Percentage per tooth	**87,7%**	**12,3%**	**100,0%**
	22	Quantity	798	135	933
		Percentage per tooth	85,5%	14,5%	100,0%
	23	**Quantity**	**802**	**76**	**878**
		Percentage per tooth	**91,3%**	**8,7%**	**100,0%**
	31	Quantity	910	55	965
		Percentage per tooth	94,3%	5,7%	100,0%
	32	**Quantity**	**906**	**33**	**939**
		Percentage per tooth	**96,5%**	**3,5%**	**100,0%**

	33	Quantity	912	8	920
		Percentage per tooth	99,1%	0,9%	100,0%
	41	**Quantity**	**886**	**65**	**951**
		Percentage per tooth	**93,2%**	**6,8%**	**100,0%**
	42	Quantity	896	39	935
		Percentage per tooth	95,8%	4,2%	100,0%
	43	**Quantity**	**951**	**42**	**993**
		Percentage per tooth	**95,8%**	**4,2%**	**100,0%**
Total		Quantity	10.231	955	11.186
		Percentage per tooth	91,5%	8,5%	100,0%

Table 3 – Distribution of endodontically treated teeth by group.

			Treated channel		
			No	**Yes**	**Total**
Tooth	11	Quantity	725	174	899
		Percentage per tooth	80,6%	19,4%	100,0%
	12	**Quantity**	**796**	**159**	**955**
		Percentage per tooth	**83,4%**	**16,6%**	**100,0%**
	13	Quantity	780	128	908
		Percentage per tooth	85,9%	14,1%	100,0%
	21	**Quantity**	**758**	**152**	**910**
		Percentage per tooth	**83,3%**	**16,7%**	**100,0%**
	22	Quantity	783	150	933
		Percentage per tooth	83,9%	16,1%	100,0%
	23	**Quantity**	**754**	**124**	**878**
		Percentage per tooth	**85,9%**	**14,1%**	**100,0%**
	31	Quantity	929	36	965
		Percentage per tooth	96,3%	3,7%	100,0%
	32	**Quantity**	**915**	**24**	**939**
		Percentage per tooth	**97,4%**	**2,6%**	**100,0%**
	33	Quantity	902	18	920
		Percentage per tooth	98,0%	2,0%	100,0%
	41	**Quantity**	**909**	**42**	**951**
		Percentage per tooth	**95,6%**	**4,4%**	**100,0%**
	42	Quantity	915	20	935
		Percentage per tooth	97,9%	2,1%	100,0%
	43	**Quantity**	**929**	**64**	**993**
		Percentage per tooth	**93,6%**	**6,4%**	**100,0%**
Total		Quantity	10.095	1.091	11.186
		Percentage per tooth	90,2%	9,8%	100,0%

Correlating the results of endodontically treated teeth with the presence of periapical pathology, we could observe that in 59% of the cases the lesion was associated with filled teeth, as shown in Table 4.

Table 4 – Relationship between endodontically treated teeth and periapical lesion

			Treated Channel		
			No	**Yes**	**Total**
Injury	Absent	Quantity Percentage per Injury	9.703 94,8%	528 5,2%	10.231 100,0%
	Present	Quantity Percentage per Injury	392 41,0%	563 59,0%	955 100,0%
Total		**Quantity Percentage per Injury**	**10.095 90,2%**	**1.091 9,8%**	**11.186 100,0%**

Table 5 shows the prevalence of intraradicular retainers in the anterior teeth (5%) and in each dental group. Element 21 had the highest percentage of pins, 9.9% of the left maxillary central incisors had a pin. Element 33 had the lowest prevalence of retainers, only 0.7% of the 914 lower left canines.

Table 5 – Prevalence of intraradicular retainers in permanent and group anterior teeth.

			Intraradicular Retainer		
			Absent	**Present**	**Total**
Tooth	11	Quantity	813	86	899
		Percentage per Tooth	90,4%	9,6%	100,0%
	12	**Quantity**	**869**	**86**	**955**
		Percentage per Tooth	**91,0%**	**9,0%**	**100,0%**
	13	Quantity	838	70	908
		Percentage per Tooth	92,3%	7,7%	100,0%
	21	**Quantity**	**820**	**90**	**910**
		Percentage per Tooth	**90,1%**	**9,9%**	**100,0%**
	22	Quantity	847	86	933
		Percentage per Tooth	90,8%	9,2%	100,0%
	23	**Quantity**	**812**	**66**	**878**
		Percentage per Tooth	**92,5%**	**7,5%**	**100,0%**
	31	Quantity	951	14	965
		Percentage per Tooth	98,5%	1,5%	100,0%
	32	**Quantity**	**923**	**16**	**939**
		Percentage per Tooth	**98,3%**	**1,7%**	**100,0%**
	33	Quantity	914	6	920
		Percentage per Tooth	99,3%	0,7%	100,0%
	41	**Quantity**	**931**	**20**	**951**
		Percentage per Tooth	**97,9%**	**2,1%**	**100,0%**
	42	Quantity	927	8	935
		Percentage per Tooth	99,1%	0,9%	100,0%
	43	**Quantity**	**977**	**16**	**993**
		Percentage per Tooth	**98,4%**	**1,6%**	**100,0%**
Total	Quantity		10.622	564	11.186
	Percentage per Tooth		95,0%	5,0%	100,0%

The relationship between periapical lesion and the presence of an intraradicular retainer, as shown in Table 6, revealed that 30.8% of the teeth with pins had radiolucency in the region of the root periapex.

Table 6 – Relationship between intraradicular retainer vs. periapical lesion.

			Pine		
			Absent	**Present**	**Total**
Periapical lesion	**Absent**	Quantity	9.961	270	10.231
		Percentage	97,4%	2,6%	100,0%
	Present	Quantity	661	294	955
		Percentage	69,2%	30,8%	100,0%
Total		Quantity	10.622	564	11.186
		Percentage	95,0%	5,0%	100,0%

To evaluate the quality of the root canal filling, two criteria were established: the longitudinal length of the filling and the homogeneity of the filling material observed on the radiograph. In less than half of all cases (44.5%), the filling was classified as satisfactory. The tooth in which the actual working length (CRT) limit was most often preserved, in percentage terms, was the left mandibular canine, with 66.7% of the cases of teeth filled in this situation. The least satisfactory results were elements 32 and 43, with only 25% of the cases satisfactorily filled, as shown in Table 7.

Regarding the homogeneity of the filling material, 55.1% of the cases presented radiographically adequate characteristics. The highest percentage of teeth with homogeneous filling was found in the right mandibular lateral incisors, while the one with the greatest complication to obtain a homogeneous obturator mass was element 43, with 56.3% of the cases classified as non-homogeneous filling. Table 8 shows these results.

The relationship between apical periodontitis and the quality of endodontic treatment. This relationship is shown in Tables 9 and 10, which relate the presence of periapical lesion with the longitudinal limit of the filling and with the homogeneity of the filling material, respectively.

Table 7 – Prevalence of the longitudinal limit of endodontic filling by group.

			Longitudinal limit of the blank				
			Sub-filled	**Satisfactory**	**Exact**	**Overfilled**	**Total**
Tooth	11	Quantity Percentage	70 40,2%	80 46,0%	14 8,0%	10 5,7%	174 100,0%
	12	Quantity Percentage	50 31,4%	79 49,7%	16 10,1%	14 8,8%	159 100,0%
	13	Quantity Percentage	66 51,6%	60 46,9%	2 1,6%	0 0,0%	128 100,0%
	21	Quantity Percentage	66 43,4%	64 42,1%	20 13,2%	2 1,3%	152 100,0%
	22	Quantity Percentage	60 40,0%	72 48,0%	12 8,0%	6 4,0%	150 100,0%
	23	Quantity Percentage	58 46,8%	58 46,8%	8 6,5%	0 0,0%	124 100,0%
	31	Quantity Percentage	10 27,8%	14 38,9%	12 33,3%	0 0,0%	36 100,0%
	32	Quantity Percentage	8 33,3%	6 25,0%	6 25,0%	4 16,7%	24 100,0%
	33	Quantity Percentage	4 22,2%	12 66,7%	2 11,1%	0 0,0%	18 100,0%
	41	Quantity Percentage	12 28,6%	12 28,6%	16 38,1%	2 4,8%	42 100,0%
	42	Quantity Percentage	6 30,0%	12 60,0%	0 0,0%	2 10,0%	20 100,0%
	43	Quantity Percentage	48 75,0%	16 25,0%	0 0,0%	0 0,0%	64 100,0%
Total		**Quantity Percentage**	**458 42,0%**	**485 44,5%**	**108 9,9%**	**40 3,7%**	**1.091 100,0%**

Table 8 – Prevalence of filling material homogeneity by group.

			Homogeneity		Total
			Flawed	Homogeneous	
Tooth	11	Quantity Percentage	82 47,1%	92 52,9%	174 100,0%
	12	Quantity Percentage	80 50,3%	79 49,7%	159 100,0%
	13	Quantity Percentage	62 48,4%	66 51,6%	128 100,0%
	21	Quantity Percentage	64 42,1%	88 57,9%	152 100,0%
	22	Quantity Percentage	68 45,3%	82 54,7%	150 100,0%
	23	Quantity Percentage	54 43,5%	70 56,5%	124 100,0%
	31	Quantity Percentage	14 38,9%	22 61,1%	36 100,0%
	32	Quantity Percentage	8 33,3%	16 66,7%	24 100,0%
	33	Quantity Percentage	8 44,4%	10 55,6%	18 100,0%
	41	Quantity Percentage	10 23,8%	32 76,2%	42 100,0%
	42	Quantity Percentage	4 20,0%	16 80,0%	20 100,0%
	43	Quantity Percentage	36 56,3%	28 43,8%	64 100,0%
Total		**Quantity Percentage**	**490 44,9%**	**601 55,1%**	**1.091 100,0%**

Underfilled teeth accounted for 42% of all root canal teeth. Of these, 44.8% had periapical lesions, while teeth with adequate filling (44.5% of the sample of teeth with endodontic treatment) were associated with periapical pathology in 36.1% of the cases. Of the teeth treated without the presence of lesions, the satisfactory canals showed 53.4% of treatment success.

Table 9 – Relationship between the longitudinal limit of the filling vs. periapical lesion.

			Longitudinal limit of the blank				Total
			Sub-filled	Satisfactory	Exact	Overfilled	
Injury	Absent	Amount Percentage	206 39,0%	282 53,4%	24 4,5%	16 3,0%	528 100,0%
	Present	Amount Percentage	252 44,8%	203 36,1%	84 14,9%	24 4,3%	563 100,0%
Total		**Amount Percentage**	**458 42,0%**	**485 44,5%**	**108 9,9%**	**40 3,7%**	**1.091 100,0%**

Table 10 - Relationship between homogeneity of filled material vs. periapical lesion.

			Homogeneity		Total
			Flawed	Homogeneous	
Injury	Absent	Quantity Percentage	174 33,0%	354 67,0%	528 100,0%
	Present	Quantity Percentage	316 56,1%	247 43,9%	563 100,0%
Total		**Quantity Percentage**	**490 44,9%**	**601 55,1%**	**1.091 100,0%**

Although found in only 10 cases, we observed the presence of intraradicular retainer in teeth without endodontic treatment, or with obturator material completely removed. Periapical pathology was present in all of them.

Of the 1091 cases with endodontically treated teeth, only 335 cases (30.7%) had a totally satisfactory endodontic treatment, i.e., with a longitudinal limit of the filling as measured by the CRT and with a radiographically homogeneous obturator mass.

DISCUSSION

As in several other studies, the radiographs analyzed in this study were obtained on the recommendation of another dental professional and not exclusively for research purposes, since frequent radiographic evaluation of healthy teeth with the sole purpose of detecting and monitoring the signs of apical periodontitis is not usually indicated for safety reasons in relation to the effects of radiation.

Traditionally, periapical radiography has been used to assess the outcome of root canal treatment with the absence of a periapical radiolucent being considered a confirmation of a healthy periapex, they are good diagnostic aids in endodontics, although they have limitations. Its accuracy

in detecting periapical bone defects is significantly higher than that of panoramic radiographs. However, no radiolucent inflammatory lesion can be reliably accurately diagnosed through clinical and radiographic examinations alone.

It should be emphasized, however, that it is not possible to detect from a simple x-ray whether an apical zone of bone loss is growing in size or healing. For this reason, cross-sectional studies such as this one are limited by the dynamic nature of periapical healing, and long-term follow-up studies may reflect better outcomes of endodontic interventions, since radiography is a static image of a dynamic process. Thus, classifying endodontic treatments as success or failure was used based on radiography and not on treatment time.

In previous studies, the prevalence of apical periodontitis ranged from 1.4% to 27% of all teeth in the sample. A similar result was found in this study, when the prevalence was 21.6%. In their study, Kabak and Abbott (2005) found that the prevalence of BP in incisors was 6% and in canines was 4%, for Georgopoulou et al. (2005), this prevalence was 9.4%. Compared to the present study, the maxillary central incisors had a much higher prevalence, ranging from 30.6% to 23.6%. The results of the mandibular incisors ranged from 25.0% to 16.7%.

The essential factor for endodontic success is the elimination of microorganisms from the root canal system through the association of procedures, i.e., cleaning, enlargement, modeling, use of intracanal antimicrobial medications, and quality of canal filling and coronary restoration. However, root canal cleaning and modeling cannot be evaluated by periapical radiography because a two-dimensional image does not provide complete information about the quality of the treatment performed. For this reason, this study evaluated only the longitudinal limit and the homogeneity of the filling.

"The compaction of the filling material is an important factor for the sealing of the canal filling and, consequently, for the effectiveness of the treatment" (FRACASSI et al. 2013), "since well-performed instrumentation and filling can prevent the infiltration of bacteria and their products to the periapex" (RICUCCI, GRÖNDAHL, BERGENHOLTZ, 2000). "The choice of a particular length of root canal instrumentation and filling is clinically controversial and complicated, probably as a result of the limitations of periapical radiography" (MOURA et al. 2009).

The presence of periapical lesion (21.6%); in relation to the filling limit for the majority, it was below (62.5%), followed by CDC (21.6%); in a little less than half (45.8%) there was a failure in the homogeneity of the restorative material. The presence of retainer space was verified in 35.8% of the sample and coronary sealing was verified in a little more than half (51.6%).

Poorly filled root canals do not necessarily indicate failure, but they can facilitate bacterial invasion and its by-products into the root canals, which in turn can lead to diseases causing treatment failure (LOFTUS, KEATING, MCCARTAN, 2005). Apical periodontitis is found less frequently

when the quality of endodontic treatment is good (ECKERBOM, FLYGARE, MAGNUSSON, 2007). In this study, we found that 49% of the teeth in which the filling was radiographically homogeneous and 17% of the cases of teeth treated at the CRT limit had apical periodontitis. The values increased when the tooth was underfilled or the obturator mass was not homogeneous.

"There are no statistical differences in relation to the prevalence of apical periodontitis related to endodontic treatment when it was performed by a general dentist or by an endodontist" (DUGAS et al. 2003).

For Segura-Egea (2004), Tavares et al. (2009), Peters et al. (2011), adequate filling has a more significant impact on the outcome of endodontic treatment than the quality of coronary restoration.

The presence of intraradicular pins did not influence the prevalence of BP in the study by Boucher et al. (2002), 26% of the filled canals had pins and of these 29% had apical periodontitis. In 2008, Touré et al. observed that 18.9% of the teeth treated endodontically had intraradicular retainer and that 66.2% of these were associated with BP. In our data, 18.6% of the teeth with pins had an associated lesion, a different result when compared to the 24.3% of lesions associated with teeth with inhomogeneous fillings, and the 32.4% of the cases in which the filling was performed at the exact limit of the canal. Once again, it was observed that the quality of the treatment was the most important factor in the success rate of the treatment.

CONCLUSIONS

With the analysis of all the results obtained through the methodology used and after discussing them, it is possible to conclude that:

- Periapical lesions are commonly found on digital periapical radiographs;
- The anterior permanent teeth of the maxilla are most commonly affected by apical periodontitis;
- The prevalence of periapical lesions in the permanent anterior teeth is low when compared to the other countries mentioned in the other studies;
- The quality of endodontic treatments performed in the city of Recife needs to improve;
- The quality of the canal filling was the main factor for causes of BP associated with endodontically treated teeth;
- Half of the teeth submitted to endodontic treatment required an intraradicular pin;
- The presence of a retainer does not influence the prevalence of BP in endodontically treated teeth.

REFERENCES

1. Abbott, P. V. (2004). Classification, diagnosis and clinical manifestations of apical periodontitis. *Endodontic Topics*, 8, 36–54.

2. Al-Omari, M. A., Hazaa, A., & Haddad, F. (2011). Frequency and distribution of root filled teeth and apical periodontitis in a Jordanian subpopulation. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, 111, e59–e65.

3. Ananthraj, A., Karthik, V., Neena, I., Praveen, P., & Rani, P. (2011). Comparison of digital radiography and apex locator with the conventional method in root length determination of primary teeth. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 29(4), 300.

4. Becconsall-Ryan, K., Tong, D., & Love, R. M. (2010). Radiolucent inflammatory jaw lesions: A twenty-year analysis. *International Endodontic Journal*, 43, 859–865.

5. Boucher, Y., Matossian, L., Rilliard, F., & Machtou, P. (2002). Radiographic evaluation of the prevalence and technical quality of root canal treatment in a French subpopulation. *International Endodontic Journal*, 35, 229–238.

6. Consolaro, A. (2008). Dentes com lesão periapical crônica diagnosticada e tratada durante o tratamento ortodôntico: Quando retomar a aplicação de forças? *Revista Clínica de Ortodontia Dental Press*, 7(1), 109–111.

7. Cotti, E. (2010). Advanced techniques for detecting lesions in bone. *Dental Clinics of North America*, 54, 215–235.

8. Cotti, E., Vargiu, P., Dettori, C., & Mallarini, G. (1999). Computerized tomography in the management and follow-up of extensive periapical lesion. *Endodontics & Dental Traumatology*, 15(4), 186–189.

9. De Moor, R. J. G., Hommez, G. M. G., De Boever, J. G., Delme, K. I. M., & Martens, G. E. I. (2000). Periapical health related to the quality of root canal treatment in a Belgian population. *International Endodontic Journal*, 33, 113–120.

10. Dugas, N. N., Lawrence, H. P., Teplitsky, P. E., Pharoah, M. J., & Friedman, S. (2003). Periapical health and treatment quality assessment of root-filled teeth in two Canadian populations. *International Endodontic Journal*, 36, 181–192.

11. Eckerbom, M., Flygare, L., & Magnusson, T. (2007). A 20-year follow-up study of endodontic variables and apical status in a Swedish population. *International Endodontic Journal*, 40, 940–948.

12. Eckerbom, M., & Magnusson, T. (1997). Evaluation of technical quality of endodontic treatment – Reliability of intraoral radiographs. *Endodontics and Dental Traumatology*, 13, 259–264.

13. Endo, M. S., Signoretti, F. G., Kitayama, V. S., Marinho, A. C., Martinho, F. C., & Gomes, B. P. F. A. (2014). Culture and molecular detection of *Enterococcus faecalis* from patients with failed endodontic treatment and antimicrobial susceptibility of clinical isolates. *Brazilian Dental Science*, 17(3), 83–91.

14. Estrela, C., Bueno, M. R., Leles, C. R., Azevedo, B., & Azevedo, J. R. (2008). Accuracy of cone beam computed tomography and panoramic and periapical radiography for detection of apical periodontitis. *Journal of Endodontics*, 34(3), 273–279.

15. Estrela, C., Leles, C. R., Hollanda, A. C. B., Moura, M. S., & Pécora, J. D. (2008). Prevalence and risk factors of apical periodontitis in endodontically treated teeth in a selected population of Brazilian adults. *Brazilian Dental Journal*, 19(1), 34–39.

16. Ferreira, C. M., de Almeida Gomes, F., & Uchoa, C. C. (2014). Prevalência de lesão endodôntica em pacientes diabéticos. *Revista Brasileira em Promoção da Saúde*, 27(2), 163–168.

17. Fracassi, L. D., Ferraz, E. G., Albergaria, S. J., Veeck, E. B., Costa, N. P., & Sarmento, V. A. (2013). Evaluation of the quality of different endodontic obturation techniques by digital radiography. *Clinical Oral Investigations*, 17, 97–103.

18. Georgopoulou, M. K., Spanaki-Voreadi, A. P., Pantazis, N., & Kontakiotis, E. G. (2005). Frequency and distribution of root-filled teeth and apical periodontitis in a Greek population. *International Endodontic Journal*, 38, 105–111.

19. Gulsahi, K., Gulsahi, A., Ungor, M., & Genc, Y. (2008). Frequency of root-filled teeth and prevalence of apical periodontitis in an adult Turkish population. *International Endodontic Journal*, 41, 78–85.

20. Gundappa, M., Ng, S. Y., & Whaites, E. J. (2006). Comparison of ultrasound, digital and conventional radiography in differentiating periapical lesions. *Dentomaxillofacial Radiology*, 35, 326–333.

21. Hollanda, A. C. B., Alencar, A. H. G., Estrela, C. R. A., Bueno, M. R., & Estrela, C. (2008). Prevalence of endodontically treated teeth in a Brazilian adult population. *Brazilian Dental Journal*, 19(4), 313–317.

22. Huumonen, S., & Ørstavik, D. (2002). Radiological aspects of apical periodontitis. *Endodontic Topics*, 1, 3–25.

23. Kabak, Y., & Abbott, P. V. (2005). Prevalence of apical periodontitis and the quality of endodontic treatment in an adult Belarusian population. *International Endodontic Journal*, 38, 238–245.

24. Murray, B. E. (1990). The life and times of the *Enterococcus*. *Clinical Microbiology Reviews*, 3(1), 46–65.

25. Pieper, C. M., Münchow, E. A., & Piva, E. (2015). Regression of large periapical lesion using calcium hydroxide therapy: A six-year follow-up case report. *Brazilian Dental Science*, 18(1), 17–21.

26. Pontes, F. S. C., Fonseca, F. P., Jesus, A. S., Alves, A. C. G., Araújo, L. M., Nascimento, L. S., & Pontes, H. A. R. (2014). Nonendodontic lesions misdiagnosed as apical periodontitis lesions: Series of case reports and review of literature. *Journal of Endodontics*, 40(1), 16–27.

Proposal of a Portuguese/Kimbundu Bilingual Atlas of Human Anatomy

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ABSTRACT

This work has as its central theme *Proposal of a Portuguese/Kimbundu Bilingual Atlas of Human Anatomy.* It is an interdisciplinary investigation, involving the areas of Linguistics and Medicine. The research focuses on the perspective of contributing to the promotion and diversification of theories and teaching methods articulated with the Didactics of the Teaching of Portuguese as a Second Language in the general education system, as well as on the valorization and promotion of Angolan languages. We think that the work will be very interesting, as it will contribute to the lack of information that is felt at the family and school level on issues related to the anatomy of the human body in the complete clarification of its constitution and functioning of the body, safeguarding the possible social phenomena linked to child sexual violence in our country, as well as, in the protection, diagnosis and cure of certain diseases. The bilingual study of Human Anatomy is essential for the knowledge and understanding of the human body as a whole, when the mother tongue of the students is different from the language of instruction. Thus, the interaction and immersion of the student in all the structures and characteristics of each of the organs, or parts, becomes effective as an essential means to promote life, prevent, care for and cure ailments as a technique, art and science.

Keywords: Atlas, Anatomy, Teaching, Bilingual and Second Language.

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INTRODUCTION

The learning of National Languages is an imperative of Angolanity, because in addition to enabling contact between the various actors that make up the same community, it also allows the identification of each people with all other Angolans towards the single Nation, as a result of the whole, thus consolidating the constitutional imperative of state unity and ideological and cultural pluralism.

Even today, teaching is organized in such a way as to privilege the study of concepts, language and methodologies, making learning inefficient for interpretation and intervention in reality. Therefore, Anatomy is an opportunity to stimulate teaching-learning.

The teaching/learning process becomes more effective when theory and practice are associated. Disciplines such as Anatomy are related to the student's daily life. Some contents are difficult to visualize in lectures, requiring practices and didactic resources for the student to visualize and build, with autonomy, scientific knowledge.

There are several didactic strategies, from the traditional way in schools, through the blackboard and chalk board to the most modern ones, using computers. Teaching can be conceptualized as a process of facilitation or conduction, with the aim that the student learns.

The teaching-learning process is characterized by the combination of student activities directed by the teacher, there is a need to believe in the student, in his ability to learn, discover, create solutions, challenge, face, propose, choose and assume the consequences of his choice.

This Atlas can be used both by the teacher during theoretical-expository classes, thus making the interaction between them, and by the students as a study resource, in which they can be stimulated to participate more actively in the construction of knowledge.

The bilingual study of Anatomy is essential for the knowledge and understanding of the human body as a whole, when the students' mother tongue is different from the language of instruction. Thus, the interaction and immersion of the student in all the structures and characteristics of each of the organs, or parts, becomes effective as an essential means to promote life, prevent, care for and cure evils as a technique, art and science.

With the aim of contributing to the Didactics of the teaching/learning of Portuguese as a Second Language in General Education, to facilitate the comparison of images obtained by a bilingual scheme that coincide with the real structures and to promote the insertion of National Languages in General Education, facilitating their use as a language of thinking, wanting and acting as a language of communication and culture.

METHODOLOGY

With the need to minimize the communication difficulties that teachers and students face, we felt the need to propose a Portuguese/Kimbundu Bilingual Atlas of Human Anatomy, capable of motivating and valuing students' efforts, promoting a better command of Portuguese as a Second Language, theoretical and practical disciplinary contents in General Education.

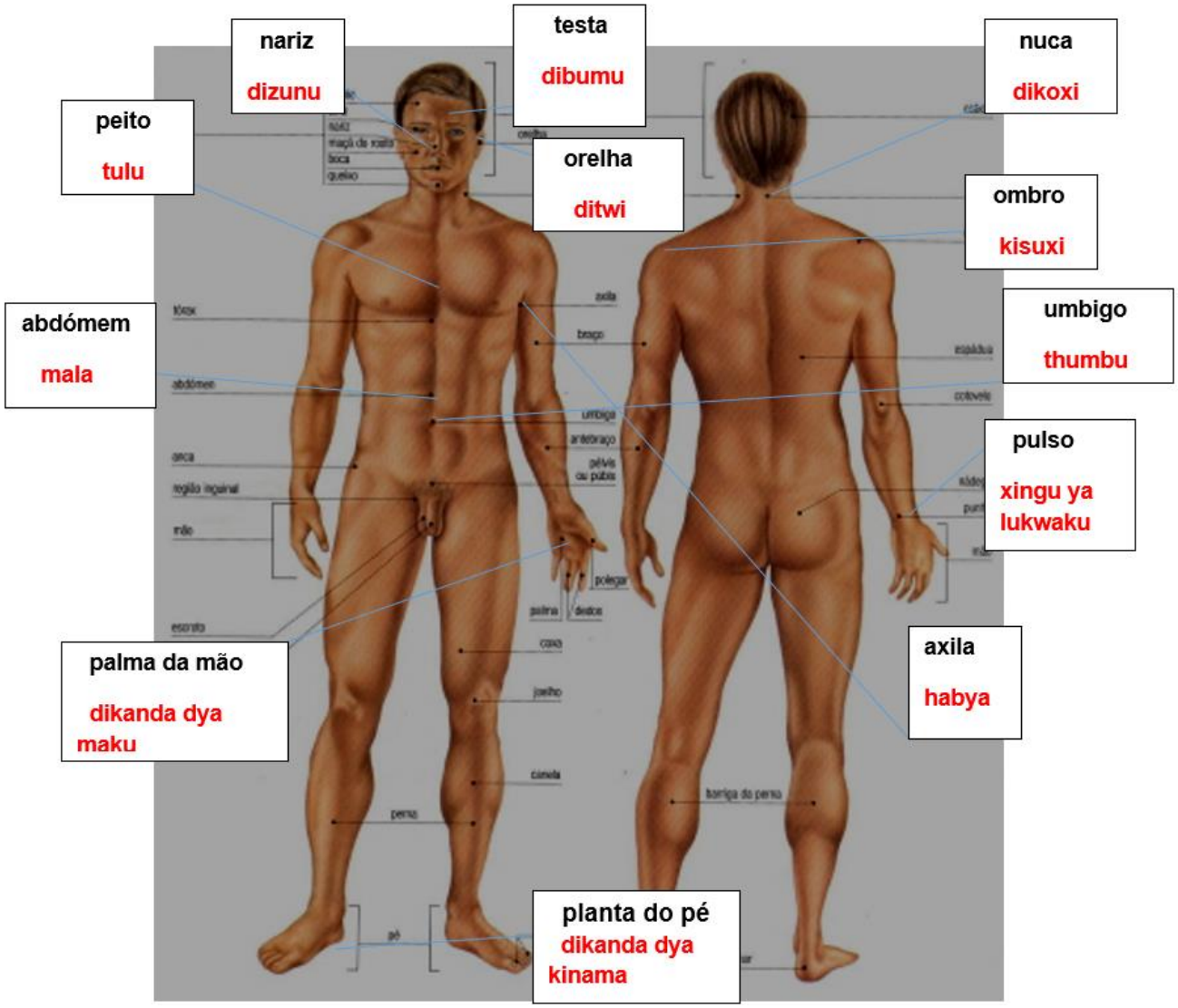
To carry out our intention, we collected the engravings of the Atlas of Human Anatomy in Portuguese, fromthe human body, the skeleton, as well as the digestive, respiratory, urinary, female reproductive and male reproductive systems.

The data were organized, cataloged and translated into the Kimbundu National Language in order to become an important reference source for the study.

As a complement, we made a bibliographic consultation that contributed to the justification of our arguments on the subject under analysis. Our study was not exhaustive, because it is a first approach.

The elaboration of a didactic resource is not always easy, but with motivation, commitment and common sense, difficulties can be overcome.

Our bilingual *corpus* of reference in the field of Human Anatomy consists of several *subcorpora*: documentary, lexicographic, textual and oral, which served as the basis for the selection of terms in Portuguese and their equivalents in Kimbundu.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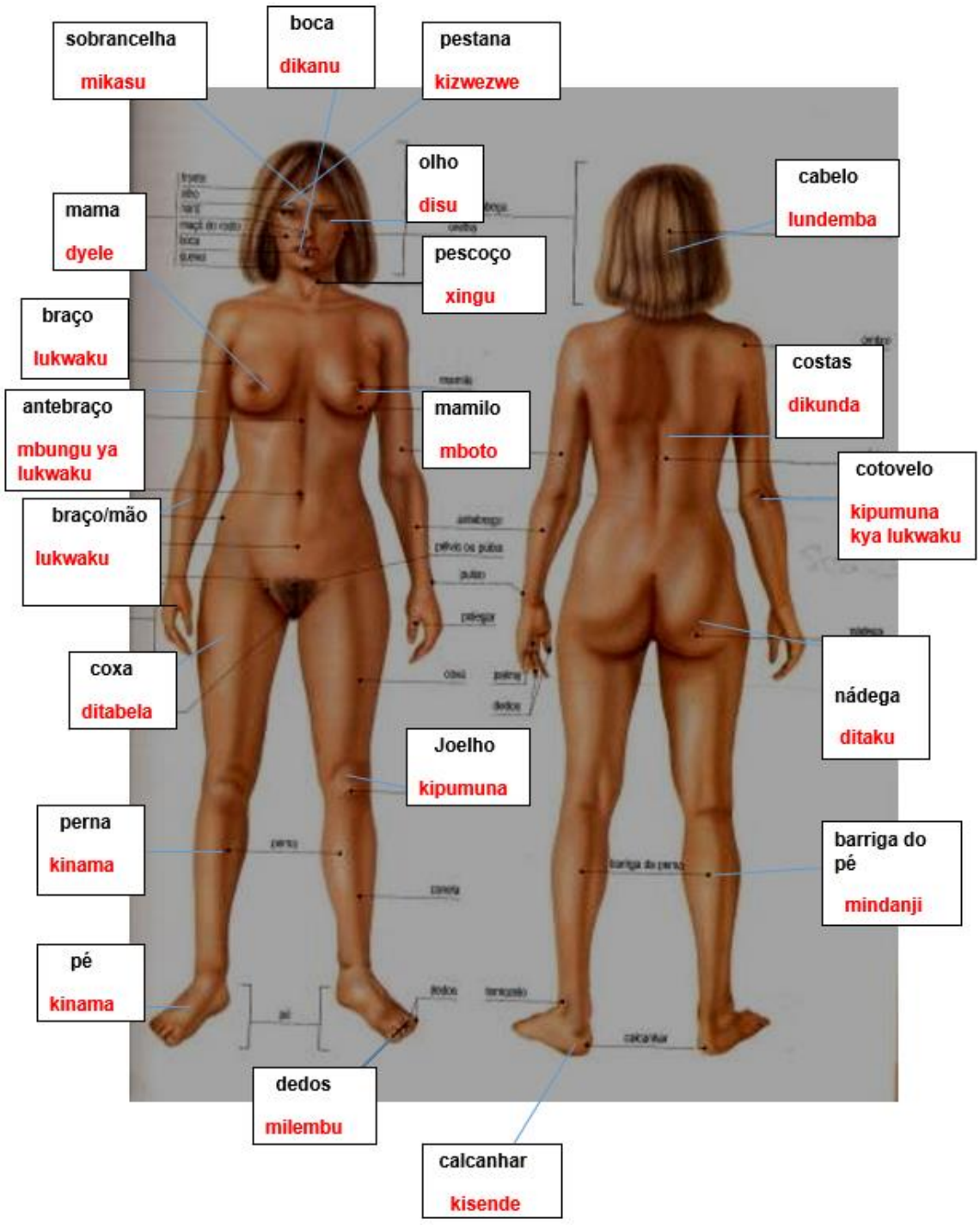
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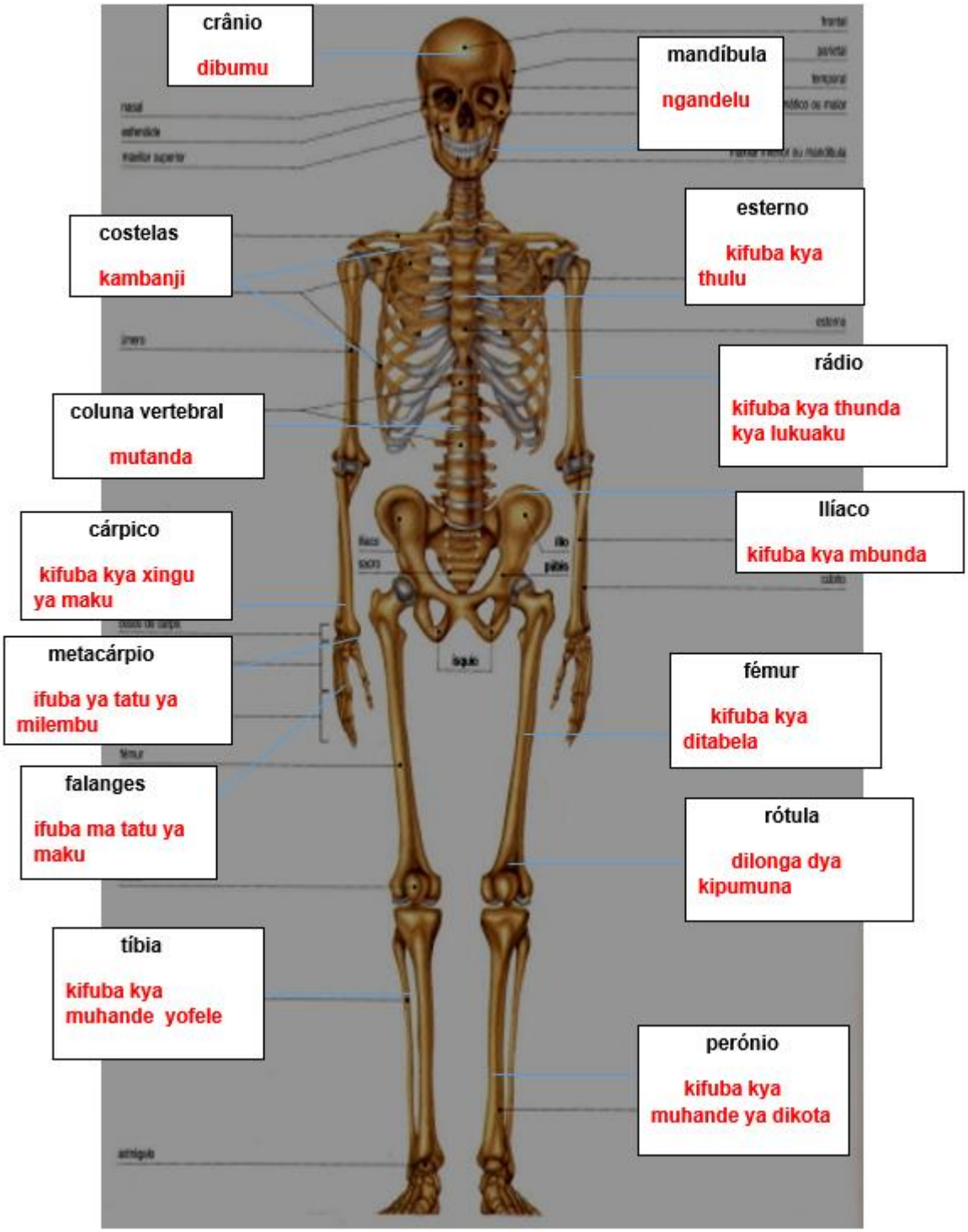
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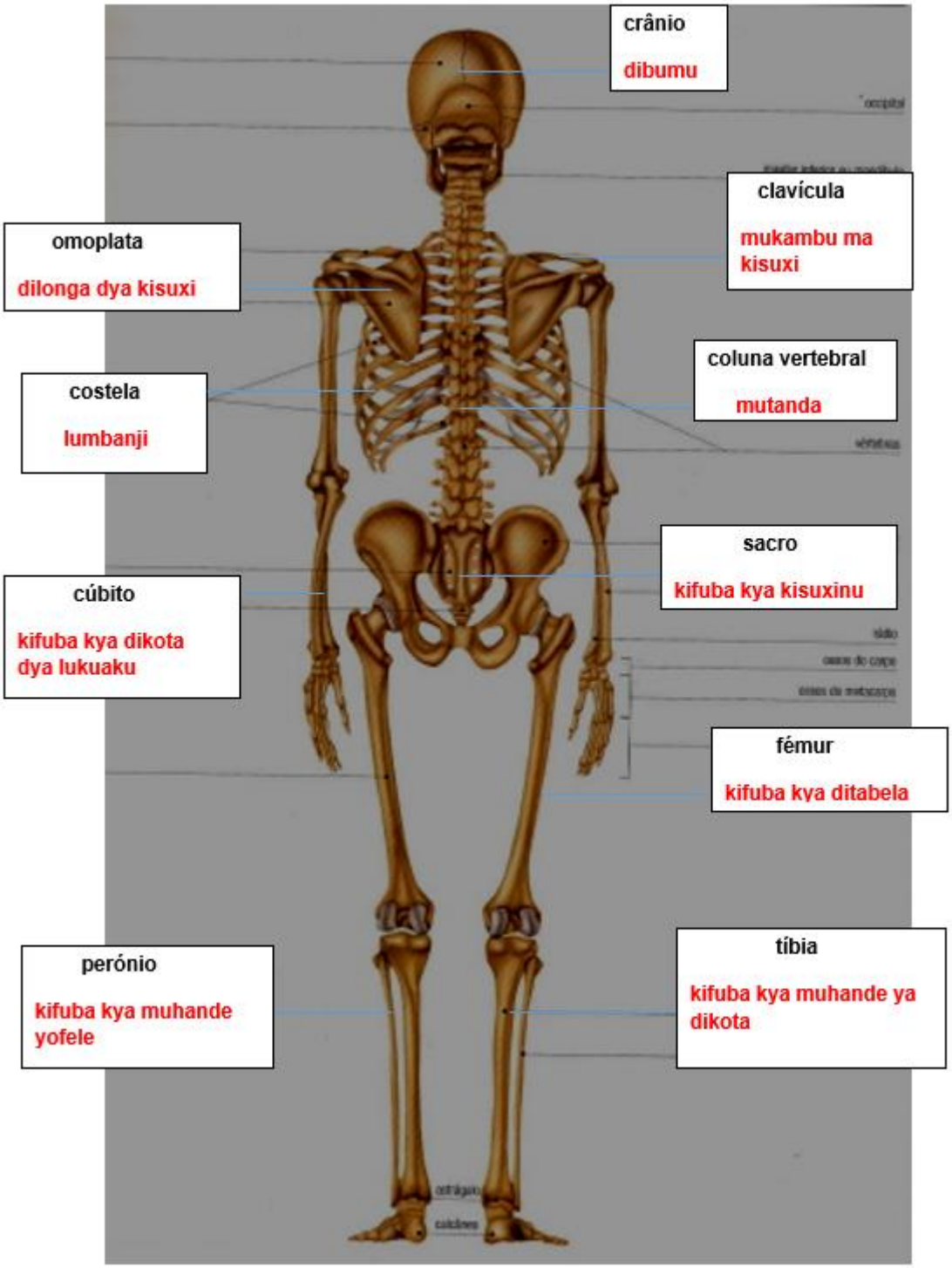
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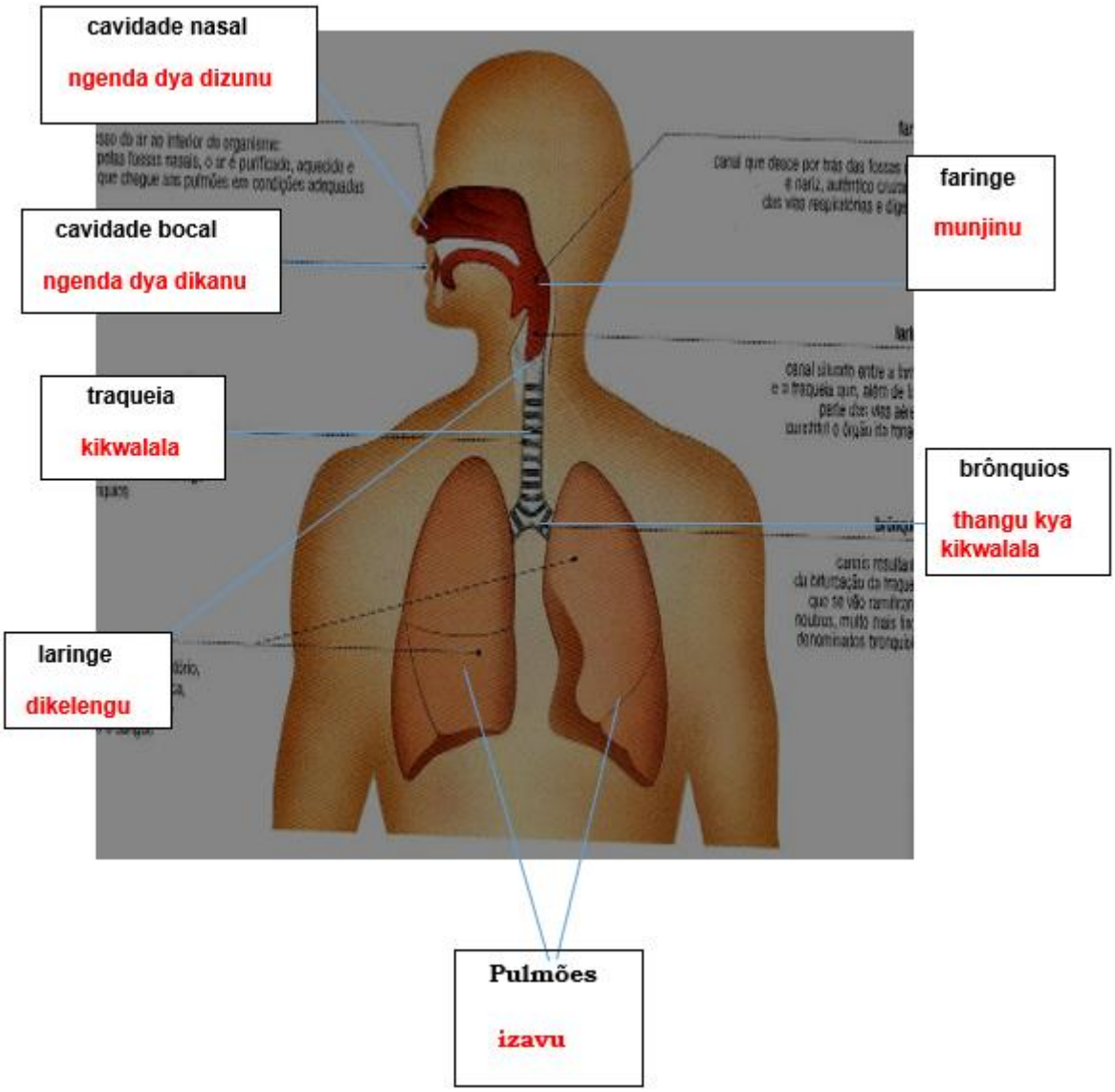
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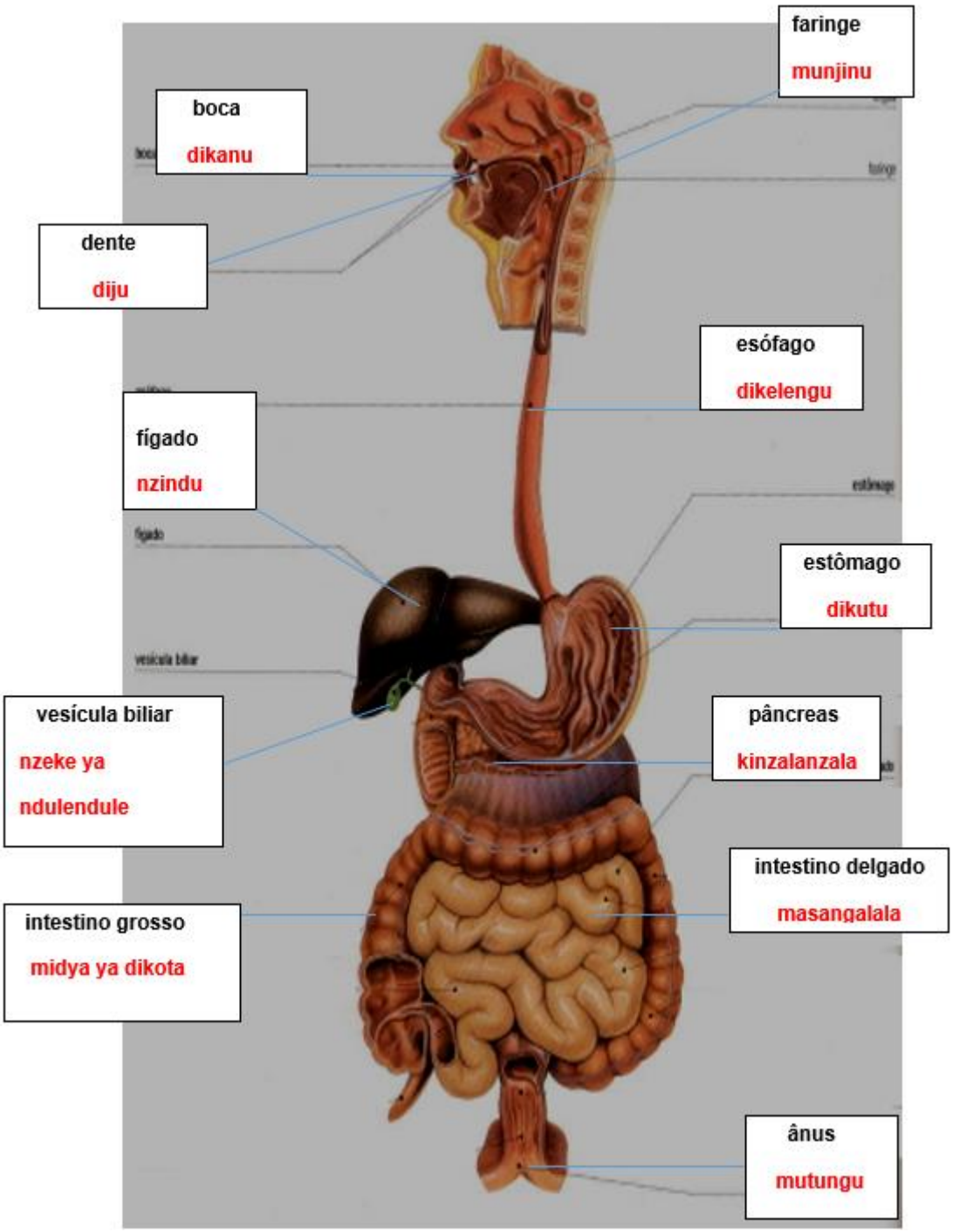
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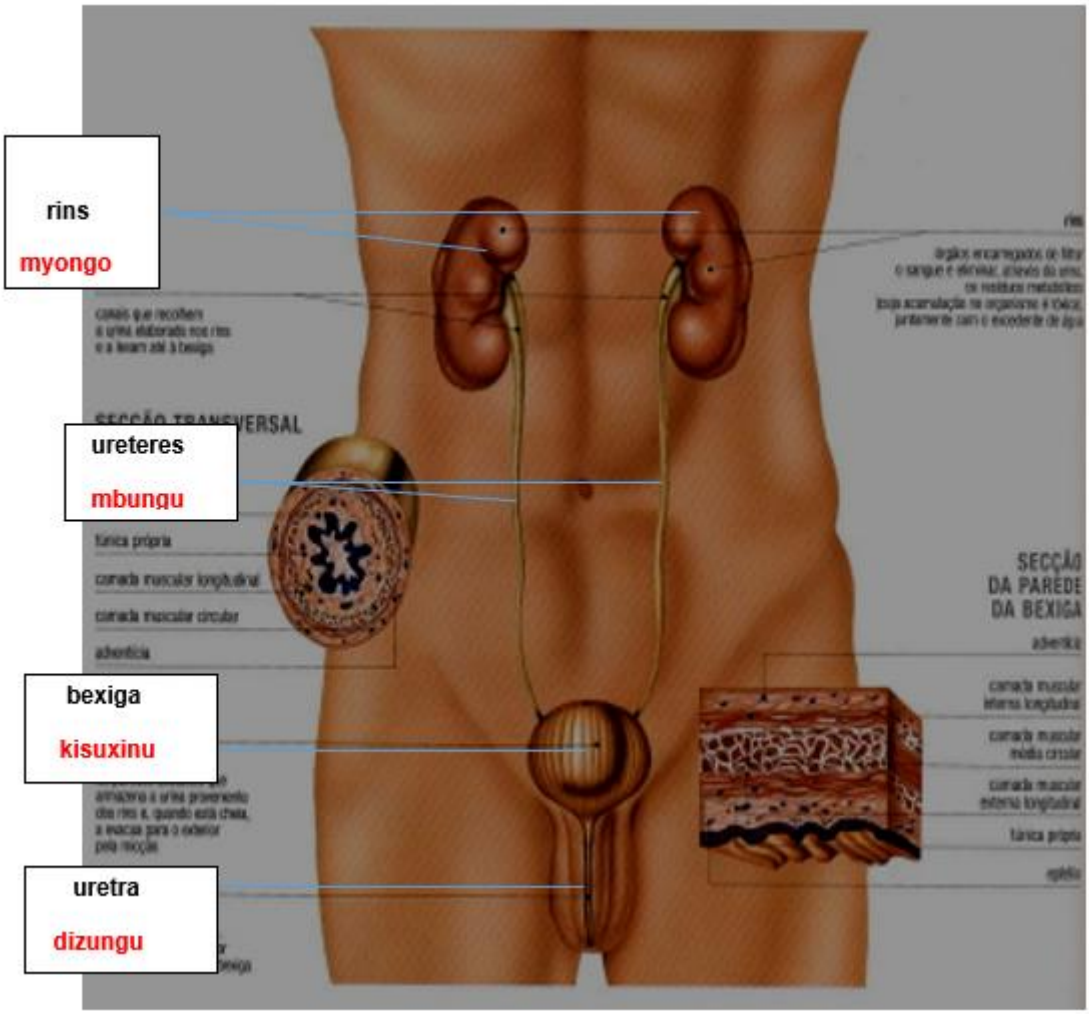
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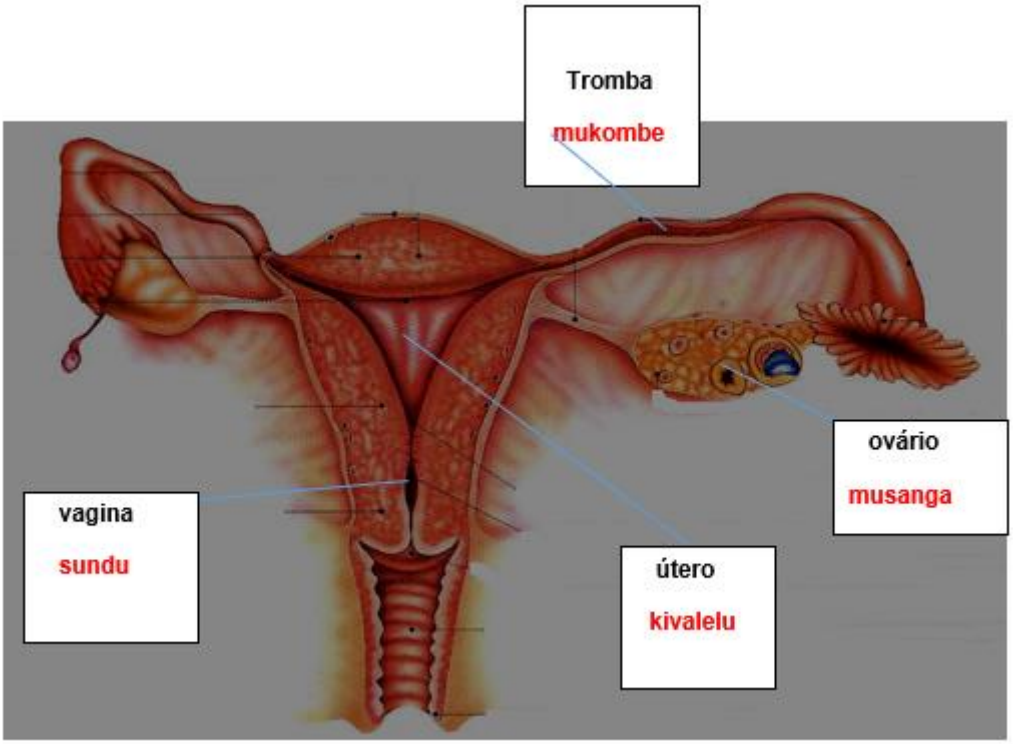
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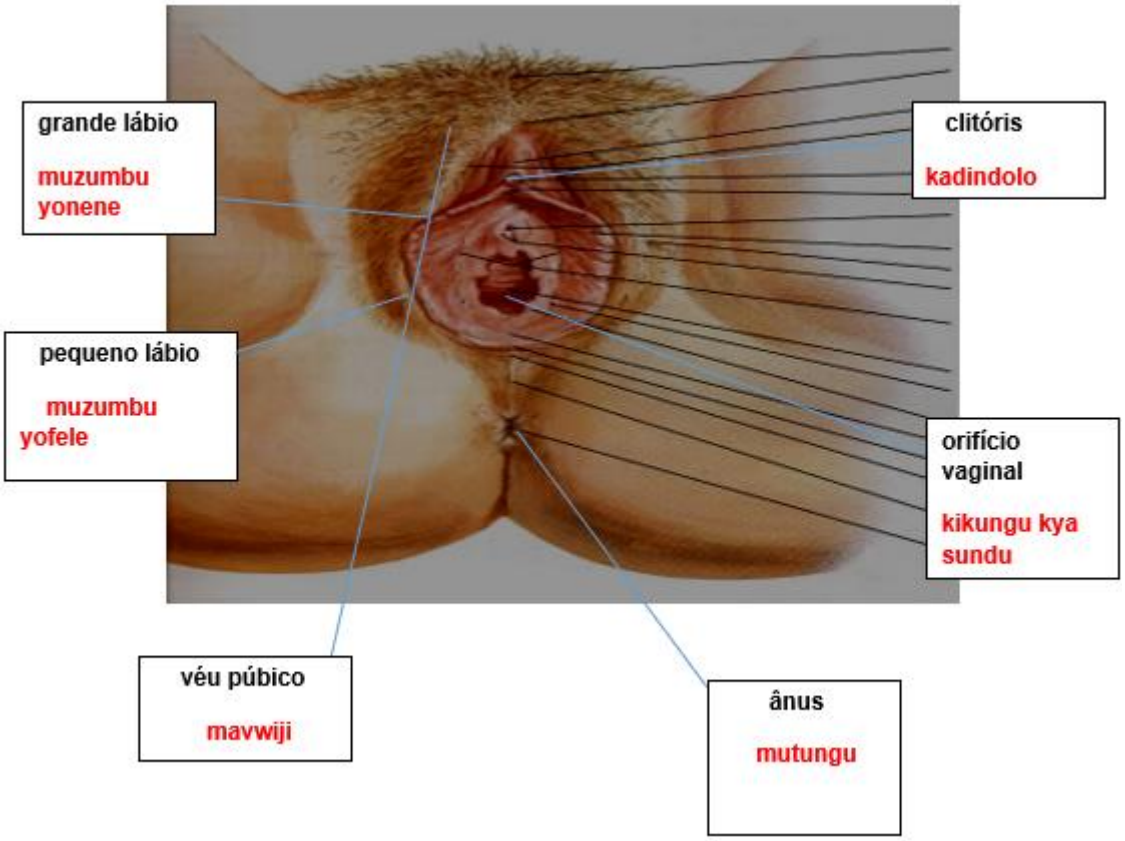
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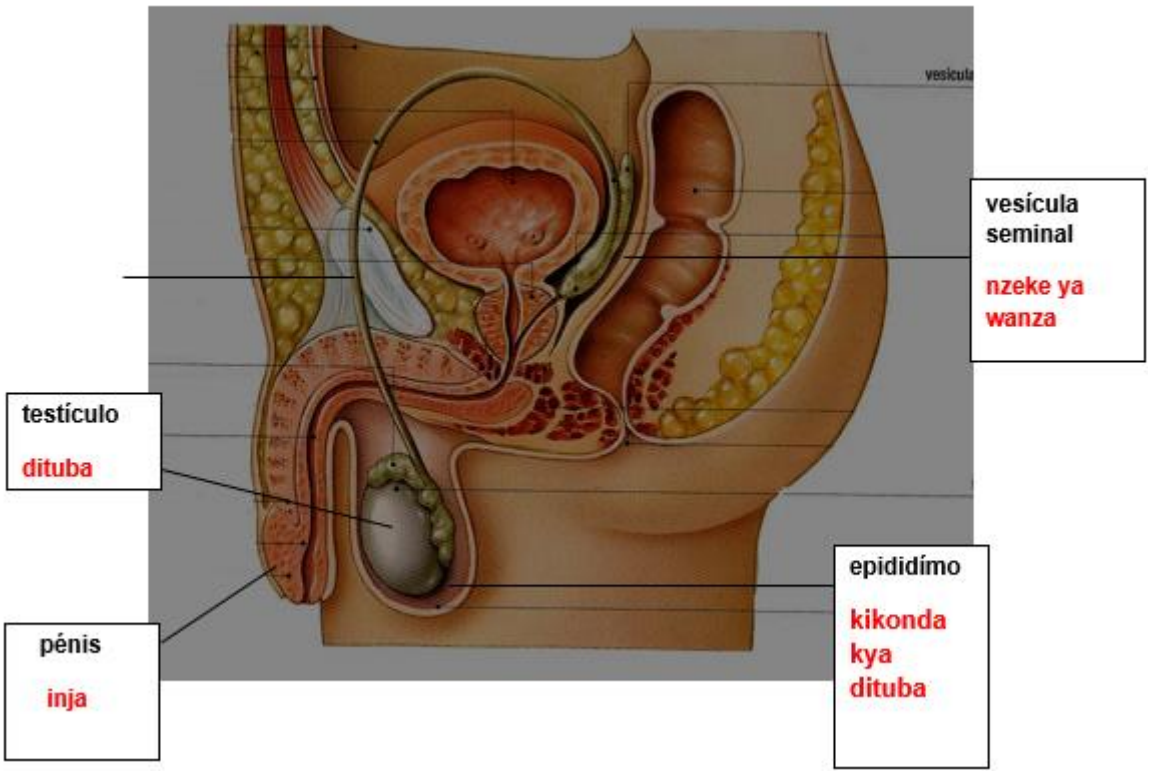
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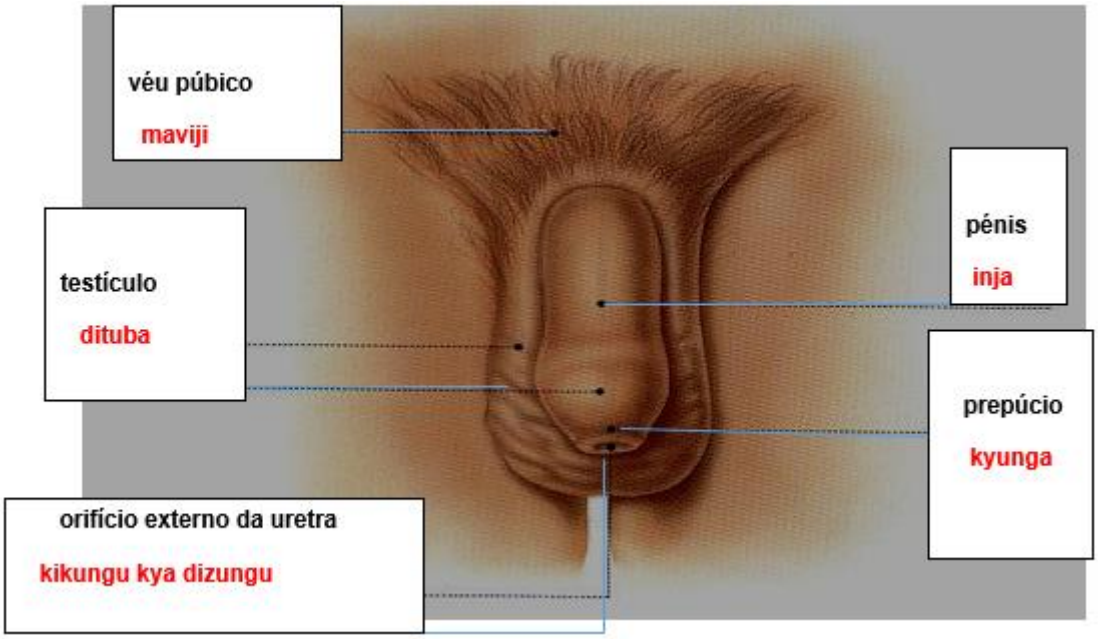

CONCLUSION

Language is learned by communicative necessity and not by imposition of any kind. It is false to think, in scientific and pedagogical terms, that a certain language can be recovered in school. We know that it was in European universities that Latin died.

Science, today, is the object of wide dissemination, so much so that there was a time when it was postulated that the content of specialized languages was restricted to professionals in the area; Today, science and technology have become the subject of news and, at that time, of interest to the non-specialist public.

The acquisition of technical, scientific and professional knowledge, as well as the linguistic means that allow its expression and communication, involves the teaching/learning of specialty languages, whether it is the teaching of second languages or the teaching of mother tongues, in a training context.

When we talk about the inclusion of national languages in the education system, we do not want children to be forced to learn the languages they do not want to learn. On the contrary, we want the linguistic rights of Angolans to be respected, observed, and that our languages have teaching material, like other languages in the world.

The functionality operated by the lexicon specialized in the transmission of knowledge, in the transfer of technological devices, as well as in contractual relations, makes Terminology increasingly assume relevance in and for today's society, whose development paradigms are closely related to the process of globalized economy and to the accelerated scientific and technological development.

We cannot, however, ignore the difficulty that exists in protecting linguistic identity in the context of globalization in which we operate. The globalisation of the economy, which takes place

through international trade agreements, gives absolute priority to economic agreements, linked to the use of a dominant language, threatening linguistic diversity.

However, it is the power of the market that sometimes prevents linguistic diversity from being ensured in all circumstances of the citizen's social, political and economic life. This fact means that a foreign language is better able to be used in interactions than a local language.

Therefore, first of all, it is necessary to make a survey of the different existing needs in relation to language studies. Language learning must be a learning experience and a contribution to plural understanding and tolerance and solidarity within the framework of new approaches to interculturality and multiculturalism.

It is necessary to develop computer products, teaching/learning in the national language, which follow the evolution of new technologies, filling the gaps identified at the scientific, professional and academic level.

The need to rely on plurilingual reference works in the search for both concepts and terminological denominations affects a wide range of professionals involved with technical languages. Among them, translators, interpreters, documentary filmmakers, technical editors, lexicographers and terminographers, university students, as well as professionals considered as indirect users of Terminology stand out.

Today's society suffers the impact of the accelerated production of knowledge, translated by the most varied technological innovations that affect its daily life. There is a process of technical-scientific literacy, which determines the expansion of contacts with terminologies.

Terminology is undoubtedly a privileged instrument for the promotion of languages and terminological research is also a privileged instrument for the development of specialist languages.

The existence and circulation of terminologies in different communicative scenarios are testimonies that they fulfill the double function of fixing technical-scientific knowledge and promoting its transfer in a punctual manner; In this way, the social role of terminologies in the field of human communication is also outlined. This role is also associated with the idea of standardization or harmonization.

The attempt to establish a standardised terminology in technical languages is typical of the adoption of linguistic policies articulated on the belief that the recurrent use of the same term guarantees the univocity of specialised communication.

We advocate the creation of strategies to encourage, promote and develop the learning of the Kimbundu language, developing integrated methodologies in the digital age. In this sense, it is necessary to use interactive content and controlled collaborative work, which presupposes choices in the design of the contents.

As culture is an important factor in human society today, each community must use its local languages to transmit its experience to the younger generations, thus perpetuating its socio-cultural reality.

UNESCO considers that all the languages of the world are essential for the identity of the person, of communities and for their peaceful coexistence, as well as being a strategic factor in making progress towards sustainable development, as well as for the harmonious articulation between the global and local dimensions.

It also calls on governments, United Nations bodies, civil society organisations, educational institutions, professional associations and all other interested parties to develop their activities in favour of the respect, promotion and protection of all languages, those at risk, whether at individual or collective level.

Developing culture does not mean submitting it to others. We must therefore admit that acculturations resulting from cultural contact with other peoples should not result in a loss of the Angolan's personality in the context of his material and spiritual anthropological values.

There is an urgent need to rescue Angolan cultural values by valuing Angolan national languages within family circuits.

All language communities have the right to use their language, to maintain it and to promote it in all its forms of cultural expression.

REFERENCES

1. Alexandre, P. (1981). *Les langues bantoues*. Em *Les langues dans le monde ancien et moderne* (pp. 351-376).

2. Andrade, E. d. (2007). *Línguas Africanas-Breve Introdução à Fonologia e à Morfologia*. Lisboa: Editora A. Santos.

3. Atkins, G. (1955). A demographic survey of the kimbundu-kongo language border in Angola. *Boletim da Sociedade de Geografia de Lisboa*, (pp. 325-347). Lisboa.

4. *Atlas de Anatomia* (2ª ed.). (2005). (A. Magalhães, Trad.). Lisboa: Plátano Editora.

5. Barros, L. A. (2002). Proposta de homogeneização da terminologia designativa das obras lexicográficas e terminológicas. Em M. Correia, *Terminologia, Desenvolvimento e Identidade Nacional, VI Simpósio Ibero-Americano de Terminologia* (pp. 123-185). Lisboa: Edições Colibri/ILTEC.

6. Bastin, Y. (1975). *Les langues bantoues*. Em *Inventaire des études linguistiques sur les pays d'Afrique Noire d'expression françaises et sur Madagascar* (pp. 123-185).

7. Benveniste, É. (1094). *Problème de linguistique générale*. Paris: Gallimard.

8. Bergstrom, M., & Reis, N. (1998). *Prontuário Ortográfico* (35ª ed.). Lisboa: Editorial Notícias.

9. Bleek, W. H. (1862). *A Comparative Grammar of South African Languages* (Vol. I). London: Trübner & Co.

10. Bleek, W. H. (1869). *A Comparative Grammar of South African Languages* (Vol. II). London: Trübner & Co.

11. Boulanger, J.-C. (2001). Convergências e divergências entre a Lexicografia e a Terminografia. Em M. S. Lima, & P. Ramos, *Terminologia e ensino de segunda língua*. Porto Alegre: NEC, ABECAN.

12. Bourigault, D. (1999). Terminologie et intelligence artificielle. *Terminologies nouvelles*, 19, 29-32.

13. Bower, L., & Pearson, J. (2002). *Working with Specialized Language: A Practical Guide to Using Corpora*. London: Routledge.

14. Cabré, M. T. (1993a). *La terminologia, els mètodes, les application*. Barcelona: Empúries.

15. Cabré, M. T. (1993b). *La Terminología: Teoría, metodología e aplicaciones*. Barcelona: Editorial Antártida/Empúries.

16. Cabré, M. T. (1994). Terminologie et Dictionnaires. *Meta*, 39(4), 589-597.

17. Cabré, M. T. (1999a). La terminología hoy: concepciones, tendencias y aplicaciones. Em *La Terminología: representación et comunicación, elementos para una teoría de base comunicativa y otros artículos* (pp. 17-38).

18. Cabré, M. T. (1999b). *La terminología: representación y comunicación-elementos para uma teoría de base comunicativay otros artículos*. Barcelona: Institut Universitari de lingüística aplicada.

19. Cabré, M. T. (1999c). Una nueva teoría de la terminología: de la denominación a la comunicación. Em *La Terminología: representación et comunicación, elementos para una teoría de base comunicativa y otros artículos* (pp. 109-127).

20. Cannecattim, B. M. (1864). *Dicionário da língua bunda ou angolense: Explicada na portugueza e Latina*. Lisboa: Impressão Régia.

21. Carvalho, J. G. (1967). *Teoria da Linguagem. Natureza do fenómeno linguístico e análise das línguas* (6ª ed., Vol. 1). Coimbra: Editora Limitada.

22. Carvalho, J. G. (1983). *Teoria da Linguagem, Natureza do Fenómeno Linguístico e análise das línguas* (6ª ed., Vol. I). Coimbra: Coimbra Editora Limitada.

23. Casteleiro, J. M. (2001). *Dicionário da língua portuguesa contemporânea, Academia das Ciências de Lisboa*. Lisboa: Editorial Verbo.

24. Chatelain, H. (1888/1889). *Gramática Elementar do Kimbundu ou língua de Angola*. Genève: Typ. De Charles Schuchardt.

25. Chatelain, H. (1888a). *Eme ué ngatatanga! Karivulu pala ku rilonga kimbungu*. Genève: Typ. De Charles Schuchardt.

26. Chatelain, H. (1888b). *Grundzuge des kimbundu oder der Angola Sprache*. Berlin: Asher & Co.

27. Chicuna, A. M. (2009). *Tratamento lexicográfico dos portuguesismos em Kyombe* (Tese de Doutoramento). Lisboa: Universidade Nova de Lisboa-Faculdade de Ciências Sociais e Humanas.

28. Conceição, M. C. (1994). Socioterminologia: Uma nova abordagem das terminologias. *Terminologias*, 9-10 (TERMIP), 33-41.

29. Contente, M. (2008). *Terminocriatividade, Sinonímia e Equivalência Interlinguística em Medicina* (Tese de Doutoramento). Lisboa: Edições Colibri.

30. Crispim, L. (1997, Julho-Setembro). Português, língua oficial, língua segunda. *Nortisul*, nº1, 18.

31. d´Andrade, E. (2007). *Línguas Africanas – Breve Introdução à Fonologia e à Morfologia*. Lisboa: Editora A. Santos.

32. Fernandes, J., & Ntondo, Z. (2002). *Angola: Povos e Línguas*. Luanda: Editorial Nzila.

33. Fleischman, S. (2001). Language and Medicine. Em D. Schiffrin, D. Tannen, & H. E. Hamilton (Eds.), *The Handbook of Discourse Analysis* (pp. 483-489). Massachusetts: Blackwell Publishers.

34. Galisson, R. (1983). *Des Mots pour Comuniquer*. Paris: Clé International.

35. Galisson, R., & Coste, D. (1983). *Dicionário de didáctica das línguas*. Coimbra: Livraria Almedina.

36. Isquerdo, A. N., & Oliveira, A. M. (2001). *As ciências do léxico: lexicologia, lexicografia e terminologia* (2ª ed.). Campo Grande: Editora da UFMS.

37. Júnior, A. A. (1941). *Dicionário kimbundu-português: Linguístico, botânico, histórico e coreográfico*. Luanda: Ed. Argente Santos e Cª Lda.

38. Júnior, J. M. (1979). *História e Estrutura da Língua Portuguesa* (2ª ed.). Rio de Janeiro: Padrão-Livraria Editora Ltda.

39. Lino, M. T. (1979). Importância da Lexicologia Contrastiva. *Letras soltas*, 1. UNL.

40. Lino, M. T. (1989). Língua Portuguesa, língua das ciências e das técnicas: Neologia científica e técnica e lexicografia. *Actas do Congresso Internacional A Língua Portuguesa – Que futuro?*. Lisboa: Sociedade da Língua Portuguesa.

41. Lino, M. T. (1990). Métodos lexicológicos e métodos terminológicos. Comunicação apresentada no *Colóquio Internacional de Terminologia Científica e Técnica*, U.N.L., Fevereiro. Lisboa: Universidade Nova de Lisboa.

42. Lino, M. T. (1991a). Terminologia da lexicologia e lexicografia. Em A. P. Linguística (Tomo II). Lisboa: Associação Portuguesa de Linguística.

43. Lino, M. T. (1991b). Terminologia da terminologia e da terminografia. Em A. P. Linguística (Tomo II). Lisboa: Associação Portuguesa de Linguística.

44. Maia, P. A. (1986). *Dicionário complementar português/kimbundu/kikongo*. Lisboa: Lousã Ed.

45. Nacionais, I. d. (1980a). Histórico sobre a Criação dos Alfabetos em Línguas Nacionais. Lousã: Ed.70.

46. Nacionais, I. d. (1980b). *Léxico temático de saúde português/kimbundu*. Luanda: Projecto Ang/77/009.

47. Netter, F. H. (2001). *Atlas de Anatomia Humana* (3ª ed.). Rio de Janeiro: Saunders.

48. Ngunga, A. (2004). *Introdução à Linguística Bantu*. Maputo: Imprensa Universitária.

Extermination of the black and poor population in the Covid-19 pandemic: Necropolitics in the US

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ABSTRACT

This text aims to analyze a debate that is historical and that produces discussions about human rights, namely: the extermination of the black and poor population by micropolitics. Our analysis proposal is based on the indiciary paradigm of Carlos Ginzburg that allowed the observation of clues, indications and signs in order to investigate government authoritarianisms. For this reflection, we researched several cases in an attempt to understand the conspiracies in the US against the black and poor population and to narrate the strategies used by the black movement to remove Donald Trump from power. Some authors were fundamental to the analysis: Mbembe (2016), Silvio Almeida (2018) Djamila Ribeiro (2017), WEB. Du Bois (1999). Boaventura Santos (2007) Munanga (2003) For this article we worked on two moments of analysis: the protests in the streets with the strength of the Blac Lives Black Lives Matter movement and the strategy of black militants for the removal of white supremacist Donald Trump from the presidency of the USA.

Keywords: Racism, COVID-19, Necropolitics, Black militancy.

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INTRODUCTION

This text seeks to analyze a debate that is historical, in the social sciences and other areas, and that produces discussions about human rights, that is: the extermination of the black and poor population by the necropolitics of authoritarian governments. As Sílvio Almeida (2018) states, to talk about structural racism is to look at the historical context of many struggles that have slavery as their main basis. According to the author, we are experiencing a lowering of the agenda, because now, more than fighting for rights, we are fighting not to be killed.

Our proposed analysis is based on Carlos Gizburg's indiciary paradigm. The author, by proposing this method, allowed many of us researchers to observe clues, clues and signs in order to investigate what is hidden and cannot be problematized with traditional methods. For this reflection, we will use indiciarism in an attempt to understand possible conspiracies in the US against the black and poor population residing in that country and narrate the strategies used by the black movement to remove Donald Trump from power. Some authors were fundamental to the analysis, the main ones are: Mbembe (2016), Silvio Almeida (2018), Djamila Ribeiro (2017), WEB. Du Bois (1999), Boaventura Santos (2007), Munanga (2003).

The purpose of this text is to narrate fundamental points about the black movement in the USA in the face of the demonstrations, which culminated: with the removal of Donald Trump from the US presidency and with the victory of Joe Bind and Kamala Harris. Our perspective is to understand how the organization and power of the militancy of the black movement is managing to intervene, directly in the policies of white supremacy in the USA, occupying spaces of struggle and creating networks of power. To do this, we will work with some issues: the mapping of anti-racist protests and protests against police violence enhanced in the face of the death of George Froyd, andthe fundamental role that some black men and women had in this struggle. The narratives of power strategies, used by these militants. Some militants, mostly women, are presented in the text, they are: women Patrisse Cullors, Alicia Garza, and Opal Tometi founders of the Black Lives Matter movement; US Vice President Kamala Harris; activist Stacey Abrams; Washington Mayor Muriel Bowser and Senator Raphael Warnock.

The political context we are living in has demanded from us black militants a reflection that We Du Bois (1999, p. 117) describes as becoming aware of our power. For the author, it is necessary to study, to reflect on our history of struggle, because in this way,

> (...) the Negro will find and solve them for himself, because of his isolation. Do you have any other way to do it than based on study, thought, and use of the rich experience of your past? (WE DU BOIS, 1999, P. 117)

BLACK AND POOR POPULATION IN THE COVID-19 PANDEMIC: NECROPOLITICS IN THE US AGAINST THE BLACK AND POOR POPULATION

Understanding that the lethality of COVID 19 in the territories, where the black and poor populations are, is part of a genocide project is an important basis for analyzing the functioning of necropolitics taken over by authoritarian governments. Mbembe (2016, p.25) argues that death and freedom are intertwined if slavery is based on observation. For the author, "terror is a characteristic that defines both slave states and late-modern colonial regimes", as both impose the absence of freedom, such as the experience of the pandemic and several other practices of loss of rights as we have constantly experienced, as a black and poor population. As Mbembe (2016, p. 25) states, experiencing a constant "being in pain". "A Certain Kind of Madness" Caused by

> (...) fortified structures, military posts and roadblocks everywhere; constructions that bring up painful memories of humiliation, interrogations and beatings; curfews that trap hundreds of thousands of people in their cramped homes every night from dusk to dawn;

For the analysis, we will work with four axes: 1) The research released by the British newspaper The Guardian[5] that presents the relationship between the spread of the virus in the US and the April 30 demonstrations against the Lockdown; 2) The lethality of COVID-19 in communities where black and poor people are; 3) Would it be possible to direct the lethality of this virus to exterminate some population? If so, what population would this be? And which city would be chosen? 4. What was the prediction of the possible behavior of the Black Movement in the face of such brutality, considering the history of similar cases? The U.S. had research that showed the lethality of COVID-19 post-demonstration.

On April 30, the population took to the streets to express their dissatisfaction with the Lockdown. The company VoteMap[6] tracked the cell phones of the protesters and analyzed the relationship between their movement in the demonstrations and the movement of the virus. In this period, the US had a growth curve similar to Italy and Brazil, in the period after the demonstrations the country starts to double cases every day. Six days after the demonstrations (May 6), President Donald Trump considered the COVID 19 crisis to be worse than the attack on Pearl Harbor and the collapse of the World Trade Center. On May 27, the U.S. is registered as the 1st country in the world to reach the mark of 100,000 daily deaths due to the Coronavirus. The US was aware of the great lethality of the virus. B) The lethality of COVID-19 in the communities where black and poor people are.

On April 30, research began to circulate in the US with the information that the highest number of deaths from the coronavirus were in black and low-income communities and Latinos. A

[5] https://noticias.uol.com.br/saude/ultimas-noticias/redacao/2020/05/18/protestos-lockdown-coronavirus-eua.htm
[6] https://noticias.uol.com.br/saude/ultimas-noticias/redacao/2020/05/18/protestos-lockdown-coronavirus-eua.htm

prominent example was the Bronx district, New York, which had 28% of deaths[7]. In relation to the other cities, it was observed that blacks represented 22% of the population and 28% of the dead. Alarming numbers were found in Louisiana, where 32% of the population is African-American and accounted for 70% of the total dead. Donald Trump, upon receiving the news about the lethality of the virus in the black and rotten population, said: "They have been affected very, very hard. It doesn't make sense and I don't like it."[8] The US was aware of the great lethality of the virus in the extermination of the black and poor population.

Would it be possible to direct the lethality of this virus to exterminate some population? If so, what population would this be? And which city would be chosen? Minneapolis (the city where George Floyd was signed) is a progressive city (for its political struggles), however, with self-indicators of poverty and unemployment. In this city is the first Black to hold the position of chief of police (Medaria Arradondo), the city also has one of the few housing complexes for gays (an achievement of the LGBT movement). Minneapolis has an important Indian movement dating back to 1968. It has a history of important protests in the fight against racism, such as the murder of black men dating back to 2015 (Lamar Clark) and 2018 (Thurman). They would not be silent in the face of a new brutal crime. 656.6 km from Minneapolis is Chicago, the 3rd largest city in the USA, which has the first female mayor, black and lesbian, former Federal Prosecutor Lori Lightfoot[9].

The murder of George Floyd took place in Minneapolis, at an intersection that divides two zones with historically conflicting populations, one populated by whites and the other by blacks. Blacks are only 20% of the population, but they represent more than 60% of the victims in shootings with police involvement. George was charged with purchases with stolen credit cards. Which was not proven, since there were neither purchase invoices in the aforementioned store, nor credit cards in his car from which he was brutally removed. US President Donald Trump said that this "tragic death" will be investigated strictly by the FBI. The demonstrations of revolt, until 05/31/2020, reached the participation of 75 cities in the USA, 1,700 people had been arrested so far[10].

What was the prediction of the possible behavior of the Black Movement in the face of such brutality, considering the history of similar cases? In 2014 Eric Garner was murdered by strangulation in a very similar way to George Floyd. He repeated to the police "I can't breathe". Also unjustly imprisoned. At least 50 demonstrations took place across the country and in one of these demonstrations the presence of 2,500 people was registered.

[7] https://noticias.r7.com/internacional/covid-19-afeta-duramente-bairro-de-nova-york-de-maioria-latina-16042020
[8] https://www.diversity.org.br/post/coronav%C3%ADrus-mata-negros-e-pobres-de-forma-desproporcional-nos-eua
[9] https://g1.globo.com/mundo/noticia/2019/04/03/chicago-elege-sua-primeira-prefeita-negra-e-gay.ghtml
[10] https://g1.globo.com/fantastico/noticia/2020/05/31/protestos-pela-morte-de-george-floyd-nos-estados-unidos-chegam-a-75-cidades-americanas.ghtml

This whole narrative of mapping a project of extermination of the black and poor population is important to understand, as Munanga (2003, p. 15) states, that historically black ethnic-racial identity has been linked to a biologicism with racist political content. Strategically treating this population as non-human would justify the absence of social public policies. Understanding what happens in the USA helps us to look at Brazil and analyze the importance of proposals that transform the reality of our population, but proposed andoppose another
unifying identity proposed by the dominant ideology, that is, the mestizo identity,
which in addition to seeking national unity also aims at the legitimization of the so-called Brazilian racial democracy and the conservation of the status quo. (MUNANGA, 2003, p. 15)

FROM THE STREET TO THE WHITE HOUSE: BLACK AND BLACK STRATEGIES FOR THE FALL OF WHITE SUPREMACIST PRESIDENT DONALD TRAMP

Narrating the Black Lives Matter movement is relevant because it makes visible the demonstrations in resistance and struggle against the racist murder of George Floyd. The movements, mostly organized by BLM, have been significant in the fight against racism in the U.S. and even other countries, given the extent and strength it has gained.

Djamila Ribeiro (2019) argues that many claim not to be racist, but contribute to perpetuating oppression against black men and women. The engagement of so many people - including artists, singers and other influential people in the media - to the Black Lives Matter movement was fundamental to the questioning, because,

> The question is, what are you actively doing to combat racism? Even if a person could affirm themselves as non-racist (which is difficult, or even impossible, since it is a rooted social structure), this would not be enough — inaction contributes to perpetuating oppression (RIBEIRO, 2019, p. 6)

O MOVIMENTO BLACK LIVES MATTER

To understand this context of the marches and elections in the USA, it is necessary to make an assessment of this very important movement that was Black Lives Matter (BLM). We seek to understand the importance of the black movement in the mobilization of the population to the streets, in the production of important elements for the campaign and also, in the third moment and in the demand for spaces in the Office of the President of the United States. In 2020 we had a rise in temperature in the United States mainly because of police violence.

So in several cities there were several protests in reaction to police violence against the black population, it was mainly in this context that Black Lives Matter began to have a more influential activity in this process. Three activists, Patrisse Cullors, Alicia Garza, Opal Tometi founded an organization at the national level that is Black Lives Matter (BLM). The objective was to produce an

ideologically strengthened movement so that it could carry out expressive activities to confront racism in the United States. An important flag was raised in June and July 2020 of the movement acting in campaigns to cut the funding of police forces in the US

This debate about cutting police funding has advanced on the part of many politicians in states governed by Democrats. The mobilizations were large and important. In some regions, protesters were in many blocks, expelling police forces and territorializing a central part of the city. This whole movement has caused the Democrats' electoral agenda for Joe Biden's presidential election to be taken over by the BLM movement. [11]

An important issue to be highlighted in the militants who founded BLM is the power of these women, let's present it for an understanding of this. **Opal Tometi** is a strategist, writer, and community leader in the United States. She was the executive director of the first national U.S. Immigrant Rights organization for people of African descent. He had access to important media to project the black lives matter movement[12] such as in magazines: *Essence* and *Glamour*; the channels BET, CNN and MSNBC. He has published articles in media outlets including *Time* and *The Huffington Post*.

Patrisse Cullors is an activist in the movement that advocates for changes in the Los Angeles prison system, has a degree in religion and philosophy and teaches the master's degree in Social Justice and Community Organizing at Prescott College. She is also active in the area of culture, she produced plays. Patrisse has received several awards, was named activist of the year 2017. The last of the three is **Alicia Garza,** In addition to being an activist, she works on several fronts: civil rights, rights, employees and domestic workers. She is an editorial writer. He has several publications hair*The Feminist Wire, The Guardian*,*Truth Out*, *The Nation*, *Rolling Stone* and *HuffPost* [13].

It is important to understand how these three women created this movement, which is no longer just the United States, it is a worldwide movement. In 2013, with the death of black teenager Trayvon Martin and the acquittal of white man George Zimmerman[14] , Alicia, just as thousands of people felt outraged, made a Facebook post that said : "Black people. I love you. I love us. Our Lives Matter, Black Lives Matter," Black Lives Matter. Patrisse Cullors shared it with a hashtag "#BlackLivesMatter". With this post, there was popularization on Facebook, Twitter and other activist friends created networks with the name Black Lives Matter. The movement spread around

[11] Report of August 5, 2020, was written by Adriano Cerqueira, professor of international relations, PhD in history and member of the United States elections observatory. ttps://www.ibmec.br/mg/noticias/influencia-do-blm-na-eleicao-presidencial-dos-estados-unidos
[12] https://pt.wikipedia.org/wiki/Opal_Tometi
[13] https://pt.wikipedia.org/wiki/Alicia_Garza
[14] More than 100 cities in the U.S. held protests. Go to http://g1.globo.com/mundo/noticia/2013/07/protestos-voltam-ruas-nos-eua-contra-absolvicao-de-zimmerman.html

the world, including in Brazil. When Georg Floyd was murdered in 2020, Black Lives Matter gained new strength and burst into the world's mainstream media.

The Black Lives Matter movement was not the only movement that acted against racism in this period narrated, but it was very representative in the issues of mobilization in the streets, giving negative visibility and producing disapproval of the authoritarian and racist behaviors of President Donald Trump. So 64% of the American population had sympathy for the people who were in the protests.[15] There is a crucial point in this issue to understand the media and society supporting protesters and militants against racism. A significant part of the protesters were famous people[16] who took to the streets or who stayed on social networks publicizing the protests. Important names such as Ariana Grande, Lana Del Rey, Beyoncé, Viola Davis, many made themselves available, including to pay bail for people who were detained, as was the case of the famous Katy Perry and Harry Styles. It was essential to publicize police brutality against these famous protesters, as was the case of Halsey who was shot during the protests and recorded images of this police violence on her social networks. This movement of violence that also affected the famous decisively influenced public opinion, the followers of these artists also began to condone the militancy of their idols.

BLACK FEMINIST MILITANCY PRODUCING STRATEGIES OF POWER

The objective of this topic is to give visibility to a movement of resistance and struggle produced by women in the USA who, just like women, who were enslaved, fought, resisted bravely, are transmitting,

> (...) for their nominally free female descendants, a legacy of hard work, perseverance and self-sufficiency, a legacy of tenacity, resistance and insistence on sexual equality – in short, a legacy that spells out the parameters for a new condition of women (ANGELA DAVIS, 2016, P. 44

In this item of the article we will present the performance of three women who were instrumental in the process of removing Donald Tramp from the US Presidency, they are, Kamala Harris, the vice president of the USA; Muriel Bowser, mayor of Washington and Stacey Abrams, minority leader in the Georgia General Assembly from 2011 to 2017.

The vice presidency occupied by a black woman, Kamala Harris, with an Indian mother and a Jamaican father, was a key issue for this turnaround of the black movement in the United States. As a senator, she was active in the protests against anti-racists. Kamala Harris has a history of pioneering in politics, she was the first black prosecutor in the history of the state of California and the second

[15] https://g1.globo.com/mundo/noticia/2020/06/02/maioria-nos-eua-simpatiza-com-protestos-e-reprova-resposta-de-trump-diz-pesquisa.ghtml

[16] https://blogs.ne10.uol.com.br/social1/2020/06/01/famosos-vao-as-ruas-para-manifestar-em-favor-do-movimento-black-lives-matter/

woman to occupy the United States Senate. The movement's proposal is that, in 2024, she will assume the presidency. It will be the first time that the United States will have a black woman as president. The first and only black person was Barack Obama [17] , who governed from 2017 to 2019.

Another key person, at this historic moment in the US elections, was Stacey Abrams[18]. The black activist and lawyer has a history of participation in elections, in 2013, she created the New Georgia Project, which is a non-governmental organization that aimed to promote the electoral registration of people, especially blacks, who had been excluded from electoral processes.

Stacey toured Georgia and several other states to increase the participation of blacks and U.S. citizens of foreign origin, such as Latinos and Asians, in the elections. According to Vogue Magazine, she managed to double the participation of young people in the elections and inspired white Democratic voters to return. According to the data, 45% of the new 800 voters, thanks to her work, swelled the elections in favor of an agenda of the black movement. The biggest highlight was this mobilization of the black population that through the vote can express its dissatisfaction with Donald Trump.

The importance of the Democratic mayor of Washington,[19] Muriel Bowser, a black woman, with a degree in history and a master's degree in public policy. Muriel became Trump's number 1 antagonist because she was denouncing violence in protests over the death of George Floyde and creating strategies to protect and support protesters.

Muriel Bowser was fundamental mainly in two moments. The first moment was in relation to the marches when, in an arm wrestling match with Tramp, the mayor orders the phrase "Black Lives Matter" to be painted on a street near the White House[20]. In addition to the painting, she changed the name of the street that was renamed Black Lives Matter Plaza.

During the invasion of the Capitol[21], where the official counting of the votes that gave defeat to Donald Trump took place, Mayor Muriel Bowser imposed a 12-hour curfew. In the capital, from 6 pm onwards, no person should, without the authorization of the Mayor, walk, ride a bicycle, run, circulate, or stand still in the car or any other means of transport.

Another important moment, for the mayor, was during Joe Biden's inauguration, she strengthened the police force, received reinforcements from nearby cities. But he also managed to get 21,000 members with the national guard[22] and with that the United States removed any possibility of

[17] Read more at: https://guiadoestudante.abril.com.br/atualidades/kamala-harris-representatividade/
[18] https://noticias.uol.com.br/colunas/leonardo-sakamoto/2020/11/06/ativista-negra-pelo-direito-ao-voto-esta-por-tras-da-onda-biden-na-georgia.htm
[19] https://exame.com/mundo/a-prefeita-negra-e-destemida-que-virou-a-antagonista-no1-de-trump/
[20] https://oglobo.globo.com/mundo/em-confronto-com-trump-prefeita-de-washington-pinta-vidas-negras-importam-em-rua-que-leva-casa-branca-24465553
[21] Joe Bind had already won the election, the vote count was only an official confirmation. A group stormed the Capitol incited by President Donald.
[22] https://g1.globo.com/mundo/noticia/2021/01/20/posse-de-joe-biden-tem-esquema-de-seguranca-sem-precedentes.ghtml

interrupting the inauguration of the new president. Understanding the gravity of the moment, she took measures such as closing streets, bridges, subway stations to prevent circulation near the places of President Biden's inauguration. With all this, he avoided possible attacks by extremist groups on the ceremony.

THE STRENGTH OF THE BLACK MOVEMENT IN THE POSTS OF THE JOE BIDEN ADMINISTRATION

The black movement sought to guarantee the participation of blacks in a self-ranking position in the office of the US presidency, all as a strategy to guarantee the historical agendas of the movement. The importance of this articulation of the militants recalls a discussion by Boaventura Santos (2007 p. 17), according to the author, the knowledge considered official, scientific, used to define government policies and society as a whole needs to be distributed equitably. Which means that those who have been historically excluded do not have their knowledge valued, so policies are not produced for them. The perspective of the ecology of knowledge deals with,

> (...) on the one hand, to explore the internal plurality of science, that is, the alternative scientific practices that have become visible through feminist and postcolonial epistemologies, and, on the other hand, to promote interaction and interdependence between scientific and other non-scientific knowledges.

There is a historical diversity in this election in the United States[23], because the black movement made some demands and demands with the aim of ensuring the realization of important agendas for the movement. Fulfilling the agreement, President Biden guaranteed 50% of non-whites (blacks, Latinos and Asians) in the presidency. In a comparative sense, Trump had 16% of non-white people in his cabinet, in low-level positions.

The importance of blacks in the self-echelon can be observed in the example of the Jurist, Alejandro Mayorkas, elected to the Department of Homeland Security. He is the first Latin American to occupy this secretariat, responsible for the implementation and management of the country's immigration policy, remembering that this was one of the great problems of Trump's authoritarian government.

An important name in this cabinet is Lioyd Austin, the secretary of defense is the first black to lead the pentagon. The other is Ohio Rep. Marcia Fudge who was appointed secretary of housing and urban development, other blacks, including the new director general of the Environmental Protection agency Michael Regan, who will be the first black to head the department, Cecilia Rouse

[23] https://www.opovo.com.br/noticias/mundo/2021/01/20/com-diversidade-historica--biden-tem-metade-do-gabinete-de-nao-brancos.html

who will be the first chair of the council of economic advisers and the first black person to hold the position, and finally, also Linda Thomas Greenfield , the country's ambassador to the UN.

Two Asians were appointed to cabinet-level positions, including Neera Tanden, who will be director of the Office of Management and Budget, and Katherine Tai, who was appointed as the United States Trade Representative. They are the first two Asian or American women in these positions of the Presidency's cabinet. In addition to Alejandro Mayorkas, who was appointed the position of homeland security, we have Xavier Becerra, secretary of health and human services, Miguel Cardona, secretary of education, and Isabel Guzman, who will be a small business administrator, noting that Becerra and Mayorkas are the first Latinos to lead these departments.

Evaluating this progress of the black movement in the US, we remember the study in 2019 by an agency called Pew Research Center that found that 56% of Americans said that race relations in the United States had worsened greatly with Donald Trump.[24]

What is the meaning of blacks in Joe Biden's cabinet? Confront white supremacy in the United States. The blacks, Latinos and Asians in the cabinet together with Joe Biden and Kamala Harris have the objective of guaranteeing some agendas, among them:[25] the fight against the COVID 19 pandemic guaranteed mainly vaccine for the neediest communities according to the legislation; the review of the United States economy, which has been a serious problem because the non-white population is the population most affected by the issue of the fall of the economy; there is a the main focus of police reform, because blacks are killed in an accelerated way by the police; the issue of anti-immigration policies. It is also a request from civil rights activists for positions such as judges and prosecutors in the country to also be occupied by people of color.

Another achievement, to be highlighted, was securing control of the US Congress at the beginning of President Biden and Vice President Kamala's terms. The election of Raphael Warnock, the first black senator elected by the State of Georgia[26], was fundamental in this process. Raphael Warnock represents the strength of the church, because he has spent the last 15 years in the leadership of the Ebenezer Baptist church. Church in which Martin Luther King preached until 1968 when he was killed. Like Martin, Rafhael fights for the civil rights of the black population.

During Trump's impeachment hearing on 01/13/20021, there was an assertive speech by Democrat Cori Bush, the first black congresswoman from Missouri in the United States and an activist for homeless workers, says Bushm,[27]

[24] Newspaper "O Povo" report on 01/20/2021 with reporter Alice Souza.
[25] CNN Brasil international newspaper report on 01/18/2021
[26] https://g1.globo.com/mundo/eleicoes-nos-eua/2020/noticia/2021/01/06/raphael-warnock-faz-historia-nos-eua-ao-ser-o-primeiro-senador-negro-eleito-pelo-estado-da-georgia.ghtml
[27] Unfortunately, the U.S. Senate rejected for the second time the request for the impeachment of former President Donald Trump

> The 117th Congress must understand that we have a mandate to legislate in defense of the lives of black people. The first step in this process is to eradicate white supremacy, starting with the impeachment of the white supremacist chief (CORI BUSH, 2021) [28]

What is clear in the narrative of this text is the movement of an entire black, Latino, and Asian population so that not only the historical exclusions, but especially the last initiatives of the former president were all undone and this in the short term.

CONCLUSION

Understanding social relations and their dynamics of power production is an important component of the struggle and political resistance to racism, because racism is not only in individual behaviors, it manifests itself with greater perversity

> (…) as the result of the functioning of institutions, which start to act in a dynamic that confers, albeit indirectly, disadvantages and privileges based on race (ALMEIDA, 2019, P. 26).

If the death of George Floyd was planned so that the black and poor population would be vulnerable to COVID 19 and police violence when taking to the streets, the black movement surprised with its ability to organize. In the face of the genocide by COVID 19, not only the black population, but the entire non-white population, including Latinos and Asians were fighting for the right to live. The extermination project taken up by the administration of former President Donald Tramp was so lethal that there was no other option but to go to war.

We evaluated the struggle against the U.S. white supremacist project in three major movements; 1) before the elections: mobilization strategies in the streets; intervention in the media; partnerships with agreements to support the black movement for the election of Joe Bind; a black female vice president; Financial investment in the campaign; Heavy intervention in the process of access to voting by minorities. 2) from the elections to the inauguration: intervention of the mayor of Washington in the episode of the invasion of the White House, the election of senators who guaranteed control of the American Congress. 3) Cabinet Team of the Presidency of the United States: guarantee of 50% of non-whites who not only occupy the positions, but that these positions occupied were of the highest level and of strategies that guarantee agendas agreed between the black movement and the president-elect. This black movement has expanded to blacks, Asians, Latinos who are the most affected by white supremacist policies.

[28] https://www.cnnbrasil.com.br/internacional/2021/01/18/eua-o-que-o-gabinete-diverso-de-biden-significa-para-um-pais-dividido

And in Brazil, what are the predictions that we can, as in the US, move towards taking over the presidency of Brazil? The text provokes all this in us since President Bolsonaro, like Tramp, represents these white supremacist policies and the project of genocide of the black population.

REFERENCES

1. Almeida, S. L. de. (2019). *Racismo estrutural*. Sueli Carneiro; Pólen.

2. Davis, A. (2016). *Mulheres, raça e classe* (H. R. Candiani, Trad.). Boitempo.

3. Du Bois, W. E. B. (1999). *As almas do povo negro* (J. L. P. da Costa, Trad.). Lacerda.

4. Mbembe, A. (2016). Necropolítica. *Arte & Ensaios*, 32, 123-136.

5. Munanga, K. (2003, novembro 5). Uma abordagem conceitual das noções de raça, racismo, identidade e etnia. Palestra proferida no 3º Seminário Nacional Relações Raciais e Educação - PENESB-RJ.

6. Ribeiro, D. (2019). *Pequeno manual antirracista* (1ª ed.). Companhia das Letras.

7. Santos, B. de S. (2007). Para além do pensamento abissal: das linhas globais a uma ecologia de saberes. *Novos Estudos CEBRAP*, (79), 71-94.

Indiciary paradigm as a possibility of textual reading: Perverse logic in politics

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ABSTRACT

This article presents an indiciary and ethnographic inventory inspired by Ginzburg (2007) and Žižek (2010), presenting an analysis of the affects contained in the emotions present in politics, under a new light of interpretation of totalitarianism, which goes beyond instrumental rationality, seeking a dialogue with psychoanalysis, dealing with the perverse logic of ideology in both intellectual and artistic productions.

Keywords: Ideology, Perverse logic, Totalitarian regimes, Indiciary paradigm and Psychoanalysis.

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INTRODUCTION

The historian's challenge in studying the history of the present immediately raises the discussion around the objectivity of knowledge. The distancing from the object of study, in the case of history, requires extra attention. However, we believe that no historical construction, "whether from this century or from the past, is immune to the prejudices and deviations of historians (...) it means affirming that all history is thought from the time of the historian who seeks in the near past the interlocutions for the understanding of reality" (SANTOS, 2009, p. 10).

The constant proposal to maintain the political dimension of our analyses recalls one of the main accusations made against history, for studying, among other things, the local political conjunctures. In this regard, René Remond states:

> If the political must be explained first of all by the political, there is also more in the political than the political, and consequently political history could not close itself around itself, nor take pleasure in the exclusive contemplation of its own object. Nor to privilege one type of relationship: there is, for example, no scientific reason to establish a closer connection between the political and the economic than with the ideological, the cultural, or any other term of relationship" (RENÉ REMOND (1996 p.36).

That said, we believe that the importance of studying the perverse logic in politics, from the perspective of political history and history of the present, points to possibilities of relations between history and power and their inseparable character (FALCON, 1997).

The fragment of the text The Narrator (BENJAMIN, 1993, P. 221) partially translates the objective of this article, which is to tell the experience of reading a thought-provoking text, such as that of Slavoj Zizek, entitled "The perverse subject in politics: Lacan as a reader of Mohammad Bouyeri", where the author analyzes the letter of a Muslim fanatic , Mohammad Bouyeri. In the text, there is an affective memory and a diversity of stories, tales, films that bring out artistic sensibility, with the aim of establishing a relationship between past, present and future, history, affections and politics.

THE ETHNOGRAPHY OF THE TEXT

At first it was difficult, because to a certain extent still crystallized with the logic of study and research of the positivist paradigm, it was necessary to read and reread to perceive the signs, clues, traces and indications present in Žižek's text. As Ginzburg (2007, p. 11) states, "reading historical testimonies against the grain, or as Walter Benjamin suggested, against the intentions of those who produced them" to understand totalitarian regimes, misogyny and religious fundamentalism, with imbrications with the logic of the perverse subject coined by Lacan. To guide the text, we use the paths taken by Paulo Freire (2011) who, when writing about the

importance of reading, reaffirms that to read words is to read the world, and with this we "re-read" fundamental moments of our experiences as individual and collective subjects. In our case, we "re-read" as mothers and educators, who carry out research and extension projects in the area of human formation.

PERVERSE LOGIC IN POLITICS

In order to unveil the authoritarian ideologies present in our intellectual and artistic productions, it is urgent to think about the political and ideological effects of the unconscious emotions that affect us and are present in the historical and cultural formation of Brazil. Seeking to discuss this issue, we will follow two paths to understand: how perverse logic operates in us and how resistance to this logic is possible.

In order to understand how perverse logic operates in us, it is urgent to unveil the "role played by unconscious emotions in the formation of ideologies, politics and social structure" (RODRIGUES, 2014, p. 67). Considering the individual psychic dimension of the subject in politics is, in our view, not only important but also urgent, because consciousness (Reason) does not control impulses and thoughts so efficiently. In fact, the revolution announced by Freud was precisely that "the unconscious is made of thought. It is a question here of the subject not of unreason, but of unconscious reason, whose logic is also presented through a method" (QUINET, 2011, p. 12). Thus, it is possible to conjecture that the perverse logic that operates in politics – in religious fundamentalism, in totalitarian regimes or in misogyny – is not only commanded by political, economic and cultural conjunctures and as purely conscious actions, but mainly by unconscious emotions. In other words, understanding authority and power also as emotions contained in the unconscious helps us to broaden our view of the historical and cultural process of Brazil, analyzing its political-affective implications in social relations. Behaviors or thoughts reveal feelings that help us to unravel the contradictions and ambiguities present in Brazilian political culture.

What we are affirming is that the subject is simultaneously individual and collective and that his emotions are a manifestation of politics:

> "Affection is political and shapes our actions much more than thought. We highlight Lacan's maxim (1966/1988), that the unconscious is structured as a language and this language is a drive. (...) language is life (drive) and offers a very rich material for the analysis of social symptoms (RODRIGUES, 2014, P. 239).

Putting together evidence present in different political discourses, we can observe that conservative or totalitarian thinking is always motivated by emotions of anguish and fear. Cerqueira Filho, discussing the difficulties and impasses of this thought/feeling conceptualized

by him as affective authoritarianism, states that with the crisis of the judiciary in contemporary times we have become "mini-States" and have started to submit the norms exclusively to our personal interests and decisions (CERQUEIRA FILHO, 2005).

In this sense, perverse logic can be observed in political discourses of different shades, particularly in the current political conjuncture of radicalized modernity (GIDDENS, 1991, p. 13), where it becomes imperative to problematize how resistance to this logic is possible? As possibilities of counterpoint to the perverse logic, we bring to the debate what would be the ethical act. For Žižek, the subject who acts within the perverse logic, or the "perverse", is the one who seeks to meet the will of a great other, regardless of how it inflicts suffering on someone. In short, he is capable of causing suffering to others with the awareness that he is only fulfilling a duty and therefore is not responsible for the pain he causes. The ethical act, on the other hand, is the opposite of perverse logic, the subject, even in all kinds of adversities (mistreatment, unfair accusations), persists and does not give in to the temptation to humiliate, torture, because he is fully aware that he is responsible for all his acts.

Thus, in contrast, an ethical act is the opposite of the perverse elevation of oneself to an instrument of the great other is (...) "Simple persistence against all odds is ultimately the raw material of which ethics is made." The question is how would this resistance take place? If we think of perverse logic as evidence, Foucault's discussion would help us a lot, but as our analysis also falls on the understanding of this logic as a symptom, we will seek in the discussions about memory, in dialogue with psychoanalysis, a possible path for the construction of true ethics, as opposed to this perverse elevation of ourselves, as emphasized by Žižek (2006. p. 142)

The contribution of Foucault's studies to confronting the perverse logic in politics is based on the understanding of power as a set of devices of subjection that circulates. Therefore, power is not a thing, but a relationship that produces effects at the macro and micro levels. It has a positivity, which translates into effectiveness. For the author, knowledge is a fundamental piece of power relations, and the analysis of domination is hidden in the various instances and as practices, knowledge, which do not appear as practices of subjection and domination. Foucault states that we act in the illusion that we are free, without understanding what power produces in us and, therefore, inevitably, we can become accomplices of our own domination (FOUCAULT, 2001). Thus, the confrontation proposed by Foucault would be to resist from the perspective of the agonistic, making criticism; engaging in punctual and specific struggles; offering ourselves as a point of resistance, within the understanding that power crosses us.

With the intention of expanding and not opposing Foucault's thought, we bring the possibility of thinking, not knowledge, but emotions, as a fundamental piece of power. With this, we will rely on the discussion of memory, problematizing forgetting or remembering, seeking to

build the proposal of Žižek's text on ethics, as a confrontation with the device of subjection present in the perverse logic of politics embodied in ideology. Ideology here is understood as a conception, not as a concept, given the complexity of the phenomena to which it refers. So we think like Eagleton that:

> (...) Ideology is more a matter of "discourse" than of "language" – more a matter of concrete discursive effects than of meanings as such. It represents the points at which power has an impact on certain enunciations and is tacitly inscribed within them. But it should not, therefore, be equated with any form of discursive partisanship, "self-interested" discourse, or rhetorical bias; rather, the concept of ideology aims to reveal something of the relationship between an enunciation and its material conditions of possibility, when these conditions of possibility are seen in the light of certain power struggles central to reproduction" (EAGLETON, 1997, p. 104 and 105).

That said, we emphasize that one of the concrete effects of power, present in the mechanism of ideologies, is forgetfulness. So, following the principle of "mnemotechnics" announced by Nietzsche (apud WEINRICH, 2001), the pressing issue between forgetting and remembering involves the need to keep forgetting within certain limits. The challenge would be, then, to think that, based on reflections on guilt that remain in the memory only because they cause us pain, forgetfulness should be limited for moral reasons. But how to do it, if guilt and pain are stored in the unconscious and therefore not fully accessible to reason?

Weinrich, in dialogue with Nietzsche, makes approximations with Freud's studies, presenting questions about mnemotechnics, now on the psychoanalytic basis. In a first observation, we could say that Freud is opposed to Nietzsche, if we understand that for psychoanalysis we forget what is unpleasant, guilty, painful, instead of remembering as Nietzsche says. However, we only apparently forget what causes us pain. Freud states that, in fact, we always remember our pains. They reveal themselves in the symptoms, which appear and reappear repeatedly and, almost always, without our awareness of what they reveal, to which pains they refer. For if they are repressed, although always present, we do not know, we are ignorant of their meaning, just as when we are challenged by an ideology. Reason does not reach meaning, because the logic that is operating is that of the unconscious. This path seeks the use of the method of investigation of psychoanalysis, that is, the psychoanalytic hermeneutics of discourse analysis, in a dialogue with history in the study of ideology. Ideology, as part of the social instance, is the architect of the subject's conduct. The social analysis of ideology

"requires the explanation of the process in which the global structure, through the ideological apparatuses and from the concrete social practices in which the individual is inserted, determines the universe of meanings that impacts the subject who, in turn, elaborates it at an imaginary level in his psychic structure, resulting in an internalized ideology. Thus, the system of the unconscious is linked to the ideological instance, because the manifestations of the

unconscious are supported by practices (acting) and discourses (thinking)" (RODRIGUES, 2008, p. 70).

In this sense, the question between remembering and forgetting needs to be understood, understanding that the repressed has not been forgotten, because it has not been resolved, it remains in the unconscious, working to frighten the soul, producing diseases, such as unconscious subjection to perverse logic. So "the patient is forced to repeat incessantly what is repressed/forgotten, as a symptom of illness" (WEINRICH, 2001, p. 187). With the objective of treatment, the psychoanalyst makes his patient speak, for the construction of ethics. Similarly, in order to make a critical analysis of the affects present in the ideological discourse, we can return to Benjamin, agreeing with Weinrich, and use narrative as a strategy of memory that is political; narrating and allowing oneself to be narrated as a process of social analysis of ideology and, therefore, a process of resistance, through the criticism of perverse logic.

THE INDICIARY AND ETHNOGRAPHIC INVENTORY OF THE TEXT "THE PERVERSE SUBJECT OF POLITICS: LACAN AS A READER OF MOHAMMAD BOUYERI".

Like a "detective", with knowledge, looks, desires and multiple languages, we followed the clues left by Žižek and produced the following analysis:

The text deals with an analysis of totalitarianism and political fundamentalism. To carry out this analysis with greater propriety, the author makes use of psychoanalysis based on Lacan and interprets historical acts of politics and religion using concepts coined by Lacan, such as: the perverse subject and the ethical subject. The characters and plots present in the text are contained in the presentation that we will make of temporality when presenting the ethnographic inventory.

Following the guidance of an ethnographic inventory, we organized the study with the following themes: temporality, conjuncture, periodization, problem, argument, digression, argumentative reinforcement, conclusion.

In relation to temporality, the text establishes a dialogue between present, future and past, and presents discussions at three levels. The first, citing examples of experiences, problematizing perverse logic; the second, building possibilities to broaden the understanding of how this logic operates in us; and the third, problematizing how resistance to this logic is possible. Let's go to the text: as examples of perverse logic, the author presents the trial, which took place in 1963, of Adolf Eichmann, treated by Hannah Arendt as a Nazi executioner, who was tried for killing thousands of Jews during the holocaust and who claimed that he was simply fulfilling his duty as an official. It also brings to the debate a murder carried out in 2004 by a

Muslim. The religious extremist claimed to have murdered the Dutch documentary filmmaker Theo Van Gogh because he, by producing documentaries, in partnership with the Muslim, Hirshi Ali, about the mistreatment suffered by Muslim women, would be going against the truth preached in the Koran.

In order to problematize the relationship between truths and lies, the author brings to the debate plays by William Shakespeare, dated 1601 and 1608 (Well is what ends well or All is well when it ends well) and 1566 and 1600 (As You Like It); he also highlights the existence of works of art by two great painters of Ancient Greece, Zeuxis and Parrásio, works dating from the 5th century BC; He also narrates the defeat of June 1848 in which the deputies of the party of Order were also pretending to be republicans to be what they really were.

On the third level, the author presents what he called Lacan's ethical act. To build his argument, the author turns to a documentary on the spread of the culture of life, produced in 2005, emphasizing the fundamental role of Pope John Paul II for the end of communism in Poland and perhaps throughout Europe. It also describes the experience lived by Anne Frank in the period between 1942 and 1944 which, with her diary, allowed a problematizing analysis of the Second World War; narrates a story that took place in the late 40s, of Sophia Karpai, and the conspiracy plan built to exterminate Jewish doctors. Although the author does not give details, it opens the possibility of also understanding the importance of the role played by Hannah Arendt, during the trial of the Nazi executioner, as a true ethical act.

The conjuncture is contemporaneity. The periodization of the text dates from 2004, focusing on the perverse logic that operates in fundamentalism. We then come to the problems present in the text. They are: Can resisting the temptation not to humiliate, torture and murder be considered an ethical effort (true ethical act)? And what does the wicked not understand, in his effort, to absolutely separate truths from lies?

Analyzing the arguments present in the text, we find four that we consider important: misogyny and religious fundamentalism, as unconscious feelings in the examples brought in the text; the relationship of a perverse logic present in politics, religion and women, as truths with seductive appearances to the subject; the figure of Mohammad Bouyeri, who obeys the perverse logic present in religious fundamentalism and recognizes in women the infernal phallic powers; and finally, the true ethical act presented in the text, using examples of women, Hannah Arendt, Anne Frank, Sophia Karpai. This was presented as the opposite of the perverse elevation of oneself to an instrument of the great other.

From the perspective of the digression, the author begins the text with the murder of the Dutch documentary filmmaker Theo Van Gogh, in Amsterdam, in 2004, and uses the technique of free association, going through several previous historical moments to analyze the fact.

As an argumentative reinforcement, the author uses some examples to explain the logic of temptation. However, we notice that he organizes these examples in two moments: the first to emphasize the perverse logic and the second to show the effort to resist this logic.

In perverse logic, the author emphasizes that the falsehood of the perverse lies in his own unconditional attachment to the truth, and in his refusal to listen to the truth, which resonates in a lie. As examples, Shakespeare's plays, the works of art of the painters Zeuxis and Parrásio, and the defeat of June 1848 were presented; The author makes it clear that the subject makes himself the instrument-object of the will of others. The examples cited are the murder of Dutch documentary filmmaker Theo Van Gogh and the letter threatening Hirshi Ali; The examples of the true ethical act, cited by the author, as a counterpoint to the perverse logic, are: Hirshi Ali, an ardent fighter for the rights of Muslim women - religious fundamentalism; Annah Arend, an author who describes the subterfuge used by the executioners to be able to endure the horrible acts they committed – they followed orders; Pope John Paul II, who propagated the culture of life as our only hope against the culture of death; Anne Frank, who declared her belief that there is a spark of goodness in every human being, and lastly, Sophia Karpai who with the impact of her perseverance averted yet another catastrophe in Soviet society and politics in general, and saved the lives of thousands, if not millions of people.

The perverse logic can be observed in greater action in religious fundamentalism, totalitarian regimes and misogyny; history shows that in totalitarian regimes, Stalin promoted horrible purges and executions, claiming that he did everything for the progress of humanity; in politics linked to religion, Osama Bin Laden and Bush acted on the assumption that their actions are directly ordered and guided by the divine will. We can also observe this logic in misogyny. The discussion of misogyny is present in both Lacan's and Shakespeare's works. The examples of both, highlighted by Žižek, allow us to observe the self-perception – present in Shakespeare's plays – of the female figure, who appears as the only one who can overcome appearance, and also in Lacan, when he states that "only a woman can pretend to be what she is not". The author concludes, using a fragment of Lacan: "only a woman can pretend to be what she is (...) and if in order to reign the law has to be based on the reciprocal action of deception and deception (ZIZEK, 2006. P. 142).

By way of conclusion, we can highlight that the dialogue between history and psychoanalysis opens a fruitful space in the understanding of the emotions that affect the subjects and that, therefore, are present in the political discourse and embodied in the ideologies taken as discursive formations, in the words of Foucault. The social analysis of ideologies can reveal something of the relationship between an enunciation and its material conditions of possibility, when these conditions of possibility are seen in the light of power struggles for the

reproduction of capitalism and its perverse logic of domination, which is traversed in different forms, including religious ones. The critique of the effects of this mechanism requires a paradigm beyond instrumental rationality, for the perception of ideology and its logic. We believe that our proposal of analysis, even if incipient, can provoke developments that bring the power to modify our way of perceiving and being in the world and help to re-elaborate the role of the human formation of the intellectual.

REFERENCES

1. Benjamin, W. (1993). *Magia e técnica, arte e política: Ensaios sobre literatura e história da cultura* (S. P. Rouanet, Trad.) (Vol. I, 5ª ed.). Brasiliense.

2. Deleuze, G. (1988-1989). *O abecedário de Gilles Deleuze*. Montparnasse. Transcrição disponível em: http://www.oestrangeiro.net/esquizoanalise/67-o-abecedario-de-gilles-deleuze. Acesso em 04 de fevereiro de 2010.

3. Eagleton, T. (1997). *Ideologia* (S. Vieira & L. C. Borges, Trads.). Editora da Universidade Estadual Paulista; Editora Boitempo.

4. Falcon, F. (1997). História e poder. In C. F. Cardoso & R. Vainfas (Orgs.), *Domínios da história: Ensaios de teoria e metodologia* (pp. 71-94). Elsevier.

5. Foucault, M. (2001). *Microfísica do poder* (16ª ed.). Graal.

6. Freire, P. (2011). *A importância do ato de ler: Em três artigos que se completam* (51ª ed.). Editora Cortez.

7. Giddens, A. (1991). *As consequências da modernidade* (R. Fiker, Trad.). Editora UNESP.

8. Ginzburg, C. (2007). *O fio e os rastros: Verdadeiro, falso, fictício*. Companhia das Letras.

9. Cerqueira Filho, G. (2005). *Autoritarismo afetivo: A Prússia como sentimento*. Escuta.

10. Quinet, A. (2011). *A descoberta do inconsciente, do desejo ao sintoma* (4ª ed.). Zahar.

11. Remond, R. (Org.). (1996). *Por uma história política*. Editora UFRJ/FGV.

12. Rodrigues, F. A., & Souza, J. A. (2011). Políticas públicas e gestão urbana: O caso da região metropolitana da Grande Vitória no estado do Espírito Santo. *Dimensões*, 27, 23-39.

13. Rodriguez, M. V. (2010). Pesquisa histórica: O trabalho com fontes documentais. In C. J. Costa, J. J. P. Melo, & L. H. Fabiano (Orgs.), *Fontes e métodos em história da educação* (pp. 51-72). Ed.UFGD.

14. Rodrigues, M. B. (n.d.). Vida moderna: Sensações, espetáculo, mercado, cultura e violências. *Simbiótica: Revista Eletrônica*, 1, 1-14.

15. Rodrigues, M. B. (2008). História & psicanálise: Um diálogo possível. In M. A. Soubboinik & O. M. M. C. de Souza Soubbotnik (Orgs.), *Enlace: Psicanálise e conexões* (pp. 45-67). GM Gráfica e Editora.

16. Rodrigues, M. B. (2014). Paradigmas para o século XXI: Possibilidades de aplicação do paradigma indiciário de corte psicanalítico às ciências humanas e sociais. *Passagens: Revista Internacional de História Política e Cultura Jurídica*, 6, 234-253.

17. Santos, J. (2009). Atualidade da história do tempo presente. *Revista Historiador*, 1(1), 12-27.

18. Weinreich, H. (2001). *Lete: A arte do esquecimento* (L. Luft, Trad.). Civilização Brasileira.

19. Zizek, S. (2010). O sujeito perverso na política: Lacan como leitor de Mohammad Bouyeri. In *Como ler Lacan* (pp. 129-149). Zahar.

UN 2030 Agenda for Sustainable Development: Contradictions in social protection for young people and older people

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ABSTRACT

This article aims to analyze the interlocution between social protection for young people and the elderly and the "UN 2030 Agenda for Sustainable Development", using historical-dialectical materialism as a theoretical-methodological mediation for the interpretation of the same interlocution, based on bibliographic and documentary research on the subject. Through the research, results were obtained according to which salaried work is the founding criterion of social protection in contemporary society; the UN (and all its agendas) has constituted the political dimension of capital since its origin, which imposes on allied states a certain form of social protection, thus responding to the expressions of the social question; Both young people and the social group that categorizes the elderly are converted into mere commodities that appear in the form of a labor force whose strength is maintained by social protection.

Keywords: UN, Social Protection, Youth, Elderly.

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INTRODUCTION

The theme that guides the debate in this article uses historical-dialectical materialism as a method of apprehending the main categories of the analyzed reality, a reality full of contradictions based on the value of the commodity labor, in its contemporary wage form. Such categories are expressions of the founding reality of the social being – work – through which mediations are made possible for the apprehension of the concrete totality of social protection for young people and the elderly.

> The dialectic of concrete totality is not a method that naively pretends to know all aspects of reality, without exceptions, and to offer a "total" picture of reality, in the infinity of its aspects and properties; it is a theory of reality and of the knowledge that is held of it as reality (KOSIK, 2012, 1976).

As a theory of reality and knowledge, it will deal with the dialectic of social protection for young people and the elderly in the 2030 Agenda of the United Nations and its concreteness, on which the contradictions that constitute the class struggles expressed in social policies assumed by States will be analyzed, without missing the opportunity to criticize the founding elements of the domination and exploitation of the labor force that appears as a commodity in capitalist society and that The valorization of young people and elderly people is dependent on the situation in which they find themselves between buying and selling "that commodity".

It is a debate resulting from bibliographic research with the help of documentary research by what various authors of the human and social sciences have focused on social protection and the capitalist mode of production, those that deal with youth and the elderly, and by the current document that governs the action of the United Nations directed to those groups.

Taking into account the purpose of this research, the following concerns were raised: at what point did social protection policies emerge and for what purpose? How do they arise? Why does the United Nations assume the highest position of drawing the lines and supervising the allied states as to the process of materializing the same lines of social protection for young people and the elderly? What is the relationship between social protection policies and the reproduction of capital? Are young people and old people socially protected in the same way? It is these questions that will guide our debate.

SITUATION OF YOUNG PEOPLE BETWEEN WAGE WORK AND SOCIAL PROTECTION

The situation of young people, between salaried work and social protection, expresses certain social subjects located in the various complexes that make up the working class, and that, as it is the "class that lives from work" (ANTUNES, 2009) has in its constitution an apparatus of labor and

social rights on which social protection is based to reproduce the mode of production that makes the class-that-must-live-from-salaried work. When we refer to the working class of which young people are a part, we will be agreeing that,

> An expanded notion of the working class includes, then, all those who sell their labor power in exchange for wages, incorporating, in addition to the industrial proletariat, the wage earners in the service sector, also the rural proletariat, which sells its labor power to capital. This notion incorporates the precarious proletariat, the modern part-time sub-proletariat, the new proletariat of McDonald's, the hyphenated workers of which Beynon spoke, the outsourced and precarious workers of the freeze-dried companies of which Juan José Castillo spoke, the salaried workers of the so-called "informal economy", who are often indirectly subordinated to capital, in addition to the unemployed workers, expelled from the productive process and the labor market by the restructuring of capital and who hypertrophy the industrial reserve army, in the phase of expansion of structural unemployment (ANTUNES, 2009, p. 103-104).

This is a concrete totality in the set of material totalities that explain the capitalist system, and one can only perceive the status of youth (in the homogenizing sense of the term) conceived by the United Nations as part of the population that capitalist society calls "economically active" in the sense that the current material conditions universalize who/who should be the young person(s) and what he/she should produce, taking into account the age category that favors the relentless valorization of contemporary capital.

> For Marx and Engels (2007, p. 87) "[...] what individuals are, therefore, depends on the material conditions of their production [...]". Here it is not a matter of historical determinism, but of considering the social relations of production as a historical and material process that locates subjects in distinct and antagonistic classes (FARAGE, 2023, p. 28).

Thus, the establishment of age, by which the delimitation of youth(s) takes place, always accompanies the relationship between productive forces and relations of production that configures a certain form of reproducing social life.

> The question of the "ages of life" runs through human history. Such "ages" are marked by different initiation practices, rites of passage, and training modalities, which translate the progressive insertion of individuals in essential activities of society. Behind age milestones, the determinant is the capacity – physical and psychic – to perform certain practices and social functions linked to the reproduction of the species and the production/reproduction of the conditions of existence – from the most primitive forms such as gathering and hunting, to the most complex forms that fit the conditions of contemporary industry (KLEIN, 2011, p. 185).

Due to the political dimension it occupies in the capitalist system, since its inception in 1945, the United Nations Organization (NETTO and BRAZ, 2006), through the International Labor Organization, gains legitimacy to universalize and politically homogenize the delimitation of the age of youth, in the context of the defense of Human Rights – and that is why as a form of criticism of the concept formally established by the UN, "it has become almost a consensus to conceive of youth

in its diversity, so much so that the plural "youths" replaces the singular, and has come to be widely adopted (PERONDI; VIEIRA, 2018, p.49) –, and as we have seen before, as a strategy to situate this group of the population in the most active processes of commodity production, whose exploitation is more or less consoled with social protection policies.

> The United Nations defines youth as the range of individuals between 15 and 24 years of age. The number of people in this age group has been increasing since 1945, reaching 1 billion in 1990. In 2005, young people were 1.02 billion, or 15.8% of the world's population (UNVPA, 2010, p.23).

In all salaried workers, young people (by the formal configuration of the age that legitimizes being part of the wage system, by the autonomous legal personality, which means being able to negotiate employment contracts, or more precisely, to gain the legal capacity to sell labor power as a commodity), are called upon to renew the processes of labor power. But what is wage labor? What is salary? Marx (1849) points out that,

> The workers exchange their commodity, labour-power, for the capitalist's commodity, for money, and this exchange actually takes place in a certain proportion: so much money for so many hours of labour-power. For working at the loom for twelve hours, two marks. And the two shillings—do they not represent all the other commodities that I can buy for two shillings? In fact, therefore, the worker exchanged his commodity, labour-power, for all kinds of commodities, and this in a certain proportion. By giving him two shillings, the capitalist gave him a certain amount of meat, clothing, firewood, and light, in exchange for his day's work. The two shillings, therefore, express the proportion in which labour-power is exchanged for other commodities, the exchange-value of labour-power. The exchangeable value of a commodity, valued in money, is precisely called its price. Wages, therefore, are only a special name given to the price of labour-power, which is usually called the price of labour; it is only the name given to the price of this peculiar commodity that only exists in the flesh and blood of man (MARX, 1982).

Through the dynamics of the wage system that does not have the capacity to accommodate all workers, based on the General Law of Capitalist Accumulation, several bibliographies of critical political economy clarify the three fundamental forms of relative population, which Marx had already explained.

> There are three fundamental forms of relative overpopulation: fluctuating, latent and stagnant. The *fluctuating form of overpopulation* is more widespread in industrial centers. Workers who have lost their jobs temporarily are reintegrated into production and then become unemployed again. Very few are unaware of what forced unemployment is during their working life, or at least what partial unemployment is. Those who most often end up in the army of the unemployed are the elderly workers. The capitalists take advantage of the possibility of hiring young and stronger workers who abound in the reserve army of labour, and they dismiss the elderly in the first place.
> *The latent form of overpopulation* is more typical of rural areas... As capitalism penetrates more and more into agriculture, large masses of the peasants, who cannot resist the competition of the powerful capitalist estates, are ruined.
> *Stagnant overpopulation* is formed at the expense of urban and rural workers who for a long time cannot find a job and who live by occasional work... spiritual of working (KOZLOV, 1980, p. 160-161).

This passage by the author continues to be an expression of the current reality, and explains the ways of controlling the workforce most required by the capitalist system, which is young people from various parts of the planet. But, is it enough to be young to have more possibility of selling the labor force? In the context of productive restructuring, the professionalization of work makes it possible to select the most qualified force, it is not by chance that the ideologies of academic, technical-professional training and employability (Alves, 2013) are one of the major sustainable development goals of the 2030 Agenda that the UN establishes for young people. Do all young people in nations have access to the wage system? How many are there today?

> There are currently 1.2 billion young people between the ages of 15 and 24, representing 16% of the world's population. By 2030, the number of young people is expected to reach 1.3 billion – equivalent to 7%. By that year, an additional 475 million new jobs will need to be created to absorb the 73 million young people who are currently unemployed and the 40 million who enter the labour market every year (UN, 2023).

From the data presented by the UN itself, it is clear that the reproduction of young people is so brutal that the productive system cannot include them through salaried employment in its entirety.

Employment policies express an important role for this system, the capitalist system, to naturalize unemployment, and thus get rid of the prospect of full employment, and the saving of the labor force (Sweezy, 1976; Antunes, 2009) is increasingly inexorable for the unbridled extraction of surplus value through the selection of highly qualified labor: therefore, it is no longer just any young person who is included in the wage system.

It can be compared with the form of enslaved labor, an extremely contradictory comparison, because, as

> Marx asserts that the modern worker shares all the misery of the former slave, without, however, enjoying the security which the latter had. The slave has a fixed and unchangeable quantity of means of subsistence at his whole life, while the labourer has at his disposal a very variable quantity, and may, in the event of unemployment, amount to nothing. Well, the reason for this insecurity is the cyclical dynamics of the capitalist economy, sometimes in frank prosperity, sometimes in calm; sometimes in depression, sometimes in recovery (HADDAD, 2003).

Confronting this barbarism, through social protection policies today, always reveals work as a criterion of social protection, that is, the quality of the young person's workforce can define (and this is not linear) their form of protection by the State. It wasn't always like this!

The metamorphoses of the State, through the different modes of production, allow it to intervene in the world of work in a way that is subservient to the current mode of production.

Since the fourteenth century, workers have been controlled through legislation that indicated directions over which the State had to reproduce the labor force. We observe the following trajectory:

- Statute of Workers, 1349

- Statute of artisans (Artificers), of 1563.
- Laws of the Elizabethan poor, which followed one another between 1531 and 1601.
- Domicile Act *(Settlement Act*), 1662.
- The Revised Law of the Poor Act, or the New Poor *Law Amendment Act*, 1834 (POLANYI; CASTEL *apud* BEHRING; BOSCHETTI, 2012, p. 48).

Castel, according to Behring and Boschetti (2012) points out that "these legislations established a coercive labor code and by also referring to Pereira, the authors explain that the character of the same code was punitive and repressive and not protective. The history of social protection is linked to the history of the Welfare State, a social State, it is, therefore, the origin of social policies that are a fundamental element for the struggle of the working class at the end of the nineteenth century (BEHRING; BOSCHETTI, 2012). For example, we have some historical elucidations:

- between 1883 and 1914, all European countries implemented a state system of income compensation for workers in the form of insurance;
- in the same period, 11 of the 13 European countries introduced health insurance and nine legislated on pensions for the elderly;
- in 1920, countries had some form of unemployment protection (PIERSON apud BEHRING; BOSCHETTI, 2009, p. 67)

It is noticeable that, looking at the trajectory of social protection, it is also possible to perceive the various forms of resistance that have already taken place within the working class to confront capital, resulting in the legitimization of labor rights. But the discontinuity of these conquests is being carried out by the neoliberal offensive, a forceful phase of capitalist barbarism. It is necessary to point out that from the 1960s of the twentieth century,

> … The growth rates, the capacity of the State to exercise its increasingly broad civilizing mediating functions, the absorption of the new generations into the labor market, restricted already at that time by labor-saving technologies, are not the same, contrary to the expectations of full employment, the fundamental basis of that experience. Public and private debts are growing dangerously... the explosion of youth in 1968, all over the world, and the first great recession – catalyzed by the rise in oil prices in 1973-1974 – were the striking signs that the dream of full employment and citizenship related to social policy had ended in central capitalism and was compromised in the periphery of capital where it was never effectively realized (BEHRING; BOSCHETTI, 2009, p. 103)

When the authors mention peripheral capitalism in which the welfare state was never realized, we mention, for example, the case of Angola, an African country.

> Capitalism in the Angolan social formation, slave-owning and, therefore, not concerned with achieving full employment, then we are faced with a capitalism that cannot guarantee the minimum rights of salaried labor. Therefore, historically, workers cannot enjoy the rights arising from work. They were slaves. Therefore, the advances and conquests of the working

> class that capital can be, in the states of Social Welfare, the so-called providential states, only remnants pass through Angola, as the cloud that irrigates where it rains, but leaves a sign, where it did not rain, that there was rain somewhere more or less close (MONTEIRO, 2020, p. 255).

Thus, thinking about the youth workforce in the historical totality of bourgeois sociability, in contemporary times, requires analyzing the structures of exploitation of the objective and subjective dimension of the totality of workers, whose state constitutes a category that makes such a process possible by the social protection policies initially outlined by the United Nations, because after all, politics, as a structuring dimension of the State, arises to guarantee the private appropriation of the labor of others, that is, the political dimension is one of the expressions of social relations ensured by the economic expression of those who control the means of production (PAIXÃO, 2017).

Taking into account the current reality of young people, due to the contradiction between their numerical existence and the few possibilities of being inserted in the wage system, how does the United Nations expect to face this barbarism? What to do for young people? This is where this organization's 2030 Agenda comes into play. The *slogan* "Transforming Our World: The 2030 Agenda for Sustainable Development" is the theme assumed by the UN, in the current way of interpreting and intervening in the world based on 17 goals.

> The 17 Sustainable Development Goals and 169 targets we are announcing today demonstrate the scale and ambition of this new universal Agenda. They build on the legacy of the Millennium Development Goals and will complete what they failed to achieve. They seek to realize the human rights of all and achieve gender equality and the empowerment of women and girls. They are integrated and indivisible, and balance the three dimensions of sustainable development: economic, social and environmental (UN, 2015).

As for the situation of young people, the United Nations provides that,

> By 2030, ensure that all young people and a substantial proportion of adults, both men and women, are literate and have acquired basic knowledge of mathematics;
> By 2020, substantially expand the number of scholarships globally for developing countries, in particular least developed countries, small island developing States and African countries, for higher education, including vocational training, information and communication technology, technical, engineering and scientific programmes in developed and other developing countries
> By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value
> By 2020, substantially reduce the proportion of young people without employment, education or training (UN, 2015).

Looking at these goals and, above all, at the entire constitution of this document, it is possible to see that it is not about organization with the political dimension of capital, which aims to improve democracy and citizenship. Just to give an example, in every diagnosis demonstrated by him regarding continental social inequalities, class struggle, capitalism, the exploitation of man by man or the dominant ideology are not found, nor have they been mentioned, as the bases of such inequalities.

These goals, as the basis of the social protection that the States must ratify, do not have the capacity to minimize the inequalities mentioned. In this case, we agree with Tonet when he points out that young people are seen as a fundamental workforce – and, therefore, complex social protection policies are aimed at this group – to improve the economy of countries. This situation is better explained by the condition of the elderly, whose precarious condition of selling the labor force, makes it possible to perceive the precariousness of their social protection (elderly people) since they are outside the economically active population, that is, officially they cannot produce more.

> The struggle for Human Rights only acquires its fullest and most progressive meaning, today, if it has as its ultimate goal the extinction of Human Rights itself. Therefore, it is not aimed at the improvement of citizenship and democracy, but at the radical overcoming of the capitalist social order, of which citizenship and democracy are an inseparable part (TONET, 2015, 15).

Therefore, salaried work is the criterion of social protection in contemporary society.

THE ELDERLY: BEYOND SOCIAL PROTECTION

At this point, we proposed to analyze social protection, as a "necessary" response to the immediate demands of the elderly, in a certain historical phase, the "time of fetish capital" (IAMAMOTO, 2015), when we witness the emergence of the United Nations, as a political dimension of universalized capital.

In contemporary society - society of capital - the ideology of social protection as a system of guarantees of rights (BAPTISTA, 2012) for the elderly has been propagated, as if it were sufficient to guarantee the well-being of this segment of the population, but in reality, such rights derive from the complexification of the maintenance of the workforce of young people who aspire to enjoy an old age with full satisfaction of needs, which are expressed by the high quality of life.

Quality of life (in itself already an abstract concept) is a category foreign to the United Nations with regard to the goals of the current document that governs it – "Transforming Our World: The 2030 Agenda for Sustainable Development", in a mode of production that is not ontologically sustainable – related to the social protection of the elderly, when it only presents in its lines, basic conditions for not losing one's life due to deprivation of socially produced wealth. It is the category that officially does not have the capacity to sell labor power, and since the criterion of social protection is work, those who do not work only enjoy rights that ensure survival. What are these bases that the UN presents for its agenda?

> By 2030, end all forms of malnutrition, including achieving by 2025 the internationally agreed targets on stunting and cachexia in children under five years of age, and meeting the nutritional needs of adolescents, pregnant and breastfeeding women, and older people...;
> By 2030, provide access to safe, accessible, sustainable and affordable transport systems for all, improving road safety through the expansion of public transport, with particular attention

> to the needs of people in vulnerable situations, women, children, people with disabilities and the elderly...;
> By 2030, provide universal access to safe, inclusive, accessible and green public spaces, particularly for women and children, older people and people with disabilities (UN, 2015).

Let us look back at the lines of social protection for young people comparing them with those for the elderly.

Table No. 1: Comparison of Youth and Older Person Commitments by the UN, 2015

No.	Social protection lines for young people	Social protection lines for the elderly
01	By 2030, ensure that all young people and a substantial proportion of adults, both men and women, are literate and have acquired basic knowledge of mathematics;	By 2030, end all forms of malnutrition, including achieving by 2025 the internationally agreed targets on stunting and cachexia in children under five years of age, and meeting the nutritional needs of adolescents, pregnant and breastfeeding women, and older people...;
02	By 2020, substantially expand the number of scholarships globally for developing countries, in particular least developed countries, small island developing States and African countries, for higher education, including vocational training, information and communication technology, technical, engineering and scientific programmes in developed and other developing countries	By 2030, provide access to safe, accessible, sustainable and affordable transport systems for all, improving road safety through the expansion of public transport, with particular attention to the needs of people in vulnerable situations, women, children, people with disabilities and the elderly...;
03	By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	By 2030, provide universal access to safe, inclusive, accessible and green public spaces, particularly for women and children, older people and people with disabilities (UN, 2015).
04	By 2020, substantially reduce the proportion of young people without employment, education or training	

Source: prepared by the authors, 2024

According to the bases that aim to control the labor force of young people in relation to those that aim to control the labor force of the elderly, it is evident that the social subjects most apt to sell the labor power are directed to the most complex social protection policies quantitatively and qualitatively, not because there is good will on the part of the States to promote human emancipation. What is at stake is the preservation and maintenance of the labor force in better conditions to create capital valued as a commodity.

> the creation of value takes place in the necessary labor time; valorization takes place in the surplus labor time. Thus, due to the lack of labor force because of physical limitations, psychological incapacity generated by social inequalities, workers lose their use value in capitalist society (NETTO and BRAZ, 2012. p.124).

Of the social group that constitutes the elderly, many citizens are excluded from the system of production of surplus value, even though they are part of the process of circulation of capital through the consumption of a part of the social wealth through social policies, leaving only those crumbs of

minimum resources so as not to perish. The concentration of States along the lines of the UN, in this form of protection, based on the "objectives of the millennium" was and is an expression of a capitalist system that reproduced its crises to exhaustion, not by chance the current "glaring" absolute poverty in almost every part of the planet. Therefore, we agree with the author when he points out that,

> The social policy directed at those now qualified as excluded is outlined, claiming to be inscribed in the domain of rights, as specific to late capitalism: it does not even have the formal intention of eradicating poverty, but of facing only the most extreme penury, indigence — according to its own discourse, it intends to confront absolute poverty (that is, extreme misery) (NETTO, 2012, p.428).

Since work, the founding category of the social being (LUKÁCS, 2018), the capitalist social being, through the wage labor that the worker is exploited, dominated through the expropriation of the product of his work, all objective and subjective misery stems from that expropriation, that is, the elderly person does not recognize himself as a worker who has already contributed directly or indirectly to the production of accumulated social wealth and who, By thus contributing, he would have access to the same wealth.

As the misery of subjectivity stems from the misery of the conditions of material life, hunger is accepted by the elderly as a natural fact, an expression of a society alienated by the varied forms of workers, also alienated, from youth to old age. As Paiva states,

> By way of the alienation of labor, the worker began to work for the capitalist to whom he delivers, as a wage-earner, the product of his labor that will be appropriated by capital. This mechanism of expropriation affects the objects most necessary for life and work, denying the worker the limits of hunger. Thus, alienated from his product, the worker is alienated from himself (PAIVA, 2012, pp. 97-98).

By minimalism, or the fact that the social groups seen as vulnerable, of which the elderly are a part, officially lack only minimum conditions of material life, are their minimum needs, because they are minimal, fulfilled? What has the UN failed to achieve in the Millennium Development Goals (2000-2015), which it proposes to solve in the 2030 Agenda?

> The minimalism of this proposition – blatant if compared to the objectives, in fact never achieved, of the social protection/promotion programs elaborated and implemented in the period of the "three glorious decades" of capitalism – can be appreciated in the "Millennium Declaration" (2000), consensual in the United Nations: through the "millennium development goals", there is the proposal/promise to "liberate our fellow human beings, men, women and children, from the abject and inhuman conditions of extreme poverty" (my italics); More precisely, the proposal is, in 15 years (i.e., by 2015), to reduce extreme poverty by half – this is the first of the "Millennium Development Goals": to halve the percentage of people living on less than one dollar and twenty-five cents a day. Despite this astonishing minimalism in the face of a maximized "social question", the various reports on "human development", regularly prepared by the UNDP, although emphasizing "gains" of this program, make it clear that its objectives – reiterate: minimalist – will not be achieved (NETTO, 2012, p.428).

In fact, contemporary bourgeois sociability, by founding the United Nations, creates a whole structure and dynamic that makes the UN itself subservient to the order of capital

> From the nature of the act that founds bourgeois sociability it follows that all individuals have the right – in the ontological and only later juridical sense – to seek the satisfaction of their interests. But, contrary to what liberalism claims, it is not essentially a struggle between individuals, but between social classes, between those who produce wealth and those who, because they own the means of production, appropriate most of this wealth (TONET, 2015, p.2).

Thus, it is essential to point out that the aging of the working class will be conditioned not only by biological factors, but also by multiple historical determinations, whether social, economic, psychological and political, expressions of the mode of production in force in contemporary times. Hence it can be said that the way in which a young person, belonging to the bourgeois class, will grow old, will be completely different from that belonging to the working class. Thus, the fact that there are several old ages and youths is justified, and therefore, "... it is necessary to recognize that human existence is not given by the individual desire of the subjects, but rather conditioned by their location in class society, whether as a buyer or seller of labor power" (FARAGE, 2023, p.28). Therefore, the elderly person belonging to the proletarian class will have a subordinated, unhealthy old age with various limitations because the material conditions, where he is (was) inserted, conditioned such a situation.

What is the ontological foundation of social policies whose UN becomes their rector?

> Thus, the ontological foundation of the set of rights – civil, political and social – resides in that act of buying-and-selling labor power. The concrete form of these rights will always be the result of the struggles waged between capital and labor. However, no matter how perfected these rights are, they can never exceed the limits placed on them by the reproduction of capital (TONET, 2015, p.2).

With better elucidation, the author explains.

> However, given the ontological dependence of the State on the economy, social policies, as much as they may contribute to the defense of workers' interests, will always come up against the insurmountable limits set by the reproduction of capital (*Ibdem).*

If we start from the idea that social protection is not ontological to the social being, but a product of contemporary bourgeois sociability, that is, it arises at a certain moment in the history of humanity, it is now up to us to analyze in which ontological conditions they should be radically criticized.

Social protection as an expression of Human Rights has a contradictory character in today's society, to the extent that,

> … Human Rights do have a bourgeois character. They are rights, like all others, that are part of the sociability that is built on the foundations of capital, of private property. They are not for that reason negligible now, nor can they be suppressed in socialism, except by social means. If, on the one hand, they contribute – regardless of the intentions of those who defend them – to the reproduction of capitalist sociability, on the other hand, they also enable the defense and expansion of the space for the realization of the individual and, therefore, of the human race in this same society. Thus, the struggle for Human Rights, as for the set of democratic-citizen objectifications, is not only valid but can play a very important role. But it must be clear that it can have a reformist or revolutionary character. It will have a reformist character and, therefore, will contribute to the reproduction of this inhuman social order if its ultimate goal is the improvement of citizenship and democracy. It will have a revolutionary character if it is clear about its limits and if it is articulated with clearly and radically anti-capitalist struggles (TONET, 2002, p.14).
> Tracing this reality, it is important to realize that the success and failure of the working class in confronting capitalism only occurs depending on the horizon that can be positioned between political emancipation and human emancipation (MARX & ENGELS, 2012).
> In the working class of which all young workers and all elderly people are part of carrying out anti-capitalist struggles in the horizon of political emancipation, even if rights are expanded, even if the system of guaranteeing social protection is expanded for all and access to socially produced wealth is easier, wage labor will continue to be the basis for the reproduction of inequalities, whereby the relationship of exploitation and domination between men and women will continue to prevail.

If the working class, in its anti-capitalist struggles, has human emancipation as a horizon, it will give up to deny social protection as a right, since such a right is a strategy for controlling the workforce. To deny this right must presuppose putting an end to private property both of the means of production and of labor, which appears as a commodity.

FINAL CONSIDERATIONS

The apprehension of the categories that conducted the research carried out on the relationship between social protection, young people and the elderly in the UN 2030 Agenda, makes us, once again, agree with Marx, when he stresses that the concrete is only concrete when it is the synthesis of several determinations.

In this way, social protection will only be concrete if we manage to make the necessary mediations that presuppose perceiving the structure and dynamics of the capitalist system, the State, salaried labor, profit, the commodity, as long as they are categories that make social protection concrete, of the young and the elderly, who live from work.

By founding the capitalist mode of production, wage labor becomes the measurer of social protection policies, since these aim to contribute to the reproduction of that order, controlling the working class of which young people and the elderly are integrated. The reproduction of that order stems from the establishment of social services structured by the bourgeois state, which, by creating the reformist consciousness of the working class, weakens its subjective character, destroying the revolutionary consciousness of the class itself. Thus, social protection is an instrument for the demobilization of the working class that should think and practice the revolution against the current order.

What the United Nations Organization outlines for the social groups, which were our object of analysis, is an expression of the neoliberal offensive led by the United States of America, not by chance that the institution has its headquarters in that country, the center of fetish capital, precisely so that the organization is definitely the political dimension of capital.

Social protection for young people is different and more complex than social protection for the elderly, simply because the commodity "labor power" that each social segment has at its disposal, contributes to the production and valorization of capital in different ways.

When the worker ages, he loses value to capital, which does not mean that he ceases to be exploited. The elderly person, belonging to the working class, is no longer seen as valuable, once he has reached the age delimited for active production, he is separated from the productive system, because he no longer satisfies the demands of the market, because he loses the "active force" considered for the reproduction of capital.

The only way to look at young people and the elderly as social beings, in the human-generic complex, whose valorization does not depend on their labor power as a commodity, is to break with the capitalist structure that means denying Human Rights, which means putting an end to the functionality of the UN and the States allied with each other, happens *in extremum* by the social revolution, in order to guarantee human emancipation.

REFERENCES

1. Alves, G. (2007). *Dimensões da reestruturação produtiva: ensaios de sociologia do trabalho*. Londrina: Praxis.

2. Antunes, R. (2009). *Os sentidos do trabalho: ensaio sobre a afirmação e a negação do trabalho*. São Paulo: Boitempo.

3. Baptista, M. V. (2012). Algumas reflexões sobre o sistema de garantia de direitos. *Serviço Social & Sociedade*, São Paulo, (109), 179-199.

4. Farage, E. (2023). A conjuntura e o trabalho de assistentes sociais: elementos para a construção da análise de conjuntura no cotidiano profissional. In C. H. M. Horst, T. F. M. Anacleto, & Conselho Regional de Serviço Social de Minas Gerais (Orgs.), *A dimensão técnica-operativa no trabalho de assistentes sociais* (pp. 7-40). Belo Horizonte: CRESS.

5. Haddad, F. (2003). Sindicalismo, cooperativismo e socialismo. In F. Haddad (Org.), *Sindicalismo, cooperativas e socialismo* (pp. 7-40). São Paulo: Fundação Perseu Abramo.

6. Iamamoto, M. V. (2015). *Serviço social em tempo de capital fetiche: capital financeiro, trabalho e questão social*. São Paulo: Cortez.

7. Klein, L. R. (2011). A luta pelas leis fabris do século XIX e a definição das idades do trabalho: um estudo sobre a constituição das noções de infância e adolescência. In S. Braga et al. (Orgs.), *Marxismo & Ciências Humanas: leituras sobre o capitalismo num contexto de crise: ensaios em comemoração aos 15 anos de Crítica Marxista* (pp. 185-202). Curitiba.

8. Kosik, K. (1976). *Dialética do concreto*. Rio de Janeiro: Paz e Terra.

9. Kozlov, G. (1980). *Curso de Economia Política*. Lisboa: Avante.

10. Lukács, G. (2018). *Para uma ontologia do ser social*. Maceió: Coletivo Veredas.

11. Marx, K., & Engels, F. (2012). *Manifesto do Partido Comunista*. São Paulo: Editora Schwarcz.

12. Marx, K. (1982). *Trabalho Assalariado e Capital* (Vol. 1, pp. 142-177). Editorial Avante.

13. Monteiro, A. A. (2020). *Serviço social, Estado e políticas sociais em Angola: mediações teórico-metodológicas*. Manaus: Alexa Cultura.

14. Netto, J. P. (2012). Crise do capital e consequências societárias. *Serviço Social & Sociedade*, São Paulo, (111), 413-429.

15. Netto, J. P., & Braz, M. (2012). *Economia política: uma introdução crítica*. São Paulo: Cortez.

16. ONU. (2015). *Transformando Nosso Mundo: A Agenda 2030 para o Desenvolvimento Sustentável*.

17. ONU. (2023). *Estado da juventude no mundo*. Disponível em: https://unric.org/pt/juventude-nacoes-unidas-onu-portugal

18. Paixão, B. G. (2017). *A política em Marx*. São Paulo: Instituto Lukács.

19. Perondi, M., & Vieira, P. (Orgs.). (2018). *A construção social do conceito de juventudes*. Porto Alegre: EDIPUCRS.

20. Sweezy, P. M. (1976). *Teoria do desenvolvimento capitalista* (4ª ed., Trad. W. Dutra). Rio de Janeiro: Zahar Editores.

21. Tonet, I. (2015). Qual política social para qual emancipação? *Revista Serviço Social*, 17(37).

22. Tonet, I. (2002). Para além dos direitos humanos. *Novos Rumos*, (37).

23. UNVPA - Fundo de População das Nações Unidas. (2010). *Direitos da população jovem: um marco para o desenvolvimento* (2ª ed.). Brasília: UNVPA.

Goal and behavior setting: The structured and unstructured self-regulation model

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ABSTRACT
Self-regulation, the ability to control our thoughts, emotions, and behaviors, is critical to success in many areas of life. This paper investigates the neural mechanisms underlying this complex ability, focusing on goals, priming, and the SUSR (Structured and Unstructured Self-Regulation) model.
Initially, the neural bases of self-regulation are explored, highlighting the brain regions involved in planning, inhibitory control and decision-making. The importance of goals as guides to action is emphasized, and different types of goals (short-term and long-term, specific and general) are discussed. Clear goal setting and consistent pursuit are presented as crucial for effective self-regulation.
The concept of priming, i.e., the activation of concepts or ideas in the mind that influence subsequent behavior, is introduced. Studies show that priming can modulate self-regulation, either facilitating or hindering the achievement of goals. The article discusses how priming can be used to promote more adaptive behaviors.
Finally, the SUSR model is presented as a theoretical framework to understand the processes of self-regulation. This model distinguishes between structured self-regulation, which involves the planning and execution of actions in a deliberate manner, and unstructured self-regulation, which occurs more automatically and habitually. The SUSR model offers a comprehensive perspective on the different levels of cognitive control involved in self-regulation.

Keywords: Self-regulation, Goals, Priming, SUSR Model, Neuroscience, Cognitive control.

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INTRODUCTION

Self-regulation refers to an individual's automatic and controlled efforts to alter behavior, cognition, responses, and suppress impulses, with adaptive and goal-oriented goals (Luszczynska et al., 2004). Most theories of goal-oriented self-regulation include the notion that goals are internal representations of desired states, leading the individual through a process of goal setting, comparing progress against goals, and adapting cognitive and behavioral responses to increase the chances of success (Koch & Nafziger, 2011). In the comparison process, two possibilities are experienced, related to a general feeling of approaching or distancing from the goal, described as cycles of reduction and widening of the discrepancy. The cycle of reducing the discrepancy results from a comparison between the current state and the desired state, in which the individual feels that the goals are getting closer to being achieved. This positive feedback helps the individual sustain the effort toward goal completion, while on the other hand, if there is a sense of detachment, the negative feedback can lead the individual to decrease the effort (Lord, Diefendorff, Schmidt, & Hall, 2010).

Different theories of self-regulation have been utilized over the years to explain goal-seeking in many aspects, such as long-term and short-term goals, or even in specific areas such as academic and work-related achievement goals (Latham, 2016). In addition, especially since the theory of goals was incorporated into the theoretical framework, studies on self-regulation have contributed over the years to a better understanding of social behavior and information processing (Koole & Fockenberg, 2011; Shah & Kruglanski, 2003; Vancouver, Weinhardt, & Schmidt, 2010).

Some aspects of self-regulation are important for understanding how an individual can progress toward goal achievement. For example, the theory of regulatory focus postulates two orientations of self-regulation: prevention (when the individual directs his behavior with a focus on security needs and loss avoidance) and promotion (when the focus is directed to needs to advance and approximate gains), with measures already validated (Cesario, Higgins, & Scholer, 2008). Promotion and prevention have contributed to the understanding not only of the self-regulation process itself, but especially of how individual differences can lead to a more active or passive orientation towards goals.

NEURAL BASES OF SELF-REGULATION

Self-regulation depends on several cognitive processes, which need to be considered and taken into account to better explain the internal events that can affect how the individual controls and regulates behavior. If we consider evolutionary needs, the beginning of life in groups was decisively marked by the efficiency with which individuals read, understood and adapted to the patterns of the group – an incipient form of self-regulation. To be proficient in this endeavor, it was necessary for individuals to alter their behavior, control impulses, thoughts, and actions, to relate better to others

and remain part of the group, increasing the chances of survival, which makes it plausible to assume that the brain evolved to develop specific mechanisms for this.

The neuroscience literature indicates that some cortical regions are related to self-regulatory processes, especially the prefrontal cortex (PFC) and its executive functions associated with self-regulation (Heatherton & Wagner, 2011). If we consider, for example, the classic case of Phineas Gage and the damage to the CPF, which resulted in a radical change in behavior and personality, most of the transformation occurred due to uninhibited behavior, lack of conformity to social norms, and impulsive actions, all related to an impairment of self-regulatory functions (Heatherton, 2011).

Autoregulatory functions are often linked to three specific areas of the PFC: the ventromedial prefrontal cortex (mPFC), the orbitofrontal cortex (LOC), and the lateral prefrontal cortex (PFC), which, when damaged, lead patients to different manifestations of self-regulatory problems, such as difficulties in managing social and affective life, as well as antisocial, violent, and compulsive behaviors (Suvorov & van De Ven, 2008). An interesting aspect of these cases is that individuals were still aware of social norms and, although they were aware of socially expected behaviors, they were unable to comply, reinforcing the idea that the CPF is not merely a repository of social norms, but a self-regulatory instance. In addition, the PFC is related to executive functions deeply linked to self-regulation, such as decision-making, planning, working memory, attentional filtering, and response inhibition (Petersen & Posner, 2012).

Damage to mPFC is linked to severe difficulties in primary physiological drives, as well as a general dysregulation of different forms of social behavior, while patients with damage to lPFC, although able to behave according to social norms, report difficulties in initiating and planning behaviors, struggling to set and pursue goals (Heatherton, 2011). Another important region related to self-regulation processes is the anterior cingulate cortex (ACC), which is responsible for cognitive control and conflict monitoring, with patients with damage in this area often experiencing symptoms such as lack of motivation and difficulty engaging in goal-oriented behaviors. The literature in the area points out that this area may be responsible for signaling the need for self-regulation in a specific situation (Heatherton & Wagner, 2011).

In line with these findings in neuroscience, the self-regulatory strength model proposes that self-regulation relies on a general resource that, when depleted, can lead to impoverished self-regulation. Some researchers have found evidence to suggest that even individuals without harm in these areas, when faced with resource depletion, report failures in self-regulatory processes in a variety of domains, such as diet, alcohol abuse, and even sports performance (Baumeister, Vohs, & Tice, 2007; Chan et al., 2015; Hagger, Wood, Stiff, & Chatzisarantis, 2010).

GOALS, GOAL SETTING, AND GOAL PURSUIT

Human behavior is often conceptualized as the final step in a process initiated by an environmental demand, which leads to information processing, planning, and then interventions in the social world, what we call action or behavior. After processing environmental demands and adding pre-existing information to the equation, individuals are often led to set goals, such as mental representations of actions or behavioral outcomes that are desirable or rewarding (Dijksterhuis & Aarts, 2010). Consequently, the desired behavior or outcome becomes the present goal, especially considering the expected reward or desirability.

This active goal or goals then become the main reference for actions, usually guiding most of our cognitive processes, such as attention, memory, and decision-making. For example, in one experiment, neutral behaviors (doing puzzles, going for a walk) were subliminally paired with positive, negative, or neutral words, so that participants could perceive the valence word but not the activity. Subsequently, the participants not only showed a tendency to engage in the conditioned activities positively, but also completed a task more quickly than the control group when they promised to participate in the activity after the task. Under these conditions, not only did the activity become a goal, but it also directed cognitive processes toward the pursuit of the goal (Custers & Aarts, 2005).

The literature on goals, goal setting, and goal pursuit distinguishes two broad perspectives for understanding how individuals set goals and pursue them. One perspective focuses on the content of a goal as the main aspect, as investigated and described in studies on academic goals (Komarraju & Nadler, 2013) and work-related goals (Lord et al., 2010). Another perspective proposes that, more than content, the effective use of self-regulatory strategies is the main aspect in relation to the definition and pursuit of goals (Oettingen & Gollwitzer, 2010).

When observing general behavior, it is not only relatively easy to infer a goal or set of goals from the observed individual, but most of the time people use this information in interpersonal interactions, offering answers based on the inferred goal (Stanovich & West, 2003). Individuals are educated from childhood to identify goals and behave to achieve specific demands, not only in school but in most domains of social life, being rewarded when they succeed in this attempt and punished when they fail (McCarthy, Jones, Harwood, & Davenport, 2010).

It is a relatively consensual understanding that goals serve as tools for individuals to engage in volitional behaviors, defining what they find rewarding to achieve and influencing strategies and effort in the pursuit of those goals. Goals are usually described as representations of desired states or behaviors that guide our efforts and direct our behavior toward their achievement (Dijksterhuis & Aarts, 2010). Because goal attainment is often a rewarding experience, individuals develop strategies to maintain goal-directed behaviors (Marien et al., 2012). At this point, an important issue arises,

which is the awareness of the goal-setting process, and it is useful to make a distinction between conscious and unconscious goals. A conscious goal can be verbalized and expressed as what we usually describe as volition or intention. Unconscious goals cannot be expressed, since the individual is not aware of the process, although information processing and other cognitive processes are functional and affecting behavior. The literature on goals is vast, and different taxonomies have been produced over the years, followed by many goal-like concepts. The general understanding is that the goals have six major dimensions (Austin & Vancouver, 1996):

(a) importance-commitment

(b) level of difficulty

(c) specificity-representation

(d) alcance temporal

(e) level of consciousness

(f) connection-complexity.

These dimensions also vary in three main perspectives: person, time, and goals. The person's perspective concerns individual interpretations and general differences for the same goal. The time perspective deals with changes in goals over time, not just at the individual level, but more generally. The goal perspective focuses on the interaction between goals in an individual. These perspectives are primarily individual, but the environment also plays an important role in goal activation, even when we consider unintentional goal setting or unconscious goals. Goals not only can, but most of the time they are activated without the individual's knowledge (Marien et al., 2012). If we consider that a person is capable of setting goals to pursue without being aware of the process, this brings a complex perspective of the phenomena involved in goal setting and pursuit.

It is common to perceive behavior as the result of a planned and intentional effort, and the pursuit of goals is usually consciously defined, with the agency of the self being the result of conscious choices and planning. However, recent findings challenge this notion, with research, mostly experimental, showing that the mere activation of a meta representation guides the behavior and higher cognitive processes involved in goal-directed behavior, without the individual's awareness (Kelley, Wagner, & Heatherton, 2013). Goals inferred from another person's actions can also be activated in an observer and can control subsequent behavior without conscious intention, thus leading to goal contagion (Capa, Cleeremans, Bustin, Bouquet, & Hansenne, 2011). With the establishment of goals, there is a need to adopt strategies to achieve them, a process of planning and maintaining appropriate cognitive and behavioral responses that can be described through self-regulation theories.

The general understanding is that conscious decisions are just one way goals can influence behavior. For example, the automotive model (Bargh et al., 2012) proposes that goals can not only be

activated outside of consciousness, but also that unconsciously activated goals are effective in providing guidelines for behavior in a similar way to conscious goals.

About the very idea of a goal, it is reasonable to assume that the goal that an individual adopts, consciously or unconsciously, has significant significance in terms of rewards and expectations of achievement. Three aspects that guide recent research on the topic will be discussed as significant aspects that affect regulatory dynamics: regulatory adjustment, regulatory engagement, and accessibility. They are commonly related to goals and affect the setting and pursuit of goals.

First, the notion that goal orientation needs some sustaining strategy is relatively consensual, otherwise the individual would struggle to stay aligned with his or her own goals. A goal can be sustained, that is, have regulatory adjustment, or it can be interrupted, if there is a regulatory mismatch, which depends not only on the goal itself, but also on the strategy adopted to pursue this goal (Cesario et al., 2008). Regulatory adjustment theory proposes that there needs to be a correspondence between the orientation towards a goal and the strategies that the individual adopts to get closer to that goal, and that these strategies can produce a state of regulatory adjustment that not only creates a sense of correctness in the pursuit of the goal, but also increases engagement in the task (Aarts, Custers, & Veltkamp, 2008; Förster, Liberman, & Higgins, 2005). In the same perspective, an important aspect of regulatory dynamics is the theory of regulatory engagement, which proposes the presence of a motivational force that can attract or repel a goal, depending on the goal's attributes, such as values and other hedonic sources of direction (Cesario et al., 2008).

For example, an individual may be drawn to a goal in a relatively weak or strong way (low or high positive value) or may feel repulsion as a relatively weak or strong force (low or high negative value). The two forces vary in intensity and direction, although they are perceived as a complete experience. There are aspects of direction and intensity that can affect the experience, with the intensity and direction of the value working independently. This means that the more intensely an individual is engaged in an activity, the more intense the experience of motivational force will be. In other words, engagement serves as an enhancer of the directional component of value experience. Consequently, an individual who is more strongly engaged in the pursuit of a goal will experience a positive target more positively and a negative target more negatively (Förster et al., 2005; Murray, Gomillion, Holmes, Harris, & Lamarche, 2012).

To be able to engage and adapt to a goal, some information needs to be accessible to the individual. Even if the information is processed outside of consciousness, it needs to be accessible in some way. The notion of accessibility is used to describe the degree to which a mental representation is currently active, more specifically in terms of information that forms concepts and, obviously, personal goals, determining social perception, influencing cognitive processing, and thus behavior (Förster et al., 2005).

PRIMING AND SELF-REGULATION

Priming refers to the cognitive, motivational, affective, and behavioral consequences of the presentation of certain stimuli, to facilitate access to certain content, modifying subsequent behavior (Molden, 2014). For many years, ideomotor and self-motivation models have been largely responsible for the general understanding of how the mechanisms of priming effects work. According to the ideomotor model, stimuli automatically activate mental representations that determine the individual's behavior, while the self-motivation model suggests that motivational stimuli activate representations linked to specific goals or objectives, which, in turn, would be responsible for activating behaviors directed to these goals (Wheeler, Petty, & Al, 2014).

Studies on goal priming have shown that different stimuli can be used to enhance goal-setting and pursuit processes, leading to better self-regulation and increasing the chances of achieving goals. Stimuli related to the means of achieving goals, also referred to as implementation sets, improved performance (Shah & Kruglanski, 2003).

Some studies also suggest that the goal-pursuing strategies adopted can increase the salience of goal representation, not only by broadening the ways in which it can be activated by priming, but also by facilitating the maintenance of goal-seeking behavior by promoting self-regulatory processes (Gollwitzer, Sheeran, Trotschel, & Webb, 2011). A good example is given by the same authors, who suggest that an individual may be more likely to make purchases after making a shopping list, as making the list makes the goal of shopping more activated, increasing the number of environmental signals that can activate this behavior. Priming effects have also been investigated in emotional self-regulation, with results indicating that emotional reactions can be controlled more effectively through this type of effect, depending on some dispositional variables, such as action-oriented or state-oriented regulation (Koole and Coenen, 2007). In the same study, action-oriented participants were more easily affected, mobilizing affective regulation more efficiently, indicating that subtle priming was sufficient to affect self-regulation.

Japanese researchers have also found interesting results on priming and self-regulation when investigating goal priming. Participants were influenced by specific goals, and then not only task performance was assessed, but also conscious goal editing, i.e., individuals intentionally performed small modifications to the goal to fine-tune their effort and increase the chances of success (Oikawa and Oikawa, 2010). According to them, after a goal is activated by priming, individuals can make conscious or unconscious adjustments during the goal-setting process, and depending on the fit and the task, not only does performance improve, but there is also less resource consumption. These authors also highlight that priming can be used to induce automatic goal pursuit, even when there are factors contrary to this specific behavior, such as diet, when an individual knows that they should eat

salad, but internal triggers are more likely to cause them to consume fat and sugar (Oikawa and Oikawa, 2010).

Also in studies on self-regulation in diets, Papies and Hamstra (2010) found that subtle diet priming evoked an effect in restricted eaters (individuals with the specific goal of avoiding unhealthy foods), which reduced unhealthy eating behavior compared to non-restricted eaters. The findings indicate that subtle priming of diet-related goals can enhance self-regulation in this context.

Another important aspect of the self-regulatory process is the validation of the process itself, which means that the individual will regulate behavior more easily when goals are perceived as important, thus deserving more resources and effort. The priming of goal-related concepts, when these concepts are validated, increases as the individual regulates behavior toward goal achievement (DeMarree et al., 2012).

Recently, despite the contribution of these models, the results of priming studies have been questioned in the scientific community due to replication problems, such as the absence of previously described effects, lack of cross-cultural replications, and even inconsistencies in the explanation of the phenomenon (Shanks et al., 2013). Recent studies, however, have brought new opportunities to study the effects of priming, especially those investigating the effect of moderators on the process (DeMarree et al., 2012).

In the studies discussed above, goal validation and implementation sets have been investigated, but more general and broad variables are rarely discussed as possible moderators in the process. It is important to investigate the effects of situational and dispositional variables on self-regulation in order to better understand the phenomenon.

THE STRUCTURED AND UNSTRUCTURED SELF-REGULATION MODEL (SUSR MODEL)

Fujita and Trope (2014) proposed a model describing two models of self-regulation, based on the presence or absence of goals. According to these authors, when a goal is established, the individual would engage a state of structured regulation, while in the absence of a goal, the individual would engage a state of unstructured regulation. While in the state of structured regulation, the individual would work with the goal of pursuing goals, with mental processing focused on information related to the goals and eliciting behavioral responses toward goal attainment. In unstructured regulation, the lack of goals would cause the individual to process the most salient information available and exhibit behavioral responses that adapt to the environment.

If we consider the model of Fujita and Trope (2014), a line of research could investigate how priming effects can be used to induce sophisticated self-regulatory processes, leading the individual to function in a specific regulatory dynamic, in which goals act as an important element that can

make certain cognitive contents more accessible and certain signals from the environment more salient, guiding behavior toward these goals (Baumeister et al., 2011).

According to Fujita and Trope (2014), subjects in a state of structured regulation, when influenced by priming, experience the activation of declarative knowledge, which facilitates subsequent behavior in relation to the stimulus presented — which, in many cases, refers to the individual's perception of the purpose of that specific task, and, therefore, the behavior seems appropriate to fulfill the goal (Gollwitzer et al., 2011). In the case of unstructured regulation, the priming effects obtained are usually activation procedures, rather than specific content, which leads individuals to act using the procedure mechanism.

The model proposed by Fujita and Trope (2014) describes two possibilities of stimulation that can lead to two different types of priming. Goal priming, when stimuli are related to goals and objectives, leading the individual to a process that the authors describe as a high-level construct, where the individual has his attention directed to the established goal, focusing attention on contextual elements that are related to the goal and controlling behavior towards this goal. Procedural priming occurs when the priming stimulus is not related to a goal, but to a procedure, form of action or technique, leading the individual to a state of low-level construct, in which, because he does not have a specific goal to achieve, he becomes more susceptible to contextual signals and even, as described in some experiments, showing a tendency to repeat techniques stimulated through priming (Doyen, Klein, Simons, & Cleeremans, 2014; Fujita & Trope, 2014; Wheeler et al., 2014).

Also, as part of self-regulation, there is a difference in cognitive processing when an individual is setting goals or trying to achieve them. When goals are being set, cognitive processing is described as deliberative cognition, and when goals are being pursued, cognition is implementative (Gollwitzer et al., 2011). As goals are the main aspect in the structured/unstructured regulation model, it is necessary to discuss the processes of defining and pursuing goals.

As a development of the model proposed by Fujita and Trope (2014), in which priming can be used to induce states of structured and unstructured regulation, it is necessary to describe these states according to recent research and discuss how these states can be induced and/or achieved. Since goals are a key element in the model, it is reasonable to start by describing the goal-setting process.

Fujita and Trope (2014) proposed a priming-induced possibility, but did not refer to the goal-setting process. This process can be described as the adoption of a specific goal that motivates an individual toward its fulfillment (Finkel, Fitzsimons, & VanDellen, 2016). Once the goal is established and the individual has the resources to achieve it, behavior and cognition will work toward its fulfillment (Locke & Latham, 2006). As a development of the model, target setting should be the first step in the process, positioned between priming and regulatory states, meaning that

priming can be used to induce target setting, which in turn induces regulatory states. This proposition, made by Victorino and Pilati (2019), deepens the complexity of the model, with the processes of goal definition as probable mediators in the induction of regulatory states by priming. As a second step, if after the goal-setting process the individual successfully sets a goal, he would then be in a state of structured regulation; If no target is set, it would lead to the state of unstructured regulation. Considering that the main difference between states is that targets can be set in advance (structured regulation) or be context-related (unstructured regulation), it is plausible to assume that both states are likely to be affected by moderators, such as self-control, regulatory adjustment, and regulatory focus, present in the process to keep efforts correctly targeted. As a third step, according to each regulatory state, the cognitive architecture would then be ready to direct information processing, behavior control, and other cognitive processes toward goal fulfillment (in the regulated state) or adaptation to the context (in the unregulated state).

Induction by priming, as well as the possible moderators and mediators, are not described in the model of Fujita and Trope (2014) have been successfully investigated (Victorino and Pilati, 2019), specifically in the Brazilian reality.

If we consider that, in everyday life, various elements of the context and even the interpretation of the subject can act as stimuli to trigger priming effects, the need to better understand this mechanism and, above all, to investigate its effects on human behavior becomes evident. In addition, the role of potential moderators should be investigated, e.g., self-control, regulatory adjustment, and regulatory focus.

Describing these states and producing experimental evidence about them is necessary to broaden our possibilities of understanding how an individual can regulate their own behavior, but first, to understand how the presence or absence of a clear goal affects, which can provide empirical knowledge on the topic and improve future efforts.

CONCLUSION

The mechanisms of self-regulation, priming, and the interaction between goals and behavior were addressed here, exploring how these processes manifest themselves both at the conscious and unconscious levels. Analysis of different theories and models, such as the Structured and Unstructured Self-Regulation Model, offers a detailed perspective on how individuals set goals and adjust their actions to achieve desired outcomes. In addition, the empirical studies described throughout the work demonstrate that the environment and contextual factors can decisively influence the process of behavioral regulation, often automatically and unintentionally.

Given the complexity and breadth of the topic, it is evident that there is still much to be investigated. One of the main directions for future research lies in further exploration of the

moderators and mediators who influence the process of self-regulation. Variables such as self-control, regulatory focus, and adjustment to goals are essential aspects that deserve greater attention in different contexts. In addition, investigating how these processes manifest themselves in different cultures and in practical situations of everyday life is a rich area of study. Experiments that examine how these dynamics work in a variety of settings, such as in the workplace, educational settings, or social interactions, could significantly expand our understanding of the topic.

In the practical field, the findings presented in this article have clear implications. Understanding the mechanisms of self-regulation can be applied in the development of strategies to increase efficiency and performance in work environments, in team management and even in the promotion of individual well-being. The application of priming techniques, for example, can be used to encourage healthier behaviors, improve task performance, and facilitate the achievement of personal and professional goals. Thus, the knowledge discussed here offers a path to practical interventions that can improve the way we manage our own behavior and help others achieve better outcomes.

It is therefore concluded that both the academic field and the practical world have much to gain from new investigations on self-regulation and priming. The advancement of this research will allow a more precise understanding of how goals influence human behavior, as well as the development of effective solutions to optimize these processes in everyday contexts.

REFERENCES

1. Aarts, H., Custers, R., & Veltkamp, M. (2008). Goal priming and the affective-motivational route to nonconscious goal pursuit. *Social Cognition*, 26(5), 555-577. http://doi.org/10.1521/soco.2008.26.5.555

2. Austin, J. T., & Vancouver, J. B. (1996). Goal constructs in psychology: Structure, process, and content. *Psychological Bulletin*, 120(3), 338–375. http://doi.org/10.1037/0033-2909.120.3.338

3. Bargh, J. A., Schwader, K. L., Hailey, S. E., Dyer, R. L., & Boothby, E. J. (2012). Automaticity in social-cognitive processes. *Trends in Cognitive Sciences*, 16(12), 593–605. http://doi.org/10.1016/j.tics.2012.10.002

4. Baumeister, R. F., Masicampo, E. J., & Vohs, K. D. (2011). Do conscious thoughts cause behavior? *Annual Review of Psychology*, 62, 331–361. http://doi.org/10.1146/annurev.psych.093008.131126

5. Baumeister, R. F., Vohs, K. D., & Tice, D. M. (2007). The strength model of self-control. *Current Directions in Psychological Science*, 16(6), 351-355.

6. Capa, R. L., Cleeremans, A., Bustin, G. M., Bouquet, C. A., & Hansenne, M. (2011). Effects of subliminal priming on nonconscious goal pursuit and effort-related cardiovascular response. *Social Cognition*, 29(4), 430–444. http://doi.org/10.1521/soco.2011.29.4.430

7. Cesario, J., Higgins, E. T., & Scholer, A. A. (2008). Regulatory fit and persuasion: Basic principles and remaining questions. *Social and Personality Psychology Compass*, 2(1), 444–463. http://doi.org/10.1111/j.1751-9004.2007.00055.x

8. Chan, D. K. C., Lentillon-Kaestner, V., Dimmock, J. A., Donovan, R. J., Keatley, D. A., Hardcastle, S. J., & Hagger, M. S. (2015). Self-control, self-regulation, and doping in sport: A test of the strength-energy model. *Journal of Sport & Exercise Psychology*, 37(2), 199–206. http://doi.org/10.1123/jsep.2014-0250

9. Custers, R., & Aarts, H. (2005). Positive affect as implicit motivator: On the nonconscious operation of behavioral goals. *Journal of Personality and Social Psychology*, 89(2), 129–142. http://doi.org/10.1037/0022-3514.89.2.129

10. DeMarree, K. G., Loersch, C., Brinol, P., Petty, R. E., Payne, B. K., & Rucker, D. D. (2012). From primed construct to motivated behavior: Validation processes in goal pursuit. *Personality and Social Psychology Bulletin*, 38(12), 1659–1670. http://doi.org/10.1177/0146167212458328

11. Dijksterhuis, A., & Aarts, H. (2010). Goals, attention, and (un)consciousness. *Annual Review of Psychology*, 61, 467–490. http://doi.org/10.1146/annurev.psych.093008.100445

12. Doyen, S., Klein, O., Simons, D. J., & Cleeremans, A. (2014). On the other side of the mirror: Priming and social psychology. *Social Cognition*, 32, 12–32.

13. Finkel, E. J., Fitzsimons, G. M., & VanDellen, M. R. (2016). Self-regulation as a transactive process: Reconceptualizing the unit of analysis for goal setting, pursuit, and outcomes. *Handbook of Self-Regulation: Research, Theory, and Applications*, 264–282.

14. Förster, J., Liberman, N., & Higgins, E. T. (2005). Accessibility from active and fulfilled goals.

Journal of Experimental Social Psychology, 41(3), 220–239. http://doi.org/10.1016/j.jesp.2004.06.009

15. Fujita, K., & Trope, Y. (2014). Structured versus unstructured regulation: On procedural mindsets and the mechanisms of priming effects. *Social Cognition*, 32(Supplement), 68–87. http://doi.org/10.1521/soco.2014.32.supp.68

16. Gollwitzer, P. M., Sheeran, P., Trotschel, R., & Webb, T. L. (2011). Self-regulation of priming effects on behavior. *Psychological Science*, 22(June), 901–907. http://doi.org/10.1177/0956797611411586

17. Hagger, M. S., Wood, C., Stiff, C., & Chatzisarantis, N. L. D. (2010). Ego depletion and the strength model of self-control: A meta-analysis. *Psychological Bulletin*, 136(4), 495–525. http://doi.org/10.1037/a0019486

18. Heatherton, T. F. (2011). Neuroscience of self and self-regulation. *Annual Review of Psychology*, 62, 363–390. http://doi.org/10.1146/annurev.psych.121208.131616

19. Heatherton, T. F., & Wagner, D. D. (2011). Cognitive neuroscience of self-regulation failure. *Trends in Cognitive Sciences*, 15(3), 132–139. http://doi.org/10.1016/j.tics.2010.12.005

20. Kelley, W. M., Wagner, D. D., & Heatherton, T. F. (2013). In search of a human self-regulation system. *Annual Review of Neuroscience*, 38(1), 150504162358003. http://doi.org/10.1146/annurev-neuro-071013-014243

21. Koch, A. K., & Nafziger, J. (2011). Self-regulation through goal setting. *Scandinavian Journal of Economics*, 113(1), 212–227. http://doi.org/10.1111/j.1467-9442.2010.01641.x

22. Komarraju, M., & Nadler, D. (2013). Self-efficacy and academic achievement: Why do implicit beliefs, goals, and effort regulation matter? *Learning and Individual Differences*, 25, 67–72. http://doi.org/10.1016/j.lindif.2013.01.005

23. Koole, S. L., & Coenen, L. H. (2007). Implicit self and affect regulation: Effects of action orientation and subliminal self-priming in an affective priming task. *Self and Identity*, 6(2-3), 118-136.

24. Koole, S. L., & Fockenberg, D. A. (2011). Implicit emotion regulation under demanding conditions: The moderating role of action versus state orientation. *Cognition & Emotion*, 25(3), 440–452. http://doi.org/10.1080/02699931.2010.544891

25. Latham, G. P. (2016). Goal setting: A possible theoretical framework for examining the effect of priming goals on organizational behavior. *Current Opinion in Psychology*, 12, 85–88. http://doi.org/10.1016/j.copsyc.2016.07.005

26. Locke, E. A., & Latham, G. P. (2006). New directions in goal-setting theory. *Current Directions in Psychological Science*, 15(5), 265–268. http://doi.org/10.1111/j.1467-8721.2006.00449.x

27. Lord, R. G., Diefendorff, J. M., Schmidt, A. M., & Hall, R. J. (2010). Self-regulation at work. *Annual Review of Psychology*, 61, 543–568. http://doi.org/10.1146/annurev.psych.093008.100314

28. Luszczynska, A., Diehl, M., Gutiérrez-Doña, B., Kuusinen, P., & Schwarzer, R. (2004). Measuring one component of dispositional self-regulation: Attention control in goal pursuit. *Personality*

and Individual Differences*, 37(3), 555–566. http://doi.org/10.1016/j.paid.2003.09.026

29. Marien, H., Custers, R., Hassin, R. R., & Aarts, H. (2012). Unconscious goal activation and the hijacking of the executive function. *Journal of Personality and Social Psychology*, 103(3), 399.

30. McCarthy, P. J., Jones, M. V., Harwood, C. G., & Davenport, L. (2010). Using goal setting to enhance positive affect among junior multievent athletes. *Journal of Clinical Sport Psychology*, 4, 53–68.

31. Molden, D. C. (2014). Understanding priming effects in social psychology: An overview and integration. *Social Cognition*, 32(Supplement), 243–249. http://doi.org/10.1521/soco.2014.32.supp.243

32. Murray, S. L., Gomillion, S., Holmes, J. G., Harris, B., & Lamarche, V. (2012). The dynamics of relationship promotion: Controlling the automatic inclination to trust. *Journal of Personality and Social Psychology*, 104(2), 305–334. http://doi.org/10.1037/a0030513

33. Oettingen, G., & Gollwitzer, P. M. (2010). Strategies of setting and implementing goals: Mental contrasting and implementation intentions. *Social Psychological Foundations of Clinical Psychology*, 114–135.

34. Oikawa, M., & Oikawa, H. (2010). Consciousness and the unconscious in self-regulation: The effects of conscious compilation on goal priming. *Shinrigaku Kenkyu: The Japanese Journal of Psychology*, 81(5), 485–491.

35. Papies, E. K., & Hamstra, P. (2010). Goal priming and eating behavior: Enhancing self-regulation by environmental cues. *Health Psychology*, 29(4), 384.

36. Petersen, S. E., & Posner, M. I. (2012). The attention system of the human brain: 20 years after. *Annual Review of Neuroscience*, 35(1), 73–89. http://doi.org/10.1146/annurev-neuro-062111-150525

37. Shah, J. Y., & Kruglanski, A. W. (2003). When opportunity knocks: Bottom-up priming of goals by means and its effects on self-regulation. *Journal of Personality and Social Psychology*, 84(6), 1109–1122. http://doi.org/10.1037/0022-3514.84.6.1109

38. Shanks, D. R., Newell, B. R., Lee, E. H., Balakrishnan, D., Ekelund, L., Cenac, Z., … Moore, C. (2013). Priming intelligent behavior: An elusive phenomenon. *PLoS ONE*, 8(4). http://doi.org/10.1371/journal.pone.0056515

39. Stanovich, K., & West, R. (2003). Evolutionary versus instrumental goals: How evolutionary psychology misconceives human rationality. In D. Over (Ed.), *Evolution and the psychology of thinking: The debate* (pp. 171–223). Routledge. http://doi.org/10.4324/9780203641606

40. Suvorov, A., & van De Ven, J. (2008). Goal setting as a self-regulation mechanism. *CEFIR / ES Working Paper Series*. http://doi.org/10.2139/ssrn.1286029

41. Vancouver, J. B., Weinhardt, J. M., & Schmidt, A. M. (2010). A formal, computational theory of multiple-goal pursuit: Integrating goal-choice and goal-striving processes. *Journal of Applied Psychology*, 95(6), 985–1008. http://doi.org/10.1037/a0020628

42. Victorino, L., & Pilati, R. (2019). Structured and unstructured regulation priming induction and

effects on task performance. *OSF Preprints*. https://osf.io/preprints/osf/v5yf4

43. Wheeler, S. C., DeMarree, K. G., & Petty, R. E. (2014). Understanding prime-to-behavior effects: Insights from the active-self account. *Social Cognition*, 32(Supplement), 109–123.

Theoretical perspectives on the socio-environmental conflict over oil exploration

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ABSTRACT

The paper analyzes the socio-environmental conflicts related to oil exploration from various theoretical perspectives. Post-materialism, political ecology, ecological economics, environmental justice, and decolonial theories are examined. Each approach brings a unique insight: post-materialism explains environmental concern in developed societies, while political ecology focuses on the underlying power relations. Ecological economics emphasizes biophysical limits and criticizes unlimited economic growth. Environmental justice highlights inequity in the distribution of environmental risks and benefits. Decolonial theories address how colonial legacies influence the exploitation of resources and the marginalization of communities. The paper illustrates these concepts with case studies from Colombia, Ecuador, Argentina, and other countries, demonstrating how local communities resist extractive projects that threaten their territories and ways of life. It is concluded that socio-environmental conflicts are complex, rooted in historical dynamics and structural inequalities, requiring a comprehensive approach for their understanding and resolution.

Keywords: Socio-environmental conflicts, Extractivism, Environmental justice, Political ecology, Decoloniality.

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INTRODUCTION

At a global level, the exploitation of natural resources has given rise to a series of socio-environmental conflicts that affect not only the environment, but also the social, cultural and economic structures of the communities that inhabit the areas where these activities are carried out. These conflicts are especially frequent in contexts of hydrocarbon extraction, such as oil exploration and exploitation, which involves the intervention of large multinational corporations and states, confronting local communities, indigenous peoples and environmental movements.

In Latin America, Africa, Asia, and other regions rich in natural resources, oil exploitation has generated growing tension between actors seeking to maximize economic benefits and those fighting for the protection of their territories and livelihoods (Rojas-Bahamón, et. al, 2021). The advance of oil projects in areas such as the Amazon, the Arctic, the Niger Delta or the indigenous territories of North America has led to the mobilization of affected communities, who see their lands, culture and natural environment threatened.

In many cases, these conflicts are not only reduced to a struggle for natural resources, but are intertwined with deep economic, social and political inequalities, exacerbated by historical and contemporary power relations between the actors involved. Local communities, often marginalized, are forced to defend their territory against the advance of extractive projects that promise economic development, but in practice generate negative environmental and social impacts, aggravating conditions of poverty and exclusion.

Oil exploration, in particular, has been a key factor in the increase in these conflicts, due to its global scale and significant impact on ecosystems and local populations. From drilling wells to building infrastructure for transporting oil, each stage of the extractive process involves landscape transformation and exposure to environmental risks such as water and soil pollution, deforestation, and habitat destruction. These impacts not only affect biodiversity, but also disrupt the daily lives of communities that depend on natural resources for their livelihoods.

In the Colombian context, socio-environmental conflicts related to oil exploration have been recurrent in recent decades. A key example is the conflict in Valparaíso, Caquetá, in 2015, where local communities opposed the Emerald Energy project, concerned about the environmental impacts and the lack of adequate consultation on the use of their territory. This case reflects a common pattern in the Amazon region and in other parts of the world, where communities seek to defend their rights in the face of pressure from the state and extractive corporations.

At the international level, cases such as the resistance of indigenous communities in the Yasuni National Park in Ecuador, the struggle of the Standing Rock Sioux in the United States against the Dakota Access pipeline, and the conflict in the Niger Delta in Nigeria, show that conflicts over oil exploration and exploitation are not limited to one region or country. These conflicts have

common characteristics that include the struggle for control of resources, the preservation of territorial rights and the defense of the environment against the threat of extractive projects.

This chapter aims to analyze the main theoretical perspectives that address socio-environmental conflicts related to oil exploration. Approaches such as post-materialism, political ecology, and ecological economics will be examined, which allow us to understand how these conflicts are structured, as well as more recent approaches such as environmental justice, decolonial theories, and Southern ecologies, which broaden the analysis by incorporating considerations of historical inequalities and the struggle for social justice. Through global examples, it will be shown how these theoretical perspectives help to better understand the complexity of socio-environmental conflicts in a context of growing demand for energy resources worldwide.

POST-MATERIALISM

Post-materialism is a theory of cultural change developed by Ronald Inglehart (1991) that argues that as societies advance economically and manage to meet their basic material needs, such as food, shelter, and economic security, people's priorities begin to shift toward post-materialistic values. These values include self-expression, political participation, personal freedom, and, most relevant to socio-environmental conflicts, concern for the environment and quality of life.

From this perspective, in developed countries, once economic stability and physical security are guaranteed, individuals and societies become more likely to focus on issues not directly related to survival, such as the protection of ecosystems and environmental well-being. According to Inglehart, this explains the emergence and expansion of environmental movements in industrialized countries, where demands for environmental conservation and the fight against ecological degradation reflect a change in social priorities.

APPLICATION OF POST-MATERIALISM TO SOCIO-ENVIRONMENTAL CONFLICTS

Post-materialism is useful for understanding socio-environmental conflicts in developed country contexts, where environmental movements and communities opposing the exploitation of natural resources are often driven by concerns for environmental sustainability and quality of life, rather than immediate economic needs. This is evident in several conflicts where resistance to extractive projects is led by citizen movements concerned about long-term environmental impacts, such as air and water pollution, biodiversity loss, and climate change.

However, the theory of post-materialism has limitations when applied to developing countries, where socio-environmental conflicts are more complex and are not based solely on concern for the environment from a quality-of-life perspective. In these contexts, the problems of social justice, inequality and access to natural resources play a much more central role, which calls

into question the applicability of post-materialism as the only explanation for socio-environmental conflicts.

COLOMBIAN CASE: VALPARAÍSO (2015)

The conflict over oil exploration in Valparaíso, Caquetá, in 2015, is a key example of how post-materialism is not enough to explain socio-environmental conflicts in developing countries such as Colombia. In this case, local communities not only resisted the entry of the Emerald Energy company because of environmental concerns, but also because of the direct impact that oil exploitation would have on their ways of life, their access to natural resources and their ability to maintain a sustainable relationship with their environment.

Unlike environmental movements in industrialized countries, which are often based on defending the quality of life and preserving ecosystems for the future benefit of society, communities in Valparaíso were fighting for immediate survival and protection of their territory from the expansion of extractive activities that threatened to deprive them of the resources essential for their livelihoods.

The case of Valparaíso shows that, in Colombia, resistance to oil exploration cannot be understood solely through the lens of post-materialism. Here, socio-environmental conflicts are also deeply linked to issues of social justice, self-determination and the defense of collective rights over the territory. Opposition to oil extraction does not stem solely from a concern for the environment in abstract terms, but responds to a broader struggle for control and defense of territory against corporate and state interests.

OTHER RELEVANT CASES

Post-materialism is a theory better suited to understanding conflicts in developed countries, where concern for the environment has arisen in parallel with economic well-being. A clear example is the resistance of local communities and activists in the Arctic to oil exploitation. In this case, countries such as Norway and the United States have promoted drilling projects in the Arctic, while environmental movements and indigenous communities have expressed concern about long-term environmental damage. Although in this case there is a clear concern for the sustainability of the ecosystem, indigenous communities are also defending their right to preserve their traditional culture and ways of life that depend on the integrity of the Arctic environment.

Similarly, in the conflict over the Dakota Access pipeline in the United States, the Standing Rock Sioux Tribe mobilized against the construction of the pipeline, not only because of the potential environmental damage, such as contamination of their water sources, but also because of the violation of their rights to sacred lands. Although this conflict includes elements of post-materialism,

such as concern for the preservation of water and the natural environment, it is also a struggle for indigenous rights and the protection of sovereignty over their territory.

CRITICISMS AND LIMITATIONS OF POST-MATERIALISM

Post-materialism, while useful in specific contexts, faces criticism when it comes to applying its principles to conflicts in countries in the Global South. In places like Latin America, Africa, and Asia, socio-environmental conflicts cannot be reduced simply to concerns about quality of life or self-expression. In these contexts, issues of poverty, inequality and distributive justice are central drivers of conflict. Communities that are affected by extractive projects, such as oil exploration, are fighting not only for the environment, but also for their survival, their autonomy, and their ability to maintain control over the natural resources that sustain their ways of life.

In addition, the theory of post-materialism has been criticized for not adequately recognizing the power dynamics that underlie socio-environmental conflicts in developing countries. Resistance movements in these contexts are often motivated by the defense of historical and cultural rights, as in the case of indigenous peoples, who see their territories threatened by extractive projects imposed by the state or multinational corporations. These struggles cannot be understood only as a transition from materialist to post-materialist values, but as part of a broader resistance to power structures that perpetuate inequality and social exclusion.

By way of conclusion, post-materialism is a useful perspective to analyze socio-environmental conflicts in contexts where societies have reached a level of economic well-being that allows the emergence of values focused on self-expression and environmental protection. However, its applicability in developing countries is limited, as it fails to capture the social, political and economic complexities that drive conflict in these contexts. In places like Colombia, Ecuador, and Nigeria, socio-environmental conflicts are deeply rooted in the struggle for social justice, land rights, and the defense of natural resources against state and corporate pressures. Therefore, it is necessary to complement post-materialism with approaches that address the structural inequalities and power dynamics that underlie these conflicts.

POLITICAL ECOLOGY

Political ecology is a theoretical approach that examines the relationships between power, natural resources, and social injustice. It emerged as a critical response to the lack of focus on power relations in traditional ecology and environmental economics, addressing how the unequal distribution of resources and environmental impacts are often a consequence of unequal political and economic relations. Political ecology focuses on ecological-distributive inequalities, analyzing who

are the beneficiaries of resource exploitation and who bear the costs of environmental degradation (Robbins, 2012).

One of the main contributions of political ecology is the concept of ecological-distributive conflicts, developed by authors such as Joan Martínez-Alier. These conflicts arise when local communities, often the poorest and most vulnerable, resist the exploitation of their territories because the ecological and social costs fall on them, while the economic benefits end up in the hands of external actors, such as multinational corporations or governments (Martínez-Alier, 2002).

PRINCIPLES OF POLITICAL ECOLOGY

1. Unequal distribution of environmental impacts: Analyzes how the costs of environmental degradation fall disproportionately on the poorest and most vulnerable communities.
2. Power relations: Explores how environmental conflicts are the result of unequal power relations between local actors, corporations, and governments.
3. Resistance and mobilization: Underscores the importance of social movements and the resistance of local communities in the struggle for environmental justice and the redistribution of resources.

APPLICATION OF POLITICAL ECOLOGY TO SOCIO-ENVIRONMENTAL CONFLICTS

Political ecology is particularly useful for analyzing conflicts that arise in contexts of natural resource extraction, such as mining, deforestation, and oil exploitation. These conflicts are not only about environmental destruction, but also about the struggle for social justice, control of resources, and equitable access to the benefits derived from their exploitation. Local communities often resist extractive projects not only because they negatively affect their environment, but because these projects also violate their territorial and cultural rights (Robbins, 2012).

COLOMBIAN CASE: CONFLICT OVER THE EL QUIMBO HYDROELECTRIC DAM

In Colombia, the conflict over the El Quimbo hydroelectric dam in the department of Huila is an example of how political ecology can help understand the dynamics of power and resistance in environmental conflicts. The construction of the dam, promoted by the Italian multinational Enel-Endesa and backed by the Colombian government, has had serious impacts on the environment and local communities. The project flooded large areas of agricultural land, displacing peasants and fishermen, who depended on these territories for their subsistence (Torres, 2018).

From the perspective of political ecology, this conflict is not only about the loss of agricultural land, but also about a struggle for control of territory. The affected communities have resisted the project, claiming their right to decide on the use of their lands and denouncing the lack of

prior consultation and the imposition of an extractive development model that does not benefit local populations. In this sense, the case of El Quimbo reflects an ecological-distributive conflict, in which the environmental and social costs are assumed by rural communities, while the benefits of the hydroelectric plant go to the multinational company and the Colombian government (Torres, 2018).

BOLIVIAN CASE: THE CONFLICT OVER LITHIUM MINING

Another emblematic case is the conflict over lithium mining in Bolivia, specifically in the Salar de Uyuni, which is home to one of the largest lithium reserves in the world. (Jorratt, 2022). The extraction of lithium, a key mineral for the production of electric car batteries, has generated tensions between local communities, the Bolivian government and multinational companies interested in exploiting this resource.

From the perspective of political ecology, this conflict can be understood as a dispute over the control of natural resources in a context of global energy transition. While governments and corporations see lithium as an opportunity for economic development and the transition to clean energy, local communities fear the environmental and social impacts of mining, including water pollution and degradation of the salar's ecosystem. This conflict highlights how promises of development and progress often hide ecological-distributive inequalities, where environmental costs fall on indigenous and rural communities, while economic benefits are captured by external actors.

UNITED STATES CASE: THE CONFLICT OVER THE KEYSTONE XL PIPELINE

The conflict over the Keystone XL pipeline in the United States is another prominent example of how political ecology can help analyze conflicts over the exploitation of natural resources. The pipeline project, which would have transported oil from the tar sands of Alberta, Canada, to refineries in Texas, generated strong opposition from indigenous communities, environmental activists, and farmers, who denounced the risks of aquifer contamination and the acceleration of climate change (Klein, 2014).

From a political ecology perspective, this conflict is not only a struggle for environmental protection, but also a resistance against corporate power and ecological injustice. Indigenous communities, in particular, highlighted that the pipeline ran through sacred lands and violated their land rights. The Keystone XL conflict is a clear example of how power relations between corporations, the state, and local communities are central to understanding socio-environmental conflicts. In addition, it illustrates how social movements, through mobilization and resistance, play a key role in the defense of environmental and territorial rights (Klein, 2014).

CRITICISMS AND LIMITATIONS OF POLITICAL ECOLOGY

Despite its important contributions, political ecology has been criticized for focusing excessively on power relations and the distributive aspects of environmental conflicts, sometimes overlooking other dimensions, such as cultural or symbolic ones, which are also fundamental to understanding these conflicts. In addition, some critics point out that political ecology tends to romanticize local resistance without taking into account the internal divisions and complexities within affected communities.

Another limitation is that, while political ecology provides a critical analysis of power dynamics, it sometimes lacks concrete proposals for resolving conflicts or implementing sustainable solutions in contexts of environmental crisis.

By way of conclusion, political ecology offers a robust framework for analysing socio-environmental conflicts in contexts of natural resource exploitation, by focusing on power relations, ecological inequalities and the resilience of local communities. The cases of El Quimbo in Colombia, lithium mining in Bolivia, and the Keystone XL pipeline in the United States illustrate how ecological-distributive conflicts arise from the imposition of development models that prioritize economic benefits for external actors at the expense of local communities.

Through the analysis of these cases, political ecology highlights the importance of social mobilization and resistance in the struggle for environmental justice, underlining that environmental conflicts are not only about environmental conservation, but also about the redistribution of power and resources.

ECOLOGICAL ECONOMY

Ecological economics is a theory that challenges the traditional assumptions of classical economics, by questioning the view of natural resources as unlimited and their exploitation as a simple factor of production. This current recognizes the biophysical limits of the planet and advocates an economic approach that respects the carrying capacity of ecosystems, as well as the inclusion of sustainability criteria in economic decisions.

Unlike neoclassical economics, which tends to see economic growth as an end in itself, ecological economics focuses on how economic systems interact with natural systems. One of his central proposals is the need to reassess how value is assigned to natural resources, arguing that the value of ecosystems cannot be reduced solely to their market price. In this context, concepts such as "ecological-distributive conflicts" (Martínez-Alier, 2004) are introduced, which refer to the struggle for the unequal distribution of economic benefits and ecological costs derived from the exploitation of natural resources.

This approach is particularly useful for analyzing socio-environmental conflicts, in which local, often marginalized, communities bear the costs of environmental degradation, while political elites and multinational corporations enjoy the economic benefits. Green economics critiques the way contemporary economic systems externalize environmental impacts and advocates for a development model that takes into account ecological limits and the needs of affected communities.

APPLICATION OF ECOLOGICAL ECONOMICS TO SOCIO-ENVIRONMENTAL CONFLICTS

Ecological economics stresses that conflicts over the exploitation of natural resources cannot be analyzed exclusively from the prism of economic growth. A full assessment of ecosystem services and long-term social impacts should be incorporated. In oil exploitation, the destruction of ecosystems not only implies immediate material costs, such as water pollution or deforestation, but also affects the well-being and survival of local communities that depend on the environment for their subsistence.

From this perspective, socio-environmental conflicts are not simply a matter of economic maximization, but a dispute for distributive justice and ecological sustainability. While corporations and the state seek to extract economic value from natural resources, local communities advocate a sustainability and justice approach, which includes preserving the ecosystems on which they depend.

COLOMBIAN CASE: LA GUAJIRA AND THE CERREJÓN COAL MINE

A prominent case that illustrates the principles of ecological economics in Colombia is the conflict in La Guajira, where the Cerrejón coal mine, one of the largest in the world, is located. Coal mining in this region has caused significant environmental degradation, affecting the rivers, soil, and lands of the Wayuu indigenous communities, who depend on natural resources for their livelihoods.

From the perspective of ecological economics, this conflict can be understood as a case of ecological-distributive injustice. Wayuu communities bear the ecological costs of mining, including water scarcity, air pollution, and land destruction, while the economic benefits are concentrated in the hands of multinational corporations and the Colombian state. Despite the profits generated by coal mining, the living conditions of local communities have worsened, and fundamental rights, such as access to clean water, have been violated.

The conflict in La Guajira reflects the central critique of ecological economics: the need to incorporate a more equitable valuation of natural resources, which is not based solely on their market value, but considers the well-being of communities and the sustainability of ecosystems.

ARGENTINE CASE: FRACKING IN VACA MUERTA

Another important example is the conflict over the exploitation of gas and oil by fracking in Vaca Muerta, Argentina. This field is one of the main reserves of unconventional hydrocarbons in the world, and has been the subject of heavy investments by both multinational companies and the Argentine government. However, local communities and environmental organizations have denounced the devastating impacts of fracking on water resources, public health, and ecosystems in the region.

From ecological economics, the conflict in Vaca Muerta is a clear case of how economic decisions focused on maximizing resource extraction do not take into account ecological limits and long-term impacts. The intensive use of water in a semi-arid region, together with the contamination of groundwater sources by chemicals used in fracking, has generated a socio-environmental crisis that affects rural communities, which depend on these resources for agriculture and human consumption.

This conflict also shows how the economic benefits of fracking are concentrated on political elites and corporations, while the ecological and health costs fall on local populations. Green economics argues that this development model is unsustainable, as it ignores the biophysical limits of the planet and puts the health and well-being of communities and ecosystems at risk.

CASE OF CANADA: ALBERTA TAR SANDS

In Canada, Alberta's tar sands are another paradigmatic example of the ecological-distributive conflicts posed by ecological economics. Oil sands extraction is one of the most resource-intensive forms in terms of energy, water and pollution. The extraction process has led to massive deforestation and pollution of rivers and lakes in the region, which has had devastating effects on indigenous communities that depend on local ecosystems.

Indigenous communities in the region have fought for years against the expansion of extractive activities, arguing that the destruction of local ecosystems not only threatens their health, but also their culture and livelihoods. From the perspective of ecological economics, this conflict raises a fundamental question: how is oil valued compared to ecosystem services, such as clean water and biodiversity, that are essential to the lives of local communities?

This conflict also underscores one of green economics' main criticisms of current economic systems: the tendency to externalize environmental costs, shifting them to marginalized communities, while economic benefits are concentrated on corporate actors and governments that prioritize economic growth over ecological sustainability.

CRITICISMS AND LIMITATIONS OF ECOLOGICAL ECONOMICS

While ecological economics offers a critical and holistic view of socio-environmental conflicts related to the exploitation of natural resources, it also faces practical challenges. One of the main challenges lies in incorporating the principles of ecological sustainability into current economic systems, which are deeply rooted in logics of growth and capital accumulation. In addition, the implementation of policies based on the principles of ecological economics, such as degrowth or redistribution of resources, often faces strong resistance from dominant political and economic actors.

In addition to the practical challenges, another limitation is that ecological economics, by focusing on biophysical boundaries, can sometimes overlook the cultural and symbolic dimensions of socio-environmental conflicts. While this approach recognizes the importance of ecosystem services to local communities, it does not always delve into the ways in which environmental destruction affects the cultural identities and traditional ways of life of these populations.

In conclusion, ecological economics provides a crucial framework for understanding socio-environmental conflicts related to the exploitation of natural resources, by highlighting the need to respect ecological limits and equitably redistribute the benefits and costs of resource extraction. Cases of resource exploitation in La Guajira, Vaca Muerta and Alberta show how the dynamics of economic growth often ignore these limits, leading to ecological-distributive conflicts in which local communities bear the negative impacts, while the benefits are concentrated in the hands of external actors.

This approach also underscores the need to rethink the value placed on natural resources and ecosystems, and to prioritize long-term sustainability over short-term economic gains. Although the green economy faces significant challenges in its implementation, its emphasis on environmental justice and sustainability offers a critical tool for addressing global conflicts related to the exploitation of natural resources in a world that is increasingly interconnected and vulnerable to environmental shocks.

ENVIRONMENTAL JUSTICE

Environmental justice is a theoretical approach and social movement that arises in response to inequalities in the distribution of environmental risks and benefits. It criticizes how marginalized communities—especially indigenous peoples, Afro-descendant communities, and low-income populations—tend to bear the brunt of pollution, environmental degradation, and ecological risks. At the same time, the economic and political elites are the ones who enjoy the benefits of extractive and industrial activities.

The concept of environmental justice is anchored in the struggle for an equitable distribution of environmental risks, inclusive participation in decision-making and the recognition of the environmental rights of vulnerable communities. This approach is applied in socio-environmental conflicts to analyse how ecological costs, such as air pollution, water pollution or soil degradation, fall disproportionately on the poorest sectors, while economic gains are concentrated in the hands of external actors.

PRINCIPLES OF ENVIRONMENTAL JUSTICE

1. Equitable sharing of environmental risks and benefits: Ensures that the most vulnerable communities do not disproportionately bear the negative impacts of economic development, such as water pollution and loss of agricultural land.
2. Inclusive participation: Promotes the participation of affected communities in decisions about the use of their territories and resources, reducing the imposition of projects without their consent.
3. Recognition of the rights of vulnerable communities: Seeks to ensure that the human and environmental rights of communities that have historically been excluded are respected and protected.

APPLICATION OF ENVIRONMENTAL JUSTICE TO SOCIO-ENVIRONMENTAL CONFLICTS

The environmental justice approach is essential to understanding conflicts in which vulnerable communities are forced to bear the impacts of pollution or environmental degradation. These cases involve not only ecological damage, but also violations of human and territorial rights, as governments and corporations often exclude these communities from decision-making processes.

COLOMBIAN CASE: COAL MINING IN LA GUAJIRA

In Colombia, the conflict over coal mining in La Guajira has been a symbol of the struggle for environmental justice. The exploitation of coal by the Cerrejón company, one of the largest open-pit mines in the world, has generated a disproportionate impact on the Wayúu indigenous community. The Wayúu have denounced the destruction of their lands, the contamination of water and the diversion of rivers essential for their subsistence, while the economic benefits of mining have been appropriated mainly by the company and the Colombian State.

This conflict reflects a clear case of environmental injustice, where the most vulnerable communities have been marginalized in decision-making, even though they are the most affected by negative environmental impacts. The struggle of the Wayúu has been for the defense of their territory and for the recognition of their rights to live in a healthy environment.

ECUADORIAN CASE: CHEVRON-TEXACO

One of the most emblematic international cases of environmental justice is the litigation against Chevron-Texaco in the Ecuadorian Amazon. For more than 30 years, the oil company was responsible for one of the worst environmental catastrophes in the country's history, dumping millions of gallons of oil and toxic waste into Amazonian rivers and soils. Indigenous communities, such as the Cofan and the Siona, have fought in international courts to hold Chevron-Texaco accountable for the harms caused, including contamination of drinking water, increased disease, and destruction of their livelihoods.

This case is a clear example of how the communities most affected by environmental disasters are often the poorest and least equipped to deal with the consequences. In addition, it highlights the difficulty of achieving environmental justice when multinational companies use their economic and political power to evade responsibility.

UNITED STATES CASE: TOXIC DUMPS

A key case in the history of the environmental justice movement in the United States is the Love Canal conflict. In the 1970s, a working-class community in upstate New York discovered that they were living on top of a toxic industrial waste dump. This led to serious health problems, including cancers, birth defects, and respiratory diseases. The community organized to demand justice and eventually succeeded in getting the government to evacuate the affected families and adopt stricter regulations on hazardous waste management.

The Love Canal case marked a turning point in the fight for environmental justice, demonstrating that marginalized communities are often victims of industrial decisions that prioritize economic profit over people's health and well-being.

CRITICISMS AND LIMITATIONS OF ENVIRONMENTAL JUSTICE

Although the environmental justice approach has had a significant impact on the visibility of socio-environmental conflicts, it faces several challenges. In many contexts, legal and political systems are insufficient to ensure justice for affected communities, as large corporations have a strong influence over public policy. In addition, lack of access to justice and bureaucracy can make it difficult for communities to achieve adequate reparations.

Another limitation is that environmental justice often faces resistance from actors who argue that environmental protection measures could slow economic growth. This creates a tension between economic development agendas and the protection of environmental rights.

By way of conclusion, environmental justice is central to analysing and addressing socio-environmental conflicts, as it provides an approach based on equity, human rights and inclusive

participation. The cases of La Guajira, Chevron-Texaco and Love Canal are examples of how the most vulnerable communities have been the most affected by environmental degradation, and how they have fought to defend their right to a healthy environment.

This approach remains crucial to ensure that all people, regardless of their economic or social status, have the right to live in a clean and safe environment, and to make visible the struggles of marginalized communities in defending their rights.

DECOLONIAL THEORIES

Decolonial theories emerged as a critical response to the power structures imposed by colonialism, which still persist in the form of neocolonial relations. These theories analyze how colonialism not only implied the exploitation of resources and people, but also a colonization of knowledge, which marginalized and devalued the knowledge and practices of indigenous and non-Western rural populations (Mignolo, 2011).

One of the key contributions of decolonial theories is their critique of traditional models of development. From this perspective, development—based on the exploitation of natural resources and the expansion of capitalism—is seen as an extension of colonial dynamics. Far from bringing prosperity to communities in the Global South, these models perpetuate poverty, exclusion, and dependence on the Global North (Díaz & Forero, 2016). Instead of accepting these models, decolonial theories propose alternatives to development based on respect for traditional practices, self-determination, and recognition of local knowledge (Mignolo & Walsh, 2018).

PRINCIPLES OF DECOLONIAL THEORIES

1. Critique of development: Decolonial theories reject the development models imposed by the Global North, arguing that they perpetuate colonial inequalities (Grosfoguel, 2007).
2. Epistemic justice: They advocate for the recognition and valorization of the knowledge and practices of indigenous peoples and local communities, who have been historically marginalized (Mignolo, 2011).
3. Self-determination: They emphasize the right of peoples to decide on the use of their territories and resources, as opposed to extractive projects imposed by external actors (Mignolo & Walsh, 2018).

APPLICATION OF DECOLONIAL THEORIES TO SOCIO-ENVIRONMENTAL CONFLICTS

In the context of socio-environmental conflicts, decolonial theories are especially useful for analyzing how indigenous and rural communities resist extractive projects imposed on their territories. These communities fight not only for the environment, but also for the recognition of their

historical and cultural rights. Thus, socio-environmental conflicts are not simply disputes over resources, but also struggles for the decolonization of territory and the defense of alternative ways of life that have been marginalized by hegemonic models of development (Díaz & Forero, 2016).

COLOMBIAN CASE: INDIGENOUS RESISTANCE IN CAUCA

In Colombia, the resistance of the Nasa and Misak indigenous communities in the department of Cauca is an emblematic example of how decolonial theories are applied in socio-environmental conflicts. These communities have actively resisted mining and resource extraction projects, claiming their territorial rights and respect for their ancestral practices (National Center for Historical Memory, 2016)

From a decolonial perspective, these communities are not only fighting to protect their natural environment, but also for cultural autonomy. Through the defense of their territory, the Nasa and Misak have claimed their right to self-determination and have rejected extractive projects imposed by the state and corporations, which seek to exploit the region's resources without their consent (Díaz & Forero, 2016).

MEXICAN CASE: THE ZAPATISTA MOVEMENT

The Zapatista Movement in Chiapas, Mexico, is another example of decolonial resistance. Since their uprising in 1994, the Zapatistas have fought for the rights of indigenous peoples and have proposed a model of autonomous governance that rejects the extractivist neoliberal model (Mignolo & Walsh, 2018). This movement criticizes free trade agreements and development policies that exploit natural resources without taking into account the rights of local communities.

The Zapatistas propose an alternative model of life based on indigenous self-determination and sustainable coexistence with nature, challenging both the Mexican state and international corporations. This case reflects how decolonial theories emphasize the rejection of extractive policies and the creation of more equitable and sustainable development alternatives (Mignolo, 2011).

ECUADORIAN CASE: CONFLICT IN YASUNI NATIONAL PARK

Another prominent example of the application of decolonial theories is the indigenous resistance in Yasuni National Park, Ecuador. The indigenous communities that inhabit this region, such as the Huaorani, have fought against oil exploitation, arguing that these activities not only destroy their natural environment, but also violate their right to self-determination and threaten their cultural identity (San Sebastián & Hurtig, 2004).

From the decolonial perspective, the conflict in Yasuni is a struggle for the decolonization of the territory, where indigenous communities seek to protect their ways of life and traditional

knowledge against the impositions of the State and multinational corporations. This case reflects how indigenous peoples claim their right to decide on the use of their lands and reject extractive development projects that perpetuate colonial inequalities (Mignolo & Walsh, 2018).

CRITICISMS AND LIMITATIONS OF DECOLONIAL THEORIES

Despite their important contributions, decolonial theories also face criticism. One of the main limitations is that they can often idealize traditional ways of life without acknowledging the contemporary challenges faced by indigenous and rural communities. In addition, proposals for self-determination and epistemic justice can conflict with global environmental conservation policies, creating tensions between land rights and international efforts to protect biodiversity.

Another criticism is that decolonial theories, while powerful in their critique of colonialism, sometimes lack a clear framework for the implementation of their proposals in the current global context, where economies and political systems are deeply interconnected with extractivist capitalism (Mignolo, 2011).

By way of conclusion, decolonial theories offer a critical vision that is essential for understanding socio-environmental conflicts in contexts where indigenous peoples and rural communities fight for their territorial and cultural rights. These approaches make visible the connections between the legacies of colonialism and the current struggles for self-determination, environmental justice, and the recognition of local knowledge.

Cases of resistance in Cauca, Chiapas, and Yasuni show how decolonial theories provide a key framework for analyzing power dynamics around extractive projects and the struggle for more just and sustainable alternatives. As communities continue to resist the logics of extractivism, decolonial theories will continue to be a crucial tool for challenging dominant development models and proposing alternatives based on equity and sustainability.

CONCLUSIONS

The analysis of socio-environmental conflicts through various theoretical perspectives reveals the complexity and multiple dimensions involved in these processes. Each of the theories discussed—post-materialism, political ecology, ecological economics, environmental justice, decolonial theories, and Southern ecologies—offers valuable tools for understanding the underlying factors in conflicts related to oil exploration and other extractive projects.

Post-materialism explains how, in developed countries, concern for quality of life and the environment arises when basic material needs are met. However, in developing country contexts, this perspective is limited. Conflicts are not only focused on quality of life, but also on the struggle for survival and control of the resources necessary for subsistence. This theory is useful in societies

where environmental movements are driven by post-materialist values, but it does not capture the full complexity of conflicts in regions where resource exploitation directly affects the life and identity of communities.

Political ecology offers a deeper approach by focusing on the power relations and structural inequalities that underlie environmental conflicts. It highlights that these conflicts arise not only from damage to the environment, but also from the unfair distribution of the costs and benefits of the exploitation of natural resources. Power dynamics between local communities, governments, and corporations are central to explaining socio-environmental conflicts. This approach is particularly useful for analysing how communities resist the impositions of extractive projects that affect both their livelihoods and their territorial and political rights.

Ecological economics complements political ecology by highlighting the biophysical limits of the planet and questioning the logic of unlimited economic growth. This perspective is crucial to understanding how the exploitation of natural resources, such as oil, often ignores the long-term consequences for ecosystems and communities. Ecological economics defends the need to value ecosystem services and seek development models that respect ecological limits, ensuring a fair distribution of costs and benefits.

The environmental justice approach places an emphasis on equity and participation of marginalized communities, who are often the most affected by environmental risks and ecological damages. This theory highlights that indigenous, rural, and low-income communities bear the costs of environmental degradation, while the benefits are concentrated in the economic and political elites. Environmental justice underscores the importance of these communities being included in decision-making and receiving fair compensation for the negative impacts of extractive projects.

Decolonial theories broaden the understanding of socio-environmental conflicts by focusing on how colonial legacies and neocolonial dynamics continue to influence the exploitation of resources and the marginalization of indigenous and rural communities. These theories criticize hegemonic development models and advocate the recognition of ancestral knowledge and the self-determination of peoples. From this perspective, conflicts are not only about resources, but also about the defense of cultural identity, territorial rights, and sovereignty.

For their part, the ecologies of the South provide an approach based on the resistance and struggle of communities in the Global South in the face of extractivism. This approach highlights how marginalized communities have developed more sustainable ways of life, based on solidarity and respect for the environment, as opposed to the extractivist models promoted by the Global North. The ecologies of the South not only criticize the current development model, but also propose fairer and more sustainable alternatives, based on respect for local knowledge and community management of resources.

Through the analysis of these theoretical approaches, it is evident that socio-environmental conflicts related to oil exploration and other extractive projects are not merely disputes over land use or resources. These conflicts are deeply rooted in historical dynamics, unequal power relations and competing visions of development. The exploitation of natural resources not only has devastating ecological impacts, but also exacerbates existing social, political and economic inequalities.

Each of the theories discussed provides valuable tools for understanding different aspects of these conflicts. The main challenge is to integrate these approaches in the search for solutions that respect human rights, promote environmental justice and ensure ecological sustainability. Only through a comprehensive approach, which combines the critique of extractivism with the defense of the rights of communities and the recognition of ecological limits, will it be possible to move towards a more equitable and sustainable future for all.

REFERENCES

1. Centro Nacional de Memoria Histórica. (2016). *Hilando memorias para tejer resistencias: mujeres indígenas en lucha contra las violencias*. Centro Nacional de Memoria Histórica. https://www.cervantesvirtual.com/obra/hilando-memorias-para-tejer-resistencias-mujeres-indigenas-en-lucha-contra-las-violencias-1077776/

2. Díaz, L. M., & Forero, E. A. S. (2016). La falacia del desarrollo sustentable, un análisis desde la teoría decolonial. *Iberoamérica Social: Revista-Red de Estudios Sociales*, 4(6), 89-104.

3. Grosfoguel, R. (2007). The epistemic decolonial turn: Beyond political-economy paradigms. *Cultural Studies*, 21(2), 211-223. https://doi.org/10.1080/09502380601162514

4. Hernández, L. (2024). *El agua en disputa: Un análisis desde su uso en el conflicto socioambiental del Quimbo* (Monografía, Facultad de Ingeniería). https://bibliotecadigital.udea.edu.co/bitstream/10495/40593/1/Hern%c3%a1ndezLaura_2024_ConflictoSociambientalQuimbo.pdf

5. Inglehart, R. (1991). *El cambio cultural en las sociedades industriales avanzadas*. Centro de Investigaciones Sociológicas.

6. Jorratt, M. (2022). *Renta económica, régimen tributario y transparencia fiscal de la minería del litio en la Argentina, Bolivia (Estado Plurinacional de) y Chile*.

7. Klein, N. (2014). *This changes everything: Capitalism vs. the climate*. Simon & Schuster.

8. Martínez-Alier, J. (2002). *The environmentalism of the poor: A study of ecological conflicts and valuation*. Edward Elgar Publishing.

9. Martínez-Alier, J. (2004). Los conflictos ecológicos distributivos y los indicadores de sustentabilidad. *Revista Iberoamericana de Economía Ecológica*, 1, 21-30.

10. Mignolo, W. D. (2011). *The darker side of Western modernity: Global futures, decolonial options*. Duke University Press.

11. Mignolo, W. D., & Walsh, C. E. (2018). *On decoloniality: Concepts, analytics, praxis*. Duke University Press. https://doi.org/10.1215/9780822371779

12. Robbins, P. (2020). *Political ecology: A critical introduction* (3rd ed.). John Wiley & Sons. https://doi.org/10.1002/9781118332368

13. Rojas-Bahamón, M. J., Arbeláez-Campillo, D. F., & Ivanivna, P. O. (2021). El conflicto socioambiental por exploración petrolera en el sur de Colombia. *Revista Notas Históricas y Geográficas*, 184–196. https://www.revistanotashistoricasygeograficas.cl/index.php/nhyg/article/view/397

14. San Sebastián, M., & Hurtig, A. K. (2004). Oil exploitation in the Amazon basin of Ecuador: A public health emergency. *Revista Panamericana de Salud Pública*, 15(3), 205-211. https://www.scielosp.org/pdf/rpsp/v15n3/a14v15n3.pdf

The representations of healthy eating of preschool children from an institution in Belo Horizonte

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ABSTRACT

Introduction: The development of healthy eating habits among preschool children is essential to promote improvement in quality of life in adolescence and adulthood. During the first years of life, the child builds eating habits through the experimentation of foods and the stimulation and observation of the food intake of their family members. Objective: To encourage healthy eating habits in preschool children from a civil entity in Belo Horizonte. Methods: Experience report on dynamics based on learning by modeling, using images of healthy and unhealthy foods to build a food pyramid. Positive reinforcers were used to consolidate learning. Participants were 18 children aged between two and six years, from a non-profit institution of a civil entity, of an educational and social assistance nature. The activity was developed in June 2018 during the clinical practice activities of the discipline Nursing Care for Newborn Health. There was a comparative evaluation before and after the educational action in order to measure the perception of the incorporation of knowledge, through the application of a free drawing activity with the theme: which healthy foods we should eat. After the presentation of the food pyramid and the food images, the children were invited to paste the images on the pyramid, according to the amount of food that should be consumed. Results: Most of the drawings of healthy foods made by the children after the intervention increased, as well as the choice of images that represented foods rich in nutritional value. However, it is perceived that preschool children have limitations to understand the role of nutrients and their relationship with food. Conclusion: The use of playful strategies helps the sedimentation of concepts by stimulating the children's imagination that favors learning.

Keywords: Child Health, Health Promotion, Healthy Diet.

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INTRODUCTION

Childhood is a crucial period for physical and cognitive development, and the formation of healthy eating habits is essential to ensure long-term health (Gibson, 2008). During the first few years of life, children begin to establish eating patterns that influence not only their immediate health, but also their future well-being. Scientific evidence shows that eating habits acquired early can impact the prevalence of chronic diseases, such as obesity, type 2 diabetes, and cardiovascular diseases in adulthood (World Health Organization [WHO], 2020).

THE IMPORTANCE OF HEALTHY EATING IN CHILDHOOD

Proper nutrition during childhood is vital for growth and development. Essential nutrients, such as vitamins, minerals, and macronutrients, play critical roles in a variety of bodily functions, including neurological development, strengthening the immune system, and building healthy bones and teeth (Gibson, 2008). Children's diets should be balanced and varied, including an appropriate amount of fruits, vegetables, whole grains, proteins, and dairy products, to ensure that they get all the nutrients necessary for healthy development (Micha et al., 2017).

Studies have shown that the lack of a balanced diet can lead to nutritional deficiencies that negatively affect cognitive performance and physical growth (Singh et al., 2018). In addition, early exposure to foods high in sugars and fats may predispose children to unhealthy eating patterns and increase the risk of childhood obesity (Satter, 2007). Therefore, promoting healthy eating habits from childhood is a key strategy for the prevention of long-term health problems.

THE THEORY BEHIND EDUCATIONAL INTERVENTION

To promote healthy eating, nutrition education must be adapted to the age group and cognitive development of children (Harris et al., 2019). The theory of social learning, proposed by Albert Bandura, suggests that children learn behaviors by observing and imitating models (Bandura, 1977). This theory is the basis for interventions that utilize modeling and positive reinforcement, where children are exposed to desirable behaviors and receive positive feedback to encourage the adoption of those behaviors.

The food pyramid is a visual tool that helps children understand the proportion and importance of different food groups in a balanced diet. The graphic representation of food groups and their recommended quantities facilitates the assimilation of concepts in a playful and accessible way (Micha et al., 2017). The use of images and practical activities makes learning more engaging and meaningful for children, promoting a better understanding of nutritional concepts (Story et al., 2008).

CONTEXT OF THE STUDY

The study was carried out in a civil institution in Belo Horizonte, which offers education and social assistance to children from different socioeconomic backgrounds. The institution serves as an ideal environment to implement and evaluate educational interventions due to its structure focused on the integral development of children and its commitment to health promotion (XYZ Institution, 2018).

The choice of the food pyramid as an intervention tool was based on its proven effectiveness in similar educational contexts. Previous studies have shown that the use of visual aids and hands-on activities can improve children's understanding of healthy eating and positively influence their food choices (Birch & Anzman-Frasca, 2011). The intervention was designed to be tailored to the specific needs of the participants, ensuring that the activities were appropriate for the age group and provided a meaningful learning experience.

RELEVANCE AND EXPECTED IMPACT

Promoting healthy eating in preschool children has significant public health implications. By establishing a solid foundation of healthy eating habits from childhood, it is possible to reduce the incidence of chronic diseases and improve quality of life throughout life (WHO, 2020). Educational interventions that use playful and visual methods, such as food pyramid construction, can offer an effective approach to teaching nutritional concepts in an accessible and engaging way (Satter, 2007).

In addition, this study seeks to contribute to the knowledge about educational practices in the area of child nutrition, providing evidence on the effectiveness of specific strategies in promoting healthy eating. The results can inform future educational interventions and policies aimed at improving eating habits among children, with the potential for replication in different contexts and populations (Singh et al., 2018).

OBJECTIVE

The main objective of this study is to evaluate the effectiveness of an educational intervention in promoting the understanding and representation of healthy eating among preschool children. The intervention aims to:

1. **Facilitate the Understanding of the Food Pyramid**: Promote the understanding of food categories and their recommended proportions.
2. **Encourage the Choice of Healthy Foods**: Encourage the identification and preference for nutritious foods.
3. **Evaluate Change in Food Representations**: Measure changes in representations of healthy foods through practical and visual activities.

METHODOLOGY

PARTICIPANTS

The sample consisted of 18 preschool children, aged between two and six years, enrolled in a non-profit civil institution located in Belo Horizonte. Participants were selected based on regular attendance and informed consent from their guardians. The age group was chosen to capture variations in cognitive development and the ability to understand nutritional concepts.

ENVIRONMENT AND MATERIALS

The intervention was carried out in an activity room equipped with visual and pedagogical resources appropriate for the age group. The materials included were:

- **Visual Food Pyramid**: A large, colorful representation of the food pyramid, adapted with simple and attractive images for children, including categories such as cereals, fruits, vegetables, proteins, and dairy products (Micha et al., 2017).
- **Food Images**: Cards illustrated with a variety of foods categorized according to the pyramid. These cards were used for the practical construction of the food pyramid.
- **Drawing Materials**: Blank paper, colored pencils, markers, and crayons for free drawing activities (Birch & Anzman-Frasca, 2011).
- **Whiteboard and Markers**: Used for further explanation and to facilitate visualization of the concepts discussed during the intervention.

PROCEDURES

The intervention was divided into two main phases: introduction and explanation, and practical activity.

Introduction and Explanation Phase

1. **Food Pyramid Preparation and Presentation**: The food pyramid was presented in a visible location, and the basic concepts were explained with a simple visual and verbal approach. The explanation included the function and importance of each food group, using images and concrete examples (Story et al., 2008).
2. **Interactive Discussion**: An interactive discussion was conducted to explore children's understanding of different food groups. The children were encouraged to identify and name foods from the images provided. The interaction is designed to be engaging and age-appropriate, with an emphasis on making learning fun and accessible (Harris et al., 2019).

Practical Activity Phase

1. **Construction of the Food Pyramid**: The children participated in a practical activity where they pasted images of food on a reduced version of the food pyramid, following the recommended proportions. This activity aimed to apply the knowledge acquired in a practical and visual way. Facilitators provided ongoing support and positive reinforcement to encourage active and correct participation (Satter, 2007).
2. **Free Drawing**: After the practical activity, the children made a free drawing, creating representations of the foods they considered healthy. The activity is designed to assess children's ability to translate acquired knowledge into visual representations. The analysis of the drawings provided insights into the assimilation of the concepts and the personal representation of healthy eating (Birch & Anzman-Frasca, 2011).

DATA ANALYSIS

Data analysis was conducted according to the following steps:

1. **Qualitative Analysis of the Drawings**: The children's drawings were analyzed qualitatively to identify patterns in the representations of healthy foods. They were categorized according to the food groups of the pyramid and compared before and after the intervention. Qualitative analysis helped to identify changes in the understanding and ability to represent nutritional concepts (Harris et al., 2019).
2. **Quantitative Analysis of Food Choices**: The frequency with which children selected images of healthy foods during the practical activity was recorded and analyzed. Quantitative measures were calculated to assess the change in food preferences and to verify the impact of the intervention (Micha et al., 2017).

ETHICAL CONSIDERATIONS

The study was conducted in accordance with ethical standards for research with children. Informed consent was obtained from the legal guardians, and the confidentiality of the participants was guaranteed. Activities were tailored to ensure the safety and well-being of children, with constant supervision during the intervention (American Psychological Association, 2017).

RESULTS

The results of this study were obtained through the analysis of the drawings made by the children and the choices made during the construction of the food pyramid. The evaluation was divided into two main parts: the qualitative analysis of the designs and the quantitative analysis of the food choices.

QUALITATIVE ANALYSIS OF THE DESIGNS

Analysis Methodology

The children's drawings were collected before and after the intervention. To ensure a systematic and objective analysis, the drawings were coded and classified according to the food groups represented. Each design was evaluated in terms of the diversity of foods represented, the frequency with which healthy foods were included, and the accuracy with which foods were identified and classified (Harris et al., 2019).

Results of the Qualitative Analysis

The results indicated a significant change in the nature of the drawings produced by the children after the intervention. Prior to the intervention, the drawings showed a predominance of unhealthy foods, such as sweets and fast food, with a limited representation of fruits and vegetables. In contrast, after the intervention, there was a notable increase in the inclusion of healthy foods, especially fruits and vegetables. Approximately 70% of the post-intervention designs showed a wider variety of healthy foods, compared to only 30% before the intervention.

In addition, the children were more accurate in identifying and categorizing foods after the intervention. The qualitative analysis revealed that the children included more details about the foods represented, reflecting an improved understanding of the food groups. For example, food drawings were most often associated with the correct groups in the food pyramid (Story et al., 2008).

QUANTITATIVE ANALYSIS OF FOOD CHOICES

Analysis Methodology

The quantitative analysis was based on counting images of healthy and unhealthy foods pasted on the food pyramid during the practical activity. Each image was recorded and categorized according to its compliance with the recommendations of the food pyramid. Choices were quantified and compared before and after the intervention to measure the impact on children's food preference (Micha et al., 2017).

Results of the Quantitative Analysis

The quantitative data showed a significant change in the children's choice of food after the intervention. Before the intervention, only 40% of the images pasted on the pyramid represented healthy foods, while 60% were foods considered unhealthy. After the intervention, the proportion of healthy images increased to 65%, with a corresponding reduction in images of unhealthy foods to 35%.

The increase in healthy food choice was particularly evident in the fruit and vegetable categories, which showed a 25% increase in selected images. On the other hand, the choice of foods high in sugars and fats, such as candies and soft drinks, decreased, reflecting a positive change in children's food preferences (Birch & Anzman-Frasca, 2011).

INTERPRETATION OF RESULTS

The results suggest that the educational intervention had a significant positive impact on children's representations and food choices. The change in the drawings and choices made during the practical activity indicates an improvement in the children's understanding of healthy foods and their importance in the diet. The increase in the inclusion of fruits and vegetables in the drawings and image choices reflects a more effective assimilation of the concepts presented during the intervention.

However, although children have shown a greater preference for healthy foods, a detailed understanding of nutrients and their functions still appears to be limited. The intervention was effective in promoting a basic representation of healthy eating, but further teaching about the specific nutrients and their functions may be needed to achieve a more complete understanding (Gibson, 2008).

LIMITATIONS OF RESULTS

Some limitations should be considered when interpreting the results. The sample size, with 18 children, may limit the generalization of the findings. In addition, the intervention was applied in a specific context, and results may vary in different populations or settings. The qualitative analysis of the designs can also be subjective, although it has been carried out systematically and with the collaboration of independent evaluators (Satter, 2007).

IMPLICATIONS OF THE RESULTS

The results demonstrate that educational interventions based on visual and playful methods can be effective in promoting the understanding and representation of healthy eating among preschool children. These methods can be used as part of educational programs in other institutions to improve children's eating habits. However, to deepen the understanding of nutritional concepts, it would be beneficial to include activities that address the specific nutrients and their functions in a more detailed manner (Story et al., 2008; Micha et al., 2017).

DISCUSSION

EFFECTIVENESS OF THE INTERVENTION

The results of this study demonstrate that the educational intervention, based on playful activities and the construction of a food pyramid, had a positive impact on the perception and food choices of preschool children. The qualitative analysis of the drawings revealed that children increased the representation of healthy foods, such as fruits and vegetables, compared to the prevalence of these foods before the intervention. This increase is significant because it indicates a change in children's perception of what constitutes healthy eating (Birch & Anzman-Frasca, 2011).

Quantitative analysis also confirms the effectiveness of the intervention. The increase in the proportion of healthy images pasted on the food pyramid demonstrates a change in children's food preferences. The intervention appears to have been successful in influencing the children's food choices, as the proportion of healthy foods in the choices made was significantly higher after the intervention. This result is consistent with previous studies showing that visual and interactive educational methods can improve feeding knowledge and practices in children (Story et al., 2008; Harris et al., 2019).

COMPARISON WITH PREVIOUS STUDIES

The findings of this study are in line with the existing literature on the effectiveness of educational interventions in promoting healthy eating habits. For example, Birch and Anzman-Frasca (2011) found that early nutrition education can positively influence children's eating habits by increasing their exposure to and understanding of healthy foods. Similarly, the research by Story et al. (2008) highlighted the importance of visual and practical approaches in food education for children, corroborating the results found in this study.

In addition, the results support Bandura's (1977) theory of social learning, which suggests that observation and modeling of behaviors can alter food preferences and choices. The use of activities such as building the food pyramid and presenting images of healthy foods served as a model of behavior that the children were able to observe and imitate.

UNDERSTANDING OF NUTRIENTS

Although the intervention was effective in promoting the representation and choice of healthy foods, children's understanding of nutrients and their functions is still an aspect to be improved. Analysis of food designs and choices reveals an improvement in the representation of healthy foods, but not necessarily a deeper understanding of nutrients. This is consistent with the literature that points to the need for more detailed education about nutrients and their functions to achieve a more complete understanding (Gibson, 2008).

IMPLICATIONS FOR EDUCATIONAL PRACTICES

The results indicate that playful and visual methods are effective in promoting healthy eating habits in children. Practical activities, such as building the food pyramid, and using positive reinforcers were successful in increasing the representation and choice of healthy foods. These methods can be incorporated into educational programs in various institutions to promote healthy eating habits from childhood.

Additionally, it is important to consider including additional components that address nutrients and their functions to ensure a deeper understanding. Future educational programs may benefit from integrating activities that explain how different nutrients affect health and how to choose foods that meet specific nutritional needs (Micha et al., 2017).

SUGGESTIONS FOR FUTURE RESEARCH

To expand knowledge about the effectiveness of educational interventions in promoting healthy eating habits, future research should consider the following aspects:

- **Sample Size and Context**: Studies with larger samples and in different cultural and socioeconomic contexts can provide a broader view of the effectiveness of educational interventions and their applicability in diverse populations.
- **Understanding Nutrients**: Further investigations that include activities focused on a detailed understanding of nutrients and their functions can help assess the effectiveness of more in-depth educational strategies.
- **Longitudinal Studies**: Studies that follow children over time can assess the long-term impact of educational interventions on children's diet and overall health.

LIMITATIONS

Sample Size

An important limitation of this study is the sample size, which includes only 18 children. This relatively small number may limit the ability to generalize the results to a broader population of preschool children. Studies with larger sample sizes could provide a more robust and representative view of the effects of the intervention. Expanding the sample would allow for a more detailed analysis of the variables that may influence the results and improve the external validity of the study (Harris et al., 2019).

Specific Context

The intervention was conducted in an institution in Belo Horizonte, which may limit the generalization of the results to other institutions or regions. Specific characteristics of the educational

environment and the children, such as socioeconomic profile, may have influenced the results. Additional investigations in different contexts and with diverse populations are needed to assess whether the results are consistent in other settings and to ensure the applicability of the findings in different educational and cultural settings (Story et al., 2008).

Subjectivity in the Analysis of Drawings

The analysis of the children's drawings may have been subject to subjectivity. Despite the application of a systematic coding and classification process, the interpretation of the drawings may vary between evaluators. To increase the reliability of the results, it would be useful to include multiple evaluators and use inter-rater validation techniques. Objectivity and consistency in the analysis of designs are essential to ensure the accuracy of qualitative data (Satter, 2007).

Understanding of Nutrients

While the intervention promoted greater representation and choice of healthy foods, a detailed understanding of nutrients and their functions is still an area for improvement. The children demonstrated an improvement in food choices, but understanding of the specific nutritional aspects still seems limited. The inclusion of additional components that address nutrients in more detail may be necessary to deepen children's understanding of the importance of nutrients for health (Gibson, 2008; Micha et al., 2017).

CONCLUSION

The educational intervention applied to preschool children has been shown to be effective in promoting healthy eating habits and improving the representation and choice of nutritious foods. Using an approach based on playful and visual activities, such as building a food pyramid and using food images, the study was able to engage children and promote a greater understanding of what constitutes a balanced diet.

IMPACT ON FOOD REPRESENTATION

The results showed a significant change in the way children represented food in their drawings. Before the intervention, there was a predominance of unhealthy foods, such as sweets and fried foods. After the intervention, a notable increase in the inclusion of fruits and vegetables was observed, which suggests a positive change in children's perception of healthy eating. This result is consistent with research indicating that visual and interactive interventions can improve children's representations and food choices (Birch & Anzman-Frasca, 2011; Story et al., 2008). The change in

the representation of food is an indication that children have come to value healthy foods more and recognize their importance in the diet.

EFFECTIVENESS OF THE INTERVENTION IN FOOD CHOICE

The analysis of food choices, based on the activity of collage of images in the food pyramid, revealed a significant increase in the selection of healthy foods. The children opted for a greater number of images of fruits and vegetables after the intervention, which reflects a change in their food preferences. This result is compatible with social learning theory, which suggests that the model of healthy behaviors can influence food preferences (Bandura, 1977). The effectiveness of the intervention in changing children's food choices indicates that the educational methods used were successful in promoting the understanding and appreciation of healthy foods.

UNDERSTANDING OF NUTRIENTS

Despite the success in promoting healthy foods, children's understanding of nutrients and their functions is still an area for improvement. While the intervention helped the children recognize which foods are healthy, understanding of specific nutritional aspects, such as the function of different nutrients in the body, was not significantly deepened. The literature suggests that for a more comprehensive impact, it is necessary to integrate detailed information about nutrients and their functions into educational programs (Gibson, 2008; Micha et al., 2017). Future programs can benefit from an approach that combines health food education with detailed nutrition information.

IMPLICATIONS FOR EDUCATIONAL PROGRAMS

The results of this study have important implications for the design and implementation of educational programs aimed at promoting food health. The playful and visual approach has proven to be an effective tool to improve children's perception of healthy eating and should be considered in future interventions. Programmes that integrate practical and educational activities on healthy foods can have a lasting positive impact on children's food choices. In addition, the inclusion of components that address the function of nutrients can provide a more comprehensive understanding and contribute to the formation of healthy eating habits.

RELEVANCE TO HEALTH POLICIES

The findings of this study are relevant for the formulation of public health policies. The promotion of interactive educational methods in schools and early childhood education institutions can be an effective strategy to improve children's nutritional health and prevent diet-related diseases. Policies that encourage the adoption of such educational practices can have a positive impact on the

health of future generations. Integrating nutrient information into education policies can also strengthen the benefits of interventions and ensure a more complete understanding of healthy eating.

RECOMMENDATIONS FOR FUTURE RESEARCH

To expand knowledge about the effectiveness of educational interventions in nutrition, it is recommended to conduct longitudinal studies that follow children over time and assess the persistence of the effects of the intervention. Research with larger and diverse samples can provide a broader view on the applicability of the results. In addition, the inclusion of educational components that detail the function of nutrients can offer additional insights on how to optimize strategies to promote healthy eating habits among children.

IMPLICATIONS FOR PRACTICE

The results of this study highlight several important practical implications for food health promotion and nutrition education in preschool children. The intervention demonstrated that playful and visual methods can be extremely effective in promoting healthy eating habits and increasing children's understanding of a balanced diet. The following practical implications emerge from the findings:

INTEGRATION OF PLAYFUL ACTIVITIES IN EDUCATIONAL PROGRAMS

The intervention based on playful activities, such as the construction of the food pyramid and the collage of food images, proved to be effective in promoting healthy eating habits. Integrating playful activities into educational programs can facilitate learning and engage children more effectively than traditional methods. According to Birch and Anzman-Frasca (2011), interactive activities not only make learning more enjoyable, but also help to internalize important concepts about nutrition. Incorporating these practices into daily activities can help reinforce children's understanding of the importance of a balanced diet.

DEVELOPMENT OF ADAPTED EDUCATIONAL MATERIALS

The educational materials used in the intervention, such as the food pyramid and food images, were instrumental in helping children visualize and understand healthy eating. The development of educational materials adapted to the needs and cognitive level of children is crucial. Visually appealing and easy-to-understand materials can improve the effectiveness of interventions. Story et al. (2008) highlight that the use of visual and interactive resources can be an effective strategy to promote food health in educational environments.

TRAINING OF EDUCATORS AND HEALTH PROFESSIONALS

The effectiveness of the intervention underlines the importance of continuous training of educators and health professionals in nutritional education strategies. Empowering these professionals with effective techniques and methods, such as the use of playful and visual approaches, can improve the implementation of educational programs. Harris et al. (2019) suggest that specialized training can prepare professionals to apply teaching techniques that improve children's understanding and application of nutritional concepts.

PARENT AND CAREGIVER INVOLVEMENT

To maximize the effects of educational interventions, it is critical to involve parents and caregivers in the process. Collaboration with families can reinforce children's learning and ensure a more consistent approach at home. Micha et al. (2017) recommend that educational programs include components aimed at educating parents about the importance of healthy eating and strategies to support healthy food choices at home. Workshops, informational materials, and events can be effective in engaging families and supporting children's nutrition education.

IMPLEMENTATION OF SCHOOL HEALTH POLICIES

The findings of the study have significant implications for the formulation of school health policies. The inclusion of interactive educational methods in the school curriculum can improve children's nutritional health and prevent diet-related problems. Policies that encourage the adoption of educational activities that promote healthy eating are essential for the success of these initiatives. Gibson (2008) suggests that creating school environments that favor the provision of balanced meals and healthy snack options can have a positive impact on children's health.

EVALUATION AND MONITORING OF INTERVENTIONS

It is important to conduct regular evaluations and monitoring of interventions to ensure their continued effectiveness. Collecting data on the effectiveness of activities, understanding of concepts, and changes in eating habits can provide valuable information for adjustments and improvements in programs. Satter (2007) highlights that evaluation based on clear criteria and feedback from educators, parents and children are fundamental to identify areas of success and opportunities for improvement.

EXPANSION AND ADAPTATION OF INTERVENTIONS

Adapting and scaling up interventions are essential to reach a wider and more diverse audience. Adapting methods and materials to different cultural and socio-economic contexts can

ensure the relevance and effectiveness of interventions. Replicating interventions in different settings can help validate and enhance educational approaches and ensure that they benefit a greater number of children (Bandura, 1977).

REFERENCES

1. American Psychological Association. (2017). *Ethical principles of psychologists and code of conduct*. APA.

2. Bandura, A. (1977). *Social learning theory*. Prentice-Hall.

3. Birch, L. L., & Anzman-Frasca, S. (2011). Learning to eat: How early nutrition influences lifelong health. *Journal of Pediatrics*, 159(2), 179-183. https://doi.org/10.1016/j.jpeds.2011.03.012

4. Gibson, R. S. (2008). *Principles of nutritional assessment* (2nd ed.). Oxford University Press.

5. Harris, J. L., Bargh, J. A., & Brownell, K. D. (2019). Priming effects of television food advertisements on eating behavior. *Health Psychology*, 38(5), 335-343. https://doi.org/10.1037/hea0000726

6. Micha, R., Peñalvo, J. L., Cudhea, F., & Rehm, C. D. (2017). Association between dietary factors and mortality from heart disease, stroke, and type 2 diabetes in the United States. *JAMA*, 317(9), 912-924. https://doi.org/10.1001/jama.2017.0947

7. Satter, E. (2007). Satter's eating competence model. *Eating Competence Education*.

8. Singh, A., Uijtdewilligen, L., Twisk, J. W. R., van Mechelen, W., & Chinapaw, M. J. M. (2018). Physical activity and performance at school. *Archives of Pediatrics & Adolescent Medicine*, 162(8), 739-746.

9. Story, M., Kaphingst, K. A., Robinson-O'Brien, R., & Glanz, K. (2008). Creating healthy food and eating environments: Policy and environmental approaches. *Annual Review of Public Health*, 29, 253-272. https://doi.org/10.1146/annurev.publhealth.29.020907.090954

10. World Health Organization. (2020). *Global strategy on diet, physical activity and health*. WHO.

Alternative substrates for the cultivation of macrofungi

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ABSTRACT

Several raw materials, or residues, can be used as alternative substrates, aiding in mushroom cultivation and reducing production costs by using resources that would otherwise be discarded. Agroindustrial residues can act as a base substrate supplementation and a carbon source, improving the substrate for fermentation or several other factors. This review highlights the importance and effectiveness of using such substrates, and the significant role it plays in contributing to a sustainable future. The socio-environmental benefits such as reducing pollution, reusing agro-industrial waste, and cutting production costs are not just advantages, but a contribution to a healthier planet.

Keywords: Mushrooms, Substrates, Supplementation.

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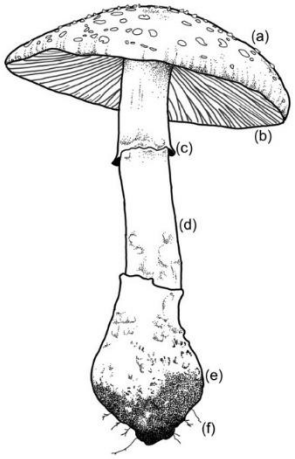
INTRODUCTION

Fungi are characterized by their heterotrophic nature, as they do not produce their food and obtain nutrients through hyphae, which are microscopic structures. Mushrooms are macrofungi part of the Fungi kingdom and can be epigeal (they grow above the ground) or hypogeal (they grow in the soil). They have a fruiting body visible to the naked eye and reproduce through spores. There is a wide morphological diversity among mushrooms, which can vary in the presence of cap, lamellae, stipe, ring, and volva, and also have a wide range of shapes and colors (Figure 1) (Cho & Quimio, 2004; Chang & Miles, 1992). The cap, or cap of the mushroom, is essential for identification, observing its color, shape, and size (Jordan, 2016).

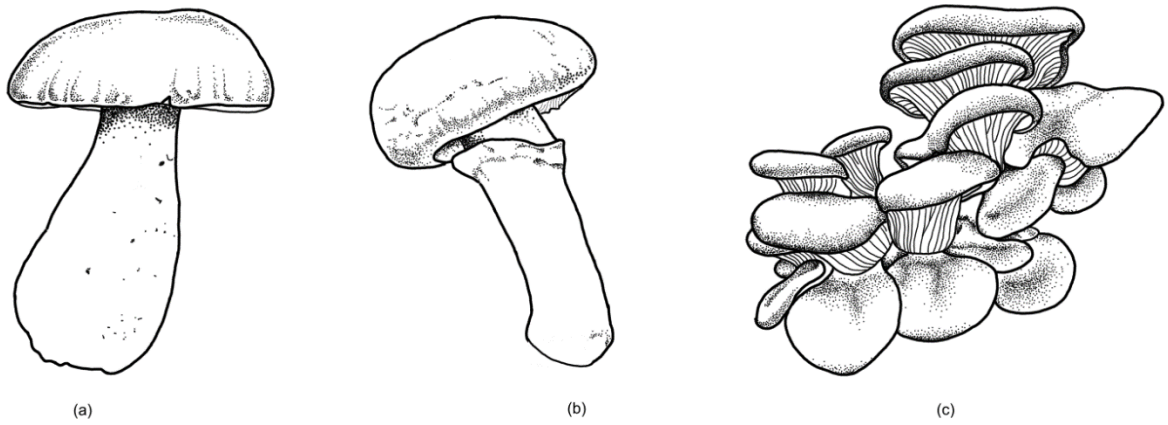
Figure 1. Morphological characteristics of *Basidiomycetes*.



Where: Species *Amanita muscaria*, Pileus (a), lamellae (b), ring (c), stipe (d), volva (e), hyphae (f).

Macrofungi can be divided into *Ascomycetes* and *Basidiomycetes*. *Basidiomycetes* are popularly known for belonging to the *Agaricaceae* and *Pleurotaceae* families. The *Agaricaceae* family can grow in sacs called volva and have a universal veil that covers it entirely in one of the phases of this macrofungus, and, as its development progresses, it breaks. The veil remains present in the *Agaricus* structure, and the partial veil later originates in the final phase of the mushroom's development. The ring is present in the stem (Jordan, 2016). Some morphological differences mentioned can be seen in Figure 2, with differentiation of stipe.

Figure 2. Morphological differences in the stipe of different mushroom species.

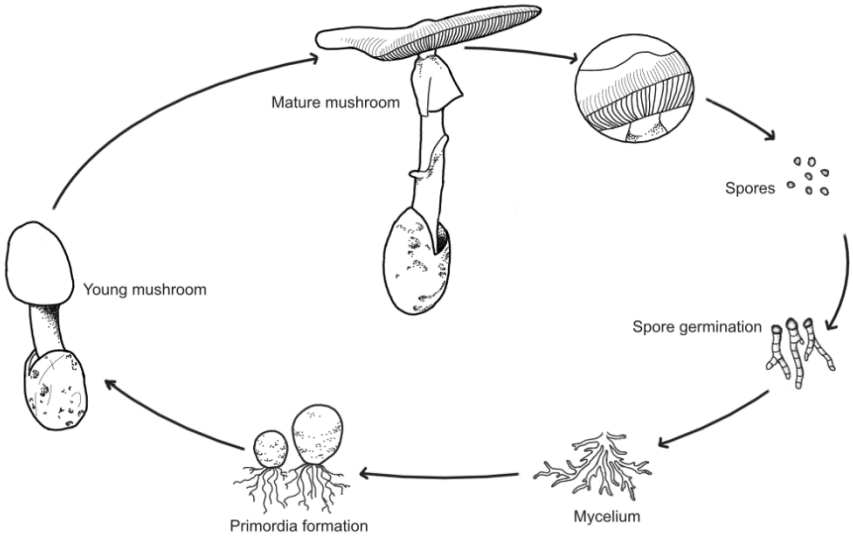


Where: (a) *Boletus edulis*, (b) *Agaricus bisporus*, (c) *Pleurotus ostreatus.*

The *Pleurotaceae* family includes the genus *Pleurotus*, which provides representatives popularly known as oyster mushrooms, one of the most popular edible mushrooms. They are cosmopolitan and act as primary decomposers of hardwoods. They have hyphae that have clamp-shaped connections and a monomictic hyphal system, a type of hyphal organization in which there is no morphological differentiation (Webster, 2007; Cho & Quimio, 2004).

In mushroom cultivation, several substrates can be used, with emphasis on alternative substrates coming from agro-industrial waste such as wheat, rice and corn straw, cotton waste, sawdust, and bagasse (Jahedi et al., 2024; Ekun et al., 2024). These substrates are used sustainably to dispose of and reduce waste, making it more economical to grow mushrooms for commercial purposes (Ekun et al., 2024). Mushroom cultivation does not vary, as the macrofungi cycle is always the exact (Figure 3), not changing according to the species. The milestone of the reproductive process is the release of spores on a substrate suitable for each species. This substrate will require specific conditions, such as nutrients, humidity, and temperature, thus initiating germination. Germination is a complex process, and the growth time will depend on the growing species. New cells are formed that will create filaments called hyphae. The set of hyphae is mycelium, the vegetative part of the cycle (Figure 3). Mycelium cultivation is commonly done with hydrated grains and vermiculite with sterilization in the containers used (Russel, 2014).

Figure 3. The life cycle of mushrooms.



Mushrooms are used as food, possess good nutritional qualities, and are beneficial to health, given that they are rich in proteins, fibers, and several vitamins and have few calories (Singh, 2017; Ukwuru, 2018). Furthermore, mushrooms have medicinal uses due to their anti-inflammatory, immunomodulatory, antimicrobial activity and acting as a liver protector (Wang et al., 2014; Yao et al., 2015, Li et al., 2016, Cui et al., 2016; Liu et al., 2016).

The popularity of mushrooms is mainly due to their different and exotic flavor. The protein content of mushrooms may be lower than that of meat and eggs, but it is similar to that of milk and corn. Therefore, they are considered superior to most fruits and certain vegetables, except for beans and peas. They also have a high content of lysine, essential amino acids, vitamin C, cyanocobalamin, thiamine, riboflavin, iron, calcium, potassium, sodium, phosphorus, and folic acid (Cho & Quimio, 2004).

The objective is to group information about various alternative substrates, showing their advantages and disadvantages. The aim is to highlight the importance and effectiveness of using such substrates, helping with socio-environmental problems such as reducing pollution, reusing agro-industrial waste, and reducing production costs.

METHODOLOGY

This study used a systematic review methodology to find alternative substrates for mushroom cultivation. A literature survey was conducted with a wide range of substrates using the Springer, SciELO, ScienceDirect, and JABB (Journal of Applied Biology & Biotechnology) databases. Articles and books published since 2001 were used, all international. In addition, books in digital format were used, and they were not limited to the year of publication as previously mentioned. All

the information found in this study was gathered, discussed, interrelated, and compared using tables and images to facilitate the comparison of the data obtained.

TYPES OF ALTERNATIVE SUBSTRATES AND THEIR COMPOSITIONS FOR MUSHROOM CULTIVATION

SAWDUST

Sawdust is a substrate with a high lignin content, and the wood from which it is made results in different growth rates for the same mushroom species (Zervakis et al., 2001). For *Pleurotus ostreatus* and *Pleurotus eryngii*, as well as for other *Pleurotus* spp., the high levels of lignocellulose, hemicellulose and cellulose can result in a delay in the incubation period, as well as in the branching of the mushroom on the substrate; this delay may be due to the difficulty in metabolizing these organic materials by the extracellular enzymes of the mushrooms (Adebayo et al., 2021).

The wood used for sawdust will result in different rates of carbohydrates, nitrogen, dry matter, proteins, minerals, moisture, crude fiber, and lipids, among others; thus, prior analysis of the substrate serves as an aid in choosing the best substrate, that is, with the best component indexes, for the selected mushroom (Bhattacharjya et al., 2015)

For some mushrooms, such as *L. edodes*, the use of live pieces of wood leads to delayed growth, whereas when previously dried sawdust is used, effective growth of the mushroom is obtained (Shinomura & Hasebe, 2004).

However, supplemented with wheat and rice bran, sawdust-based substrates can produce *P. ostreatus* mushrooms with higher nutritional and medicinal quality than mushrooms generated only from sawdust substrate (Elkanah et al., 2022).

STRAW

Among several types of substrates, wheat straw has a high amount of lignin, cellulose, and hemicellulose, which can provide high biological efficiency. It is widely used as a control substrate in cultivating *Pleurotus* spp. (Yildiz et al., 2002). The agricultural residue from which the straw will be used and the amount to be used influences the mushroom yield (Deora et al., 2021).

Culturing *Pleutorus* sp. in wheat straw results in a mushroom with a higher final weight than when it is grown in other substrates (Dedousi et al., 2024; Melanouri et al., 2022).

Mushrooms such as *Pleurotus* sp. grown on wheat straw substrate have lower yields and lower biological efficiency when compared to those grown on fruit residues. This may be due to the low amount of nutrients that wheat straw still has. (Otieno et al., 2023).

COFFEE RESIDUE

Coffee residues have a high C:N ratio, which may be responsible for the high growth rates that this substrate causes in some mushrooms, such as *Pleurotus* spp. (Akcay et al., 2023; Melanouri et al., 2022). However, the coffee residue substrate has lower lignin levels than in its SMS. Furthermore, *Pleurotus* spp. Mussolini grown on this substrate generates mushrooms with lower weights than other substrates (Melanouri et al., 2022). Juárez et al. (2019) reported that such residue is a good alternative for producing *Pleutorus ostreatus*.

According to Juárez et al. (2019), the protein content of coffee residue can vary from 17 to 35%, which indicates that the place of origin of the substrate, as well as the conditions used in its cultivation, may be able to influence the nutritional composition of the macronutrients. Coffee beans can increase the spawning time, which may occur due to the shape and size of the coffee particles (Membrillo et al., 2011).

Juárez et al. (2019) observed that after the completion of mushroom growth, using coffee residue substrate, 50% caffeine was still present, indicating that the mushroom is not capable of degrading caffeine, as previously observed by Fan et al. (2006) and Ramírez et al., (2007).

GRAIN BRAN

Wheat bran used in substrates serves as a protein source for mushrooms, increasing their crude protein (Olakanmi et al., 2024; Elkanah et al., 2022). In addition, it is a good source of hydroxycinnamic acids, which produce laccase, which in turn is associated with better use of the solid substrate during substrate colonization (Ballentine et al., 2019; El-Batal et al., 2015). Another benefit of wheat bran is the substrate's ability to retain water, thus reducing the mortality of young fruiting bodies due to lack of water (Zakil et al., 2022). Rice bran, on the other hand, contains vitamins such as thiamine, which is necessary for the production of some mushrooms such as *Flammulina velutipes* (Chang and Miles, 2004). According to Masevhe et al., 2016, using substrates such as rice bran, wheat, and oats as an additional nitrogen source for the substrate to produce high-quality mushrooms is possible. Furthermore, substrates supplemented with wheat and rice bran can produce mushrooms with better nutritional and medicinal values than those made on a single substrate, such as sawdust (Elkanah et al., 2022).

When comparing the components in sawdust, wheat bran, rice bran, and palm stem substrates, sawdust has the highest amount of cellulose and hemicellulose. In contrast, wheat and rice bran have the lowest values for these components. Furthermore, palm stem has more lignin than wheat bran (Adebayo et al., 2021). When choosing the best substrate for cultivating the mushroom, these factors should be considered.

SUGARCANE BAGASSE

Sugarcane bagasse is a raw material capable of producing large quantities of value-added products because it contains cellulose and hemicellulose. However, because it includes lignin, saccharification is inhibited, leading to low yields of value-added products (Alokika et al., 2021).

The mushroom *Ganoderma lucidumpoderia* can be grown on substrates where the only carbon source is sugarcane bagasse. The proteins secreted by this mushroom can produce lignocellulosic enzymes, which release monosaccharides from sugarcane bagasse, improving its effectiveness as a substrate (Manalavan et al., 2012).

Sugarcane bagasse and sawdust serve as a good source of organic biomass in cultivating *P. eryngii* (Li et al., 2014). Bagasse generates higher biological yields when supplemented with wheat bran (Hasam et al., 2015).

CORN COB

Corn cob is a substrate with low lignin content, thus favoring the growth of mushrooms such as *P. ostreatus*, *P. eryngii*, and *P. pulmonarius*; this occurs because the low lignin content makes cellulose more available as a carbon source (Zervakis et al., 2001). In addition, corn cob is rich in potassium but poor in sodium, phosphorus, calcium, and magnesium (Ikeda et al., 2021), so the needs of the mushroom you want to grow must be evaluated.

OTHER SUBSTRATES

According to Nerender et al. (2017) and Olakunler et al. (2019), fruit residue substrate has antifungal compounds that can act by slowing down the growth of mushrooms, a fact observed by Otieno et al. (2022) who reported a delay in the appearance of pinheads in some fruit residue substrates.

Agaricus bisporus grown on rice straw and reeds decrease production with each fruiting phase. When cultivated on wheat straw, there is a smaller decrease, and the fruiting body develops better for this substrate. Mushrooms grown on reed straw tend to have low weights and a softer texture that is likely to open the cap. In addition, *A. bisporus* cannot adequately degrade reed straw, making it unavailable as a carbon source. Reed straw ensures high porous ventilation of the substrate during the composting process due to its texture. Although it aids in fermentation, this condition can also result in a decrease in the substrate temperature (Wang et al., 2021).

Hazelnut shells, as well as hazelnut branch residues, are lignocellulose materials that contain cellulose, hemicellulose, and lignin and can serve as a substrate for lignocellulose mushrooms (Guney et al., 2013; Piliga et al., 2022). The yield of *Pleurotus ostreatus* mushrooms grown on

hazelnut-based substrates is higher than those grown on wheat straw. Thus, hazelnut residue substrate becomes an alternative to wheat straw-based substrate (Akcay et al., 2023).

Pineapple contains high lignocellulosic content, such as cellulose, lignin, and hemicellulose, making it an effective substrate for the growth of *Volvariella volvacea* (Munir et al., 2013; Narh et al., 2018). Like pineapple, empty oil palm bunches also contain cellulose, lignin, and hemicellulose (Narh et al., 2018).

The pineapple leaf substrate, when compared to empty oil palm bunches, has a higher amount of crude fiber, which contains cellulose, hemicellulose, and lignin, and is therefore essential for the growth of mushrooms (Munir et al., 2023; Carrasco et al., 2018; Hamalatha & Anbuselvi, 2013; Vos et al., 2017). Because empty oil palm bunches have a low crude fiber content, they become a substrate with a low lignocellulosic component. Furthermore, the pineapple leaf substrate has a higher mineral content than the empty oil palm bunch, although both contain essential minerals for the growth of mushrooms. For cultivating *V. volvacea*, the substrate with pineapple peel has higher amounts of essential minerals (Munir et al., 2023).

Therefore, the pineapple leaf substrate is more suitable for the cultivation of *V. volvacea* than the empty oil palm bunch because it has a higher yield and biological efficiency, as well as a shorter time for mycelial colonization and formation of the pinhead and fruiting bodies (Munir et al., 2023).

Table 1. Alternative substrates used in the growth of mushroom fruiting bodies.

Substrate	Number of uses	Substrate	Number of uses	Substrate	Number of uses
Sawdust	18	Grape pomace	1	Wheat grains	1
Wheat straw	9	Banana	1	Common reed	1
Coffee residues	7	Bean cake	1	Dried mahogany chips	1
Wheat bran	6	Cocoa powder	1	Palm oil (stalk and bunch)	1
Rice straw	6	Avocado peel	1	Reed straw	1
Sugar cane bagasse	5	Pineapple peel	1	Lentil straw	1
Empty palm kernel bunch	5	Peanut shell	1	Quinoa straw	1
Corn cob	5	Banana peel	1	Sorghum straw	1
Cotton residue	4	Cottonseed peel	1	Sawdust	1
Rice husk	3	Orange peel	1	Olive pulp	1
Corn straw	3	Mango peel	1	Banana pseudostem	1
Forestry residues	3	Watermelon peel	1	Diaper waste	1
Corn cob	3	Eggshell	1	Cedrela odorata wood waste	1
Sugar cane	2	Solid digestate of biogas	1	Gliricidia sepia wood waste	1
Rice bran	2	Corn flour	1	*Mangifera indica* wood waste	1
Coconut peat fiber	2	Palm oil fiber	1	Paper waste	1
Banana leaf	2	Pineapple leaf	1	Pueraria root waste	1
Oat straw	2	Palm oil leaf	1	Date palm waste	1

Barley straw	2	Leucaena foliage	1	Hazelnut waste	1
Tea residue	2	Fragments of face mask	1	Soybean powder	1
Corn stubble	2	Mulberry twig	1	SMS ADR*	1
Agar agar	1	Barley grain	1	Peat	1
Beechwood shavings	1	Sorghum grain	1	Total substrates	68

*Spent mushroom substrate from anaerobic digestion residue

EDIBLE MUSHROOMS

PLEUROTUS OSTREATUS AND PLEUROTUS ERYNGII

Pleurotus spp. can grow on various substrates and is popularly known for having enzymes capable of degrading lignin, cellulose, and hemicellulose (Chang & Miles, 2004).

Pleutorus ostreatus is a primary wood decomposer widely distributed in temperate zones. It is the most frequently cultivated species of the genus due to its easy cultivation. There are several strains of the species, each with different degrees of tolerance to cold or heat. The strains have different colors, such as pink, blue, and yellow (Kong, 2004; Russell, 2014).

For cultivation, it is necessary to carry out a low-temperature treatment, around 2°C to 10°C, to form fruiting bodies. The ideal fruiting temperature, the growth of fruiting bodies, is 18°C to 21°C, and the perfect humidity for this period is 90-95%. Fruiting time varies from 2 to 3 weeks (Kang, 2004; Russell, 2014).

Plerotus eryngii, like *Pleurotus ostreatus*, is a primary wood decomposer; however, it is more sensitive to diseases and climatic conditions and grows more slowly than *P. ostreatus* (Cho & Quimio, 2004; Kang et al., 2004). *P. Eryngii* requires low-temperature treatment, and the ideal fruiting temperature is between 13°C and 18°C (Kang, 2004).

Pleurotus eryngii can be grown on substrates based on wheat straw (Deora et al., 2021; Otieno et al., 2022; Dedousi et al., 2024; Melanouri et al., 2022), rice straw, corn, and sorghum (Deora et al., 2021), barley straw, oat straw, rice husk (Dedousi et al., 2024; Melanouri et al., 2022), fruit waste (Otieno et al., 2022), rice husk, coffee waste (Dedousi et al., 2024; Melanouri et al., 2022), sawdust (Dedousi et al., 2024; Li et al., 2024; Melanouri et al., 2022), peanut shell (Li et al., 2024), cotton waste (Sardar et al., 2022; Melanouri et al., 2022), olive pulp, grape pomace, corn cob (Melanouri et al., 2022). Furthermore, as a supplement to the substrates, for better cultivation efficiency, rice bran, wheat bran (Deora et al., 2021), spent mushroom substrate (SMS), commercial compost of fresh and used mushroom (SMS) (Dedousi et al., 2024) and moringa leaf powder (Sardar et al., 2022) can be used. The cultivation of *Pleurotus ostreatus* can be carried out on substrates such as wheat straw (Akcay et al., 2023; Otieno et al., 2022; Dedousi et al., 2024; Melanouri et al., 2022), rice straw, corn straw (Salazar et al., 2020), barley straw, oat straw (Dedousi et al., 2024; Melanouri et al., 2022); 2024; Melanouri et al., 2022), rice husk (Akcay et al., 2023; Dedousi et al., 2024;

Melanouri et al., 2022; Chouhan et al., 2022), wheat grain (Chouhan et al., 2022), coconut shell (Savón et al., 2020), banana leaf (Richard et al., 2020, Chouhan et al., 2022), paper waste, corn stalk (Tesfay et al., 2020), solid biogas digestate (Hultberg et al., 2022), fruit residue (Otieno et al., 2022), cotton residue, grape pomace, corn cob, olive pulp (Melanouri et al., 2022), oil palm residue (Zakil et al., 2020). al., 2022; Adebayo et al., 2021), hazelnut residue (Akcay et al., 2023), sugarcane bagasse, corn cob (Zakil et al., 2022), dried mahogany chips, wheat bran, facial mask fragment (Olakanmi et al., 2024) and palm residue (Elkanah et al., 2022). Calcium carbonate supplements (Zakil et al., 2022; Chouhan et al., 2022), gypsum (Tesfay et al., 2020), lime (Hultberg et al., 2022), spent mushroom substrate (SMS), fresh and used mushroom compost (SMS) (Dedousi et al., 2024), wheat bran (Zakil et al., 2022; Elkanah et al., 2022; Adebayo et al., 2021) and rice bran (Elkanah et al., 2022; Adebayo et al., 2021).

AGARICUS BISPORUS

Agaricus bisporus is the most productive mushroom in India (Maheshwari, 2013), and it requires a large amount of nitrogen, with a C:N (Carbon:Nitrogen) ratio of 17 to 18 during mycelial growth. It also requires fermented compost substrates, such as wheat straw and horse manure (Chang & Miles, 2004).

The ideal temperature for fruiting is 14°C to 18°C , requiring a high percentage of relative humidity. Growth should occur in the dark for good stem and cap development (Chang & Miles, 2004).

Agaricus bisporus can be cultivated on substrates such as wheat straw (Wang et al., 2021; Dedousi et al., 2024), rice straw, reed straw (Wang et al., 2021), barley straw, oat straw, sawdust, rice husk, coffee residue (Dedousi et al., 2024), sugarcane with dairy wastewater (Kumar et al., 2021). Several supplements can be added to the substrate chosen for use, among which we can mention the use of chicken feces, soybean meal, gypsum, and grain vinasse (Wang et al., 2021), spent mushroom substrate (SMS) and fresh and spent mushroom compost (SMC) (Dedousi et al., 2024).

HERECIUM ERINACEUS

Hericium erinaceus belongs to the *Hericiacea* family and has medicinal properties. Its cultivation began in Shanghai. The mushroom can be cultivated on substrates such as sawdust, corncobs, rice straw, and sugarcane bagasse. Gypsum, rice bran, wheat bran, and sucrose can be used as supplements (Chang & Miles, 2004).

The ideal temperature for *H. erinaceus* to fruit is 20°C. After the fruiting bodies appear, the ideal is to raise the temperature to around 25°C. Very low temperatures below 14°C are not recommended, as this may result in the non-formation of fruiting bodies (Chang & Miles, 2004).

Some of the substrates in which *H. erinaceus* can develop are sawdust, rice bran (Chutimanukul et al., 2023; Jahedi et al., 2024), corn cob (Chutimanukul et al., 2023), wheat straw, sugarcane bagasse, wheat bran, soybean powder, and corn flour (Jahedi et al., 2024), mulberry tree branches and puerparia root residue (Fan et al., 2021). Wheat bran, CaSO4, CaCO3 (Fan et al., 2021), and lime (Chutimanukul et al., 2023) can be used to obtain better growth results.

LENTINULA EDODES

Lentinula edodes is native to Asian countries and is known as Shitake (Cho, 2004). It is a fungus that grows on decaying tree trunks or stumps (Chang et al., 2017). It has medicinal properties by inducing the production of interferon and a homothallic life cycle, has a long cultivation, and has an ideal C:N ratio of 20 to 25 during the mycelial growth period (Chang & Miles, 2004; Cho & Quimio, 2004). During the fruiting phase, the C/N content must be balanced; if the nitrogen content is too high, the fruiting bodies will not be formed or developed (Chang et al., 2017). The ideal temperature for fruiting body formation is 10°C to 20°C, while for fruiting, it is 15°C. The perfect substrate pH is, on average, 5.0 to 5.5 (Chang & Miles, 2004; Stamets, 2000).

L. edodes can be cultivated on substrates such as coconut husks (Savón et al., 2020), sawdust (Atila & Cetin, 2024; Arenas et al., 2015), and corn stubble and cob (Arenas et al., 2015). One of the substrates that can be used is liquid biogas residue (Atila & Cetin, 2024).

VOLVARIELLA VOLVACEA

Volvariella volvacea, popularly called straw mushroom, is cultivated seasonally and grows rapidly. It grows best in compost with a lower nitrogen content (Chang & Miles, 2004). Its ideal temperature for mycelial growth is around 32°C to 35°C, and for fruiting, it is 28°C to 32°C. During mycelial growth, its perfect C:N ratio is around 40 to 60 (Chang & Miles, 2004).

V. volvacea can also be cultivated using different substrates; among the most studied are oil palm residues (Triyono et al., 2019; Kamaliah et al., 2021; Munir et al., 2023) and its association with pineapple leaves (Munir et al. 2023). NPK fertilizer, chicken feces, rice bran, and lime (Triyono et al., 2019) can be used together as supplementation.

Table 2. Mushroom species used in the study on the use of alternative substrates.

Mushroom species	Number of uses	Mushroom species	Number of uses
Pleurotus ostreatus	17	*Pleurotus floridanus*	1
Pleurotus eryngii	6	*Podoscypha petalodes*	1
Agaricus bisporus	3	*Pleurotus djamor*	1
Herecium erinaceus	3	*Pleurotus sajor-caju*	1
Lentínula edodes	3	*Flammulina velutipes*	1
Volvariella volvacea	3	*Auricularia cornea*	1
Pleurotus citrinopileatus	2	*Trametes versicolor*	1
Pleurotus pulmonarius	2	*Pleurotus eous*	1
Pleurotus florida	2	*Ganoderma lucidum*	1
Auricularia spp.	1	**Total species**	19

Table 3. Supplements used in conjunction with alternative substrates in the growth of mushroom fruiting bodies.

Supplement	Number of uses	Supplement	Number of uses
Gypsum ($CaSO_4$)	9	Sodium chloride (NaCl)	1
Lime (CaO)	7	Glycerol ($C_3H_8O_3$)	1
Rice bran	7	Betaine	1
Calcium carbonate ($CaCO_3$)	6	Urea	1
Wheat bran	6	Moringa leaf powder	1
Chicken manure	3	Thiourea (CSN_2H_4)	1
Lime	2	Fossil shells	1
Spent mushroom substrate (SMS)	1	Corn flour	1
Fresh and spent commercial mushroom compost (SMC)	1	Soybean meal	1
Liquid biogas residue from cattle manure	1	Grain vinasse	1
Rice straw	1	NPK fertilizer	1
Potassium chloride (KCl)	1	Corn cob	1
Total supplements used			**24**

EVALUATION OF PRODUCTION PARAMETERS: TOOLS TO OPTIMIZE CULTIVATION ON ALTERNATIVE SUBSTRATES

Spent mushroom substrate (SMS) and commercial fresh and used mushroom compost (SMC) are lignocellulosic by-products composed of a mixture of organic matter and mycelium remaining from mushroom cultivation (Economou et al., 2020; Guo et al., 2022).

SMS and SMC can be used in new mushroom cultivation cycles by providing sufficient carbon for growth (Phan et al., 2012; Zied et al., 2020). Primary decomposers such as *Pleurotus*, *Lentinula*, and *Ganodermas* species require substrates with higher C/N and lignin and lower nitrogen content, as in SMS. In contrast, secondary decomposers such as *Agaricus* species require a lower C/N ratio and are capable of growing on substrates already degraded by fungi or bacteria, such as SMC (Ahlawat et al., 2019; Philippoussis et al., 2001).

Thiourea is a sulfur-enriched compound that prevents protein oxidation and helps reduce oxidation catalyzed by copper ascorbate (Burman et al., 2004). In addition, thiourea acts on the homeostasis of cellular ions, increasing the intake and uptake of phosphorus and potassium and the concentration of ascorbic acid (Kaya et al., 2015). Substrates enriched with thiourea increase mycelial growth and biological efficacy (Fozia et al., 2022).

For mushroom cultivation, it is necessary to control several factors, such as temperature, humidity, light, ventilation, vitamins, minerals, and substrate acidity (Cho, 2004; Kang, 2004). Controlling these factors also influences diseases that can affect cultivated mushrooms, favored by high temperatures and humidity (Cha, 2004; Kang, 2004). Temperature and pH influence the need for vitamins, and mushrooms already require some essential vitamins, such as thiamine and biotin (Chang & Miles, 2004).

In the production of *Pleurotus* spp., the temperature during fruiting influences the color of the cap. Lower temperatures can be used to obtain mushrooms with colors such as light brown, while higher temperatures make them paler (Kong, 2004).

The cultivation temperature of mushrooms directly affects fungal growth; enzymatic activity is linked to increased temperature, which inactivates enzymes that result in mushroom growth (Chang & Miles, 2004).

Carbon dioxide (CO2) influences the amount of caps in mushrooms (Kong, 2004). These fungi obtain carbon through the catabolic breakdown of organic compounds, such as organic acids, cellulose, and lignin (Chang & Miles, 2004). CO2 influences the cap of *Pleurotus* spp. The mushrooms produce long stems with small caps at high concentrations of the compound, while at low concentrations, smaller stems are made with wider caps (Kong, 2004). Ventilation is used as a way to control CO2 during the growth of aerobic mushrooms, especially during the reproductive phase. Basidiomycetes may suffer from malformations if the environment they are being cultivated has a large amount of carbon dioxide (Chang & Miles, 2004).

For most *Basidiomycetes*, relative humidity between 95% and 100% and substrate humidity between 50% and 75% are efficient for cultivation, with the need for moisture for the initial, middle, and final stages varying (Cho, 2004).

The effect of light is variable, with some having a positive effect while others have a negative impact. For species that require light, such as *Basidiomycetes*, it triggers the formation of fruiting bodies; however, excessive lighting can cause damage to the mushrooms, destroying vitamins, possibly due to increased temperature (Cho, 2004; Chang & Miles, 2004). For species that do not require light, such as *Agaricus bisporus*, it inhibits the development of primordia, affecting the elongation of the stipes and the expansion of the cap (Chang & Miles, 2004). Liquid culture for mycelial spawning is advantageous for subsequent colonization due to its ease of dissemination. In

the laboratory, glucose can be used as a carbon source with other sugars, which tends to be the first to be used. Some species of mushrooms grow better on different carbon sources, so the best carbon source to be used must be evaluated (Chang & Miles, 2004; Russel, 2014). Liquid cultures require agitation, for which different methods of implementation can affect the mass of mycelium, total glucans, α-glucans, and β-glucans, in addition to leading to varying levels of shear stress and aeration, affecting morphological, biochemical characteristics and final productivity (Pilafidis et al., 2024).

CONCLUSION

Several materials, some more popular than others, can be used as alternative substrates for mushroom cultivation. Each substrate has advantages and disadvantages due to the choice of mushrooms and cultivation conditions. Such substrates can increase the biological yield or quality of the mushroom and can be used as base substrates or supplements. Using alternative substrates positively affects the utilization of materials from discarded materials.

LIST OF ABBREVIATIONS

Not applicable

DECLARATIONS

Ethics approval and consent to participate

Not applicable

CONSENT FOR PUBLICATION

All authors agreed with this publication.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated for this study are available upon request from the corresponding author.

COMPETING INTERESTS

There are no competing interests.

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AUTHORS' CONTRIBUTIONS

MB, SK, AFC: research and manuscript writing and discussion.

HT: research coordinator

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REFERENCES

1. Adebayo, E. A., Elkanah, F. A., Afolabi, F. J., Ogundun, O. S., Alabi, T. F., & Oduoye, O. T. (2021). Molecular characterization of most cultivated Pleurotus species in sub-western region Nigeria with development of cost effective cultivation protocol on palm oil waste. *Heliyon, 7*(2), e06215. https://doi.org/10.1016/j.heliyon.2021.e06215

2. Ahlawat, P. O., & Kaur, H. (2019). Reuse of Agaricus bisporus spent compost for commercial scale compost making of the succeeding crop of A. bisporus. *International Journal of Current Microbiology and Applied Sciences, 8*(11), 177–186. https://doi.org/10.20546/ijcmas.2019.811.022

3. Ahmad, Z. F., Xuan, L. H., Zaman, N., Alan, N. I., Salahutheen, N. A. A., Sued, M. S. M., & Isha, R. (2022). Growth performance and mineral analysis of Pleurotus ostreatus from various agricultural wastes mixed with rubber tree sawdust in Malaysia. *Bioresource Technology Reports, 17*, 100873. https://doi.org/10.1016/j.biteb.2021.100873

4. Akcay, C., Ceylan, F., & Arslan, R. (2023). Production of oyster mushroom (Pleurotus ostreatus) from some waste lignocellulosic materials and FTIR characterization of structural changes. *Scientific Reports, 13*(1). https://doi.org/10.1038/s41598-023-40200-x

5. Alokika, A., Kumar, A., Kumar, V., & Singh, B. (2021). Cellulosic and hemicellulosic fractions of sugarcane bagasse: Potential, challenges and future perspective. *International Journal of Biological Macromolecules, 169*, 564–582. https://doi.org/10.1016/j.ijbiomac.2020.12.175

6. Andrew, S. M. (2023). Production and nutritional value of Pleurotus floridanus grown on rice straw supplemented with Leucaena leucocephala foliage. *Environmental and Sustainability Indicators, 17*, 100223. https://doi.org/10.1016/j.indic.2022.100223

7. Atila, F., & Cetin, M. (2024). Valorization of liquid waste generated from biogas production as supplemental material in shiitake mushroom cultivation. *Scientia Horticulturae, 325*, 112663. https://doi.org/10.1016/j.scienta.2023.112663

8. Bellettini, M. B., Fiorda, F. A., Maieves, H. A., Teixeira, G. P., Ávila, S., Hornung, P. S., Júnio, A. M., & Ribani, R. H. (2019). Factors affecting mushroom Pleurotus spp. *Saudi Journal of Biological Sciences, 26*(4), 633–646. https://doi.org/10.1016/j.sjbs.2016.12.005

9. Bermúdez, S., Catalina, R., Oduardo, N. G., Céspedes, L. M. A., Alberni, M. S., & Pérez, L. P. (2020). Utilización de cáscara (fibra) de coco para el cultivo de setas comestibles-medicinales de interés comercial. *Tecnología Química, 40*(2), 260–268. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S2224-61852020000200260&lng=es&nrm=iso

10. Burman, U., Garga, B. K., & Kathju, S. (2004). Interactive effects of thiourea and phosphorus on clusterbean under water stress. *Biologia Plantarum, 48*(1), 61–65. https://doi.org/10.1023/b:biop.0000024276.03834.8d

11. Carrasco, J., Zied, D. C., Parto, J. E., Preston, G. M., & Pardo-Giménez, A. (2018). Supplementation in mushroom crops and its impact on yield and quality. *AMB Express, 8*(1). https://doi.org/10.1186/s13568-018-0678-0

12. Cha, J. S. (2004). Oyster mushroom cultivation. In *Mushroom growers handbook 1* (Cap. 8). MushWorld.

13. Chang, S. T., & Miles, P. G. (2004). Mushroom biology — A new discipline. *The Mycologist, 6*(2), 64–65.

14. Chen, Y., Sossah, F. L., Lv, Z., Lv, Y., Tian, L., Sun, X., Li, C., Song, B., & Li, Y. (2021). Effect of wheat bran and maize straw substrates on the agronomic traits and nutritional content of Auricularia cornea cv. Yu Muer. *Scientia Horticulturae, 286*, 110200. https://doi.org/10.1016/j.scienta.2021.110200

15. Cho, S. B., & Quimio, T. H. (2004). Oyster mushroom cultivation. In *Mushroom growers handbook 1* (Cap. 1). MushWorld.

16. Chouhan, P., Koreti, D., Kosre, A., Chauhan, R., Jadhav, S. K., & Chandrawanshi, N. K. (2022). Production and assessment of stick-shaped spawns of oyster mushroom from banana leaf-midribs. *Proceedings of the National Academy of Sciences, India. Section B, 92*(2), 405–414. https://doi.org/10.1007/s40011-021-01327-x

17. Costa, A. F. P., Steffen, G. P. K., Steffen, R. B., Portela, V. O., Santana, N. A., Richards, P. S., & Jacques, R. J. S. (2023). The use of rice husk in the substrate composition increases Pleurotus ostreatus mushroom production and quality. *Scientia Horticulturae, 321*, 112372. https://doi.org/10.1016/j.scienta.2023.112372

18. Cui, F., Xia, G., Jianjun, Z., Min, L., Chen, Z., Xu, N., Huajie, Z., Lin, L., Meng, Z., & Jia, L. (2016). Protective effects of extracellular and intracellular polysaccharides on hepatotoxicity by Hericium erinaceus SG-02. *Current Microbiology, 73*(3), 379–385. https://doi.org/10.1007/s00284-016-1073-1

19. Dedousi, M., Eirini-Maria, M., Karayannis, D., Kaminarides, E. I., & Diamantopoulou, P. (2024). Utilization of spent substrates and waste products of mushroom cultivation to produce new crops of Pleurotus ostreatus, Pleurotus eryngii, and Agaricus bisporus. *Carbon Resources Conversion, 7*(2), 100196. https://doi.org/10.1016/j.crcon.2023.08.001

20. Deora, A., Sharma, S. S., Kumari, P., Dahima, V., Kumar, S., & Rorith, M. (2021). Cultivation of Kabul Dhingri (Pleurotus eryngii) mushroom by standardizing protocols in subtropical zones of the world. *Scientific Reports, 11*(1). https://doi.org/10.1038/s41598-021-94038-2

21. Devi, R., Kapoor, S., Thakur, R., Sharma, E., Tiwari, R. K., & Joshi, S. J. (2022). Lignocellulolytic enzymes and bioethanol production from spent biomass of edible mushrooms using Saccharomyces cerevisiae and Pachysolen tannophilus. *Biomass Conversion and Biorefinery*. https://doi.org/10.1007/s13399-022-02406-3

22. Economou, C. N., Philippoussis, A. N., & Diamantopolous, A. (2020). Spent mushroom substrate for a second cultivation cycle of Pleurotus mushrooms and dephenolization of agro-industrial wastewaters. *FEMS Microbiology Letters, 367*(8). https://doi.org/10.1093/femsle/fnaa060

23. Ekun, V. S., Adenipekun, C. O., Idowu, O., & Etaware, P. M. (2024). Mushroom husbandry: A tool for pollution control and waste management with job opportunities and revenue for rural communities and farm settlements. *Waste Management Bulletin, 1*(4), 15–22. https://doi.org/10.1016/j.wmb.2023.08.001

24. El-Batal, A. I., Elkenawy, N. M., Yassin, A. S., & Amin, M. A. (2015). Laccase production by Pleurotus ostreatus and its application in synthesis of gold nanoparticles. *Biotechnology Reports (Amsterdam, Netherlands), 5*, 31–39. https://doi.org/10.1016/j.btre.2014.11.001

25. Elkanah, F. A., Oke, M. A., & Adebayo, E. A. (2022). Substrate composition effect on the nutritional quality of Pleurotus ostreatus (MK751847) fruiting body. *Heliyon, 8*(11), e11841. https://doi.org/10.1016/j.heliyon.2022.e11841

26. Fan, L., Soccol, A. T., Pandey, A., Vandenberghe, L. P. S., & Soccol, C. R. (2006). Effect of caffeine and tannins on cultivation and fructification of Pleurotus on coffee husks. *Brazilian Journal of Microbiology, 37*(4), 420–424. https://doi.org/10.1590/s1517-83822006000400003

27. Fan, X. Z., Yao, F., Yin, C. M., Shi, D. F., & Gao, H. (2021). Mulberry twig and Pueraria root residue improve the biological efficiency and potential functional value of Hericium erinaceus. *Scientia Horticulturae, 286*, 110214. https://doi.org/10.1016/j.scienta.2021.110214

28. Fozia, A. Z., Alharbi, N. K., Khan, M. I., Noreen, A., Khan, A. A., Qamar, S., Khan, I., Ramzan, M., Bahatheq, A. M., & Ahmed, A. E. (2022). Thiourea enriched cotton waste enhances biomass and nutrition contents in (white oyster) and (Phoenix oyster) mushrooms. *Journal of King Saud University. Science, 34*(4), 102054. https://doi.org/10.1016/j.jksus.2022.102054

29. Gomes, T. G., Hadi, S. I. I. A., Ribeiro, J. A. A., Segatto, R., Mendes, T. D., Helm, C. V., Júnior, A. F. C., Miller, R. N. G., Mendonça, S., & Siqueira, F. G. S. (2022). Phorbol ester biodegradation in Jatropha curcas cake and potential as a substrate for enzyme and Pleurotus pulmonarius edible mushroom production. *Biocatalysis and Agricultural Biotechnology, 45*, 102498. https://doi.org/10.1016/j.bcab.2022.102498

30. Grimm, A., Reis, G. S., Khokarale, S. G., Ekman, S., Lima, E. C., Xiong, S., & Hultberg, M. (2023). Shiitake spent mushroom substrate as a sustainable feedstock for developing highly efficient nitrogen-doped biochars for treatment of dye-contaminated water. *Journal of Water Process Engineering, 56*, 104435. https://doi.org/10.1016/j.jwpe.2023.104435

31. Guney, M. S. (2013). Utilization of hazelnut husk as biomass. *Sustainable Energy Technologies and Assessments, 4*, 72–77. https://doi.org/10.1016/j.seta.2013.09.004

32. Guo, J., Zhang, M., & Fang, Z. (2022). Valorization of mushroom by-products: A review. *Journal of the Science of Food and Agriculture, 102*(13), 5593–5605. https://doi.org/10.1002/jsfa.11946

33. Hamza, A., Mandari, V., & Kumar, D. S. (2023). Efficient production of biomass and exopolysaccharide from P. ostreatus and physio-chemical characterization of biomass powder. *Food Bioscience, 55*, 103073. https://doi.org/10.1016/j.fbio.2023.103073

34. Hemalatha, R., & Anbuselvi, S. (2013). Physicohemical constituents of pineapple pulp and waste. *Journal of Chemical and Pharmaceutical Research, 5*(5), 240–242.

35. Hou, Z., Xia, R., Li, Y., Xu, Y., Wang, Y., Feng, Y., Pan, S., Wang, Z., Ren, H., Qian, G., Wang, H., Zhu, J., & Xin, G. (2024). Key components, formation pathways, affecting factors, and emerging analytical strategies for edible mushrooms aroma: A review. *Food Chemistry, 438*, 137993. https://doi.org/10.1016/j.foodchem.2023.137993

36. Hultberg, M., Oskarsson, C., Bergstrand, K. J., & Asp, H. (2022). Benefits and drawbacks of combined plant and mushroom production in substrate based on biogas digestate and peat. *Environmental Technology & Innovation, 28*, 102740. https://doi.org/10.1016/j.eti.2022.102740

37. Ikeda, S., Yamauchi, M., Watari, T., Hatamoto, M., Yamada, M., Maki, S., Hara, H., & Yamaguchi, T. (2021). Development of enokitake (Flammulina velutipes) mushroom cultivation technology using spent mushroom substrate anaerobic digestion residue. *Environmental Technology & Innovation, 24*, 102046. https://doi.org/10.1016/j.eti.2021.102046

38. Jahedi, A., Ahmadigar, S., & Mohammadigotapeh, E. (2024). Revival of wild edible-medicinal mushroom (Hericium erinaceus) based on organic agro-industrial waste: Achieving a commercial protocol with the highest yield; optimum reuse of organic waste. *Scientia Horticulturae, 323*, 112510. https://doi.org/10.1016/j.scienta.2023.112510

39. Juárez, N., Ángel, J. I. D., Ruiz, C., & López, W. A. R. (2019). Estudio preliminar de la composición nutricional del hongo Pleurotus ostreatus cultivado en pulpa de café. *Revista de la Sociedad Química del Perú, 85*(4), 422–431. https://doi.org/10.37761/rsqp.v85i4.256

40. Kamaliah, N., Salim, S., Abdullah, S., Nobilly, F., Mat, S., Norhisham, A. R., Tohiran, K. A., Zulkifli, R., Lechner, A. M., & Azhar, B. (2022). Evaluating the experimental cultivation of edible mushroom, Volvariella volvacea underneath tree canopy in tropical agroforestry systems. *Agroforestry Systems, 96*(1), 35–47. https://doi.org/10.1007/s10457-021-00685-9

41. Kaya, C., Ashraf, M., & Sönmez, O. (2015). Promotive effect of exogenously applied thiourea on key physiological parameters and oxidative defense mechanism in salt-stressed *Zea mays* L. plants. *Turkish Journal of Botany, 39*, 786–795. https://doi.org/10.3906/bot-1409-10

42. Khoo, S. C., Ma, N. L., Peng, W. X., Ng, K. K., Goh, M. S., Chen, H. L., Tan, S. H., Lee, C. H., Luang-In, V., & Sonne, C. (2022). Valorisation of biomass and diaper waste into a sustainable production of the medical mushroom Lingzhi *Ganoderma lucidum*. *Chemosphere, 286*, 131477. https://doi.org/10.1016/j.chemosphere.2021.131477

43. Kumar, P., Kumar, V., Goala, M., Singh, J., & Kumar, P. (2021). Integrated use of treated dairy wastewater and agro-residue for *Agaricus bisporus* mushroom cultivation: Experimental and kinetics studies. *Biocatalysis and Agricultural Biotechnology, 32*, 101940. https://doi.org/10.1016/j.bcab.2021.101940

44. Kumar, S., Chand, G., & Patel, D. K. (2020). Evaluation of different substrate supplements on growth and yield of oyster mushroom (*Pleurotus florida*). *Indian Phytopathology, 73*(4), 731–736. https://doi.org/10.1007/s42360-020-00252-9

45. Li, W., Zhou, W., Kim, E. J., Shim, S. H., Kang, H. K., & Kim, Y. H. (2015). Isolation and identification of aromatic compounds in lion's mane mushroom and their anticancer activities. *Food Chemistry, 170*, 336–342. https://doi.org/10.1016/j.foodchem.2014.08.078

46. Li, X., Chen, G., Ezemaduka, A. N., Luo, N., Yu, H., & Wang, M. (2023). The yields and quality of golden oyster mushroom cultivated on common reed substrates. *Journal of Food Composition and Analysis, 121*, 105331. https://doi.org/10.1016/j.jfca.2023.105331

47. Li, Z., Zhao, C., Zhou, Y., Zheng, S., Hu, Q., & Zou, Y. (2024). Label-free comparative proteomic analysis of *Pleurotus eryngii* grown on sawdust, bagasse, and peanut shell substrates. *Journal of Proteomics, 294*, 105074. https://doi.org/10.1016/j.jprot.2024.105074

48. Liu, J. H., Li, L., Shang, X. D., Zhang, J. L., & Tan, Q. (2016). Anti-*Helicobacter pylori* activity of bioactive components isolated from *Hericium erinaceus*. *Journal of Ethnopharmacology, 183*, 54–58. https://doi.org/10.1016/j.jep.2015.09.004

49. Manavalan, T., Manavalan, A., Thangavelu, K. P., & Hesse, K. (2012). Secretome analysis of *Ganoderma lucidum* cultivated in sugarcane bagasse. *Journal of Proteomics, 77*, 298–309. https://doi.org/10.1016/j.jprot.2012.09.004

50. Melanouri, E. M., Dedousi, M., & Diamantopoulou, P. (2022). Cultivating *Pleurotus ostreatus* and *Pleurotus eryngii* mushroom strains on agro-industrial residues in solid-state fermentation. Part I: Screening for growth, endoglucanase, laccase and biomass production in the colonization phase. *Carbon Resources Conversion, 5*(1), 61–70. https://doi.org/10.1016/j.crcon.2021.12.004

51. Membrillo, I., Sánchez, C., Meneses, M., Favela, E., & Loera, O. (2011). Particle geometry affects differentially substrate composition and enzyme profiles by *Pleurotus ostreatus* growing on sugar cane bagasse. *Bioresource Technology, 102*(2), 1581–1586. https://doi.org/10.1016/j.biortech.2010.08.091

52. Munir, N., Ramli, A. N. M., Norsazali, N. F. S., & Bhuyar, P. (2023). Valorization of agro-industrial waste for the advancement of mushrooms and their production yield. *Biomass Conversion and Biorefinery*. https://doi.org/10.1007/s13399-023-04773-x

53. Nakakubo, K., Kariyazino, K., Watari, T., Yagi, F. A., Kuroda, K., Yamada, M., Yamaguchi, T., & Yamauchi, M. (2023). A novel cultivation method for growing oyster mushrooms with low potassium content using brewer's grain, an agro-waste. *Environmental Technology & Innovation, 32*. https://doi.org/10.1016/j.eti.2023.103240

54. Narender, R. B., Rajakumari, M., Sukanya, B., & Harish, S. (2017). Antimicrobial activity on peels of different fruits and vegetables. *Pharma Research, 7*. https://doi.org/10.5281/zenodo.1133694

55. Narh, M., Addo, D. L. P., Matilda Dzomeku, & Obodai, M. (2018). Bioprospecting of powdered pineapple rind as an organic supplement of composted sawdust for *Pleurotus ostreatus* mushroom cultivation. *Food Science & Nutrition, 6*(2), 280–286. https://doi.org/10.1002/fsn3.551

56. Niazi, A. R., & Ghafoor, A. (2023). Domestication of a magic therapeutical wine glass fungus (*Podoscypha petalodes*) from Pakistan. *Heliyon, 9*(6), e16146. https://doi.org/10.1016/j.heliyon.2023.e16146

57. Olakanmi, G. B., Lateef, S. A., & Ogunjobi, A. A. (2024). Utilization of disposable face masks for cultivation of *Pleurotus ostreatus* mushroom as a strategy for reducing environmental plastic pollution. *Journal of Material Cycles and Waste Management, 26*(1), 578–590. https://doi.org/10.1007/s10163-023-01859-6

58. Olakunle, O. O., Joy, D. B., & Irene, O. J. (2019). Antifungal activity and phytochemical analysis of selected fruit peels. *Journal of Biology and Medicine, 3*(1), 40–43. https://doi.org/10.17352/jbm.000013

59. Omar, A. N., Chirnside, A., & Kniel, K. E. (2024). Evaluation of white rot fungus to control growth of *Escherichia coli* in cattle manure. *Journal of Food Protection, 87*(1), 100206. https://doi.org/10.1016/j.jfp.2023.100206

60. Otieno, O. D., Mulaa, F. J., Obiero, G., & Midiwo, J. (2022). Utilization of fruit waste substrates in mushroom production and manipulation of chemical composition. *Biocatalysis and Agricultural Biotechnology, 39*, 102250. https://doi.org/10.1016/j.bcab.2021.102250

61. Philippoussis, A., Zervakis, G., & Diamantopoulou, P. (2001). *World Journal of Microbiology and Biotechnology, 17*(2), 191–200. https://doi.org/10.1023/a:1016685530312

62. Pilafidis, S., Tsouko, E., Sougleri, G., Diamantopoulou, P., Gkatzionis, K., Ioannou, Z., & Sarris, D. (2024). Submerged cultivation of selected macro-fungi to produce mycelia rich in β-glucans and other bioactive compounds, valorizing side streams of the food industry. *Carbon Resources Conversion, 7*(2), 100198. https://doi.org/10.1016/j.crcon.2023.09.002

63. Puliga, F., Leonardi, P., Minutella, F., Zambonelli, A., & Francioso, O. (2022). Valorization of hazelnut shells as growing substrate for edible and medicinal mushrooms. *Horticulturae, 8*(3), 214. https://doi.org/10.3390/horticulturae8030214

64. Putra, I. P., Aimi, T., & Shimomura, N. (2022). Basidium formation of *Rhizopogon roseolus* with *Pinus thunbergii* in agar medium. *Fungal Biology, 126*(11–12), 746–751. https://doi.org/10.1016/j.funbio.2022.09.003

65. Ramezan, D., Abadi, B. A. J., Kermani, A. S., Pirnia, M., & Farrokhzad, Y. (2021). Cultivation of turkey tail mushroom (*Trametes versicolor*) on lignocellulosic wastes and evaluation of substrate bioconversion. *Proceedings of the National Academy of Sciences, India. Section B, 91*(4), 777–787. https://doi.org/10.1007/s40011-021-01269-4

66. Ramirez, I. J. N., Angarita, C. C., & Zuluaga, H. J. O. (2007). Incorporación de cafeína en el hongo *Pleurotus sajor-caju* cultivado sobre pulpa de café. *Revista Iberoamericana de Micología, 24*(1), 72–74. https://doi.org/10.1016/s1130-1406(07)70008-6

67. Richard, E. N., Hilonga, A., Machunda, R. L., & Njau, K. N. (2020). Two-stage banana leaves wastes utilization towards mushroom growth and biogas production. *3 Biotech, 10*(12). https://doi.org/10.1007/s13205-020-02525-6

68. Romero-Arenas, O., Guerrero, M. A. M., Miguel, A. H., Valverde, B. R., & López-Olguín, J. F. (2015). Producción del hongo shiitake (*Lentinula edodes* Pegler) en bloques sintéticos utilizando residuos agroforestales. *Revista Mexicana de Ciencias Agrícolas, 6*(6), 1229–1238. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S2007-09342015000600007&lng=es&nrm=iso

69. Russel, S. (2004). *The essential guide to cultivating mushrooms*. Storey Publishing.

70. Sardar, H., Anjum, M. A., Hussain, S., Ali, S., Shaheen, M. R., Ahsan, M., Ejaz, S., Ahmad, K. S., Naz, S., & Shafique, M. (2022). Deciphering the role of moringa leaf powder as a supplement in the cotton waste substrate for the growth and nutrition of king oyster mushroom. *Scientia Horticulturae, 293*, 110694. https://doi.org/10.1016/j.scienta.2021.110694

71. Shimomura, N., & Hasebe, K. (2004). Estimation of viability of inner bark tissue of *Quercus serrata*, a substrate for log cultivation of *Lentinula edodes*, using the TTC assay method. *Mycoscience, 45*(5), 362–365. https://doi.org/10.1007/s10267-004-0188-6

72. Singh, R. (2017). A review on different benefits of mushroom. *IOSR Journal of Pharmacy and Biological Sciences, 12*, 2319-7676. https://doi.org/10.9790/3008-120102107111

73. Tesfay, T., Godifey, T., Mesfin, R., & Kalayu, G. (2020). Evaluation of waste paper for cultivation of oyster mushroom (*Pleurotus ostreatus*) with some added supplementary materials. *AMB Express, 10*(1). https://doi.org/10.1186/s13568-020-0945-8

74. Triyono, S., Haryanto, A., Telaumbanua, M., & Lumbanraja, D. J. (2019). Cultivation of straw mushroom (*Volvariella volvacea*) on oil palm empty fruit bunch growth medium. *International Journal of Recycling of Organic Waste in Agriculture, 8*(4), 381–392. https://doi.org/10.1007/s40093-019-0259-5

75. Ukwuru, M. U., Muritala, A., & U, E. (2018). Edible and non-edible wild mushrooms: Nutrition, toxicity and strategies for recognition. *Journal of Clinical Nutrition and Metabolism, 2*. https://www.scitechnol.com/peer-review/edible-and-nonedible-wild-mushrooms-nutrition-toxicity-and-strategies-for-recognition-dY0s.php?article_id=7395

76. Vega, A., León, J. A., Miranda, S., & Reyes, S. M. (2022). Agro-industrial waste improves the nutritional and antioxidant profile of *Pleurotus djamor*. *Cleaner Waste Systems, 2*, 100018. https://doi.org/10.1016/j.clwas.2022.100018

77. Wang, M., Gao, Y., Xu, Konishi, T., & Gao, O. (2014). *Hericium erinaceus* (Yamabushitake): A unique resource for developing functional foods and medicines. *Food & Function, 5*(12), 3055–3064. https://doi.org/10.1039/c4fo00511b

78. Wang, Q., Juan, J., Xiao, T., Zhang, J., Chen, H., Song, X., Chen, M., & Huang, J. (2021). The physical structure of compost and C and N utilization during composting and mushroom growth in *Agaricus bisporus* cultivation with rice, wheat, and reed straw-based composts. *Applied Microbiology and Biotechnology, 105*(9), 3811–3823. https://doi.org/10.1007/s00253-021-11284-0

79. Wang, Q., Meng, L., Wang, X., Zhao, W., Shi, X., Wang, W., Li, Z., & Wang, L. (2022). The yield, nutritional value, umami components and mineral contents of the first-flush and second-flush *Pleurotus pulmonarius* mushrooms grown on three forestry wastes. *Food Chemistry, 397*, 133714. https://doi.org/10.1016/j.foodchem.2022.133714

80. Yao, W., Zhang, J. C., Dong, C., Zhuang, C., Hirota, S., Inanaga, K., & Hashimoto, K. (2015). Effects of Amycenone on serum levels of tumor necrosis factor-α, interleukin-10, and depression-like behavior in mice after lipopolysaccharide administration. *Pharmacology, Biochemistry, and Behavior, 136*, 7–12. https://doi.org/10.1016/j.pbb.2015.06.012

81. Yildiz, S., Yildiz, U. C., Gezer, E. D., & Temiz, A. (2002). Some lignocellulosic wastes used as raw material in cultivation of the *Pleurotus ostreatus* culture mushroom. *Process Biochemistry (Barking, London, England), 38*(3), 301–306. https://doi.org/10.1016/s0032-9592(02)00040-7

82. Zárate-Salazar, R. J., Santos, M. N., Caballero, E. N. M., Martins, O. G., & Herrera, A. A. P. (2020). Use of lignocellulosic corn and rice wastes as substrates for oyster mushroom (*Pleurotus ostreatus* Jacq.) cultivation. *SN Applied Sciences, 2*(11). https://doi.org/10.1007/s42452-020-03720-z

83. Zervakis, G., Philippoussis, A., Ioannidou, S., & Diamantopoulou, P. (2001). Mycelium growth kinetics and optimal temperature conditions for the cultivation of edible mushroom species on lignocellulosic substrates. *Folia Microbiologica, 46*(3), 231–234. https://doi.org/10.1007/bf02818539

Urban planning in areas of environmental and flood risks: The Lagoas do Norte program, in Teresina, Piauí

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ABSTRACT

The population growth and the degree of urbanization of Teresina, the capital of the state of Piauí, influenced the disorderly occupation of areas closer to rivers and lagoons, which increased flood events, in addition to constituting areas of precarious infrastructure. This article discusses the relationship between the urban planning of Teresina and the conception of the Lagoas do Norte Program (PLN), highlighting its actions related to the guidelines provided for in the master plans of the municipality and the possible administrative transformations of the Municipality of Teresina. A bibliographic research was carried out on urban planning in Brazil, focusing on Sustainability, Strategic Planning and City Statute, and how such themes influenced the Master Plan of Teresina and the PLN. It was found that the PLN influenced the other subsequent plans and the possible administrative transformations of the Municipality of Teresina, focused on urban planning and the environment. It was also possible to see that the PLN presented conflicts of interest and disagreement between the actors involved, which occurred throughout the process of its implementation, verified through the local press, official documents, speeches by the technical team of the city hall and conversations with residents. It is emphasized, then, the need and importance of urban planning aimed at improving urban, social and environmental living conditions in cities.

Keywords: Urban Planning, Sustainability, Urban Requalification, Lagoas do Norte Program, Master Plan.

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INTRODUCTION

The accelerated process of urbanization experienced by Brazilian cities in the mid-twentieth century, combined with economic and political interests and the absence of environmental awareness, negatively interfered in the dynamics of cities, compromising their functions and spatial configuration, as it harmed the supply of water and energy, caused the degradation of the environment, increased poverty and insecurity (MARTINE; MCGRANAHAN, 2010).

Urban areas in Brazil have presented serious environmental problems, considerable changes in the landscape and critical points of degradation, such as illegal settlements, deficient infrastructure, as well as decharacterized and polluted preservation areas (Jacobi; Fracalanza; Silva-Sanchez, 2015). Teresina, the capital of the state of Piauí, which had an estimated population of 871,126 people for 2021 (IBGE, 2022), is not on the margins of this context. It presents problems that are also a reflection of the accelerated urban growth, evidenced in recent decades, highlighting the lack of housing, which leads the population, with lower income, to occupy public spaces or precarious areas, usually without infrastructure and considered at risk.

For Alvim, Kato and Rosin (2015), facing urban problems is complex, especially those of recovering degraded areas and maintaining housing in preserved areas, as there are political and operational difficulties inherent to the process of formation of Brazilian cities, thus requiring the convergence of urban and environmental policies. According to Coutinho *et al*. (2015), most Brazilian municipalities do not have a specific law that deals with the prevention of floods or landslides, however, they point out that, in some municipalities, the laws of land use and occupation, municipal zoning, or the master plan deal with the issue.

Master plans act as important instruments for city planning. Based on the City Statute, the Teresina Master Plan was created, "Sustainable Development Plan – Teresina Agenda 2015", constituting the normative and guiding instrument of the processes of urban transformation, its political-social, physical-environmental and administrative aspects, within the precepts of sustainability and the City Statute (TERESINA, 2006a), being instituted as the Teresina Master Plan.

Flooding problems are frequent in Teresina, considering that the city is located between two rivers, the Parnaíba and the Poti, and 28 points of flood risk areas in Teresina were mapped by the Civil Defense, concentrated in the North and Southeast zones (TERESINA, 2013). In this sense, some programs were conceived and developed by the Municipality of Teresina, aiming to comply with the guidelines proposed in the Agenda. Among these, the "Teresina Environmental Quality Improvement Program" was created, proposing measures for the environmental improvement of the capital. Thus, the Lagoas do Norte Program (PLN) was elaborated, aiming to improve the living conditions of the population, based on urban improvements and the promotion of socioeconomic and environmental development around the lagoons in the North Zone of Teresina (TERESINA, 2011).

The occurrence of floods or the overflow of watercourses is a natural phenomenon, characteristic of the areas of low course of rivers, and also responsible for the formation of plains and fluvial terraces. It is noteworthy that the dynamics of water in urbanized areas have specificities, where anthropic factors, such as buildings, pavements and intense occupation, determine the path and behavior of the waters (Viola; Nunes, 2014).

The North Zone of Teresina, in addition to occupying lower areas of the city, is formed by many lagoons. The neighborhoods that make up the so-called Lagoas do Norte de Teresina have a natural configuration composed of an extensive floodplain, which, without efficient planning, has undergone changes over the years, through hydraulic interventions, such as dikes, interconnection systems of the lagoons and level control systems, among others (TERESINA, 2007). It is noteworthy that the population growth and urbanization of Teresina contributed to the constant occupation of areas close to rivers and lagoons, enhancing flood events in rainy periods. Such events have worsened over the last 50 years, especially in areas of the North Zone, where the risks of flooding are greater. With this, it can be stated that the risk of flooding, associated with all the inherent losses, is high in the neighborhoods of Lagoas do Norte.

In this work, the relationship between the urban planning of Teresina and the conception of the Lagoas do Norte Program (PLN) was discussed, highlighting its actions related to the guidelines provided for in the city's master plans, under the influence of the themes Sustainability, Strategic Planning and City Statute.

METHODOLOGY

Research was carried out on urban planning in Brazil, in the light of Sustainable Urban Development, aiming to analyze how the themes of Sustainability, Strategic Planning and City Statute influenced the Master Plan of Teresina – Teresina Agenda 2015 and, consequently, the PLN. From there, it was examined how the PLN influenced the other subsequent plans and the possible administrative transformations of the Municipality of Teresina, focused on urban planning and the environment. in the light of Sustainable Urban Development.

To trace the process of elaboration of the Master Plan of Teresina, a bibliographic review was made on the importance of Brazilian urban planning in the management of cities, highlighting the role of the City Statute, as an instrument of Planning, as well as the role of Sustainability, as a guiding principle of the actions of managers in the city, to, finally, outline the origin of the Master Plan of Teresina – Teresina Agenda 2015, and also from the Lagoas do Norte Program (PLN).

To define the relationship, of approximation or distancing, between the Teresina Agenda 2015 and the PLN, the information, strategies and actions related to the macro objectives of the Teresina Agenda 2015 were compared to the elements and measures proposed in the PLN. Also, the programs,

and their respective actions, of the Teresina Agenda 2015 were compared with the actions of the PLN.

In order to establish possible relationships between the PLN and the other sectoral plans developed by the Municipality of Teresina, the objectives of each of these plans were analyzed, identifying the influences suffered and exerted by the PLN, considering factors that generated or guided the PLN, or the products, resulting from the PLN. While, to identify the transformations or permanences brought by the PLN, in the process of city planning and administrative management of the City of Teresina, official documents of the PLN, newspapers, articles and dissertations were researched.

The synthesis document of the "Teresina Agenda 2015" (TERESINA, 2002) and the article "Strategic planning and the Teresina Agenda 2015 plan" (AFFONSO, 2002) were also analyzed. Regarding this article, it is essential to determine its importance, as it allows the understanding of the decisions made in the realization of the Teresina Agenda, as well as the understanding of the processes adopted in its construction.

Other documents were also consulted, such as the sectoral plans: Urban Drainage Master Plan (PDDrU) (TERESINA, 2010); Teresina Urban Requalification Plan (PRU) (TERESINA, 2011); Master Plan for Urban Transport and Mobility (PDTU) (TERESINA, 2008); Municipal Plan for Basic Sanitation (PMSB) (TERESINA, 2013); Baseline study of NLP (TERESINA, 2002); Environmental Assessment of the Lagoas do Norte Program – Phase II (TERESINA, 2014), in which the results of phase 1 of the PLN are found; Environmental and Social Assessment Report (TERESINA, 2007).

The analysis of the process of elaboration of the Teresina Agenda 2015 involved the identification of its elements, the methodology used, the guidelines, the program proposals and the laws arising from this document, focusing on the pertinent documentation. With these data, the influences exerted by the themes of Sustainability, Strategic Planning and City Statute in the urban planning process of Teresina were compared.

To define the relationship, of approximation or distancing, between the Teresina Agenda 2015 and the PLN, the information, strategies and actions related to the macro-objectives of the Teresina Agenda 2015 were compared to the elements and measures proposed in the PLN. Also, the programs, and their respective actions, of the Teresina Agenda 2015 were compared with the actions of the PLN.

In order to establish possible relationships between the PLN and the other sectoral plans developed by the Municipality of Teresina, the analysis of the objectives of each of these plans was carried out, identifying the influences suffered and exerted by the PLN, considering factors that generated or guided the PLN, or the products, resulting from the PLN. While, to identify the

transformations or permanences brought by the PLN, in the process of city planning and administrative management of the City of Teresina, official documents of the PLN, newspapers, articles and dissertations were researched.

In addition, information and the perception of residents of the neighborhoods affected by the PLN were obtained from three academic meetings, such as extension courses and class disciplines, which dealt with the theme, which took place at the Federal University of Piauí (UFPI), in 2015 and 2016. In these moments, lectures were given by the technical team of the City Hall, both on Phase 1 and Phase 2 of the program, followed by a debate among the listeners, in which residents of Lagoas do Norte, a member of the State Public Prosecutor's Office and other interested parties participated, which was an opportunity for the population to put their demands.

RESULTS AND DISCUSSION

ORIGINS OF THE LAGOAS DO NORTE PROGRAM

From the analysis of the "Teresina Agenda 2015" (TERESINA, 2002) it was found that it was prepared considering the proposals of the strategic plan, using the SWOT analysis, in which the strengths and opportunities, and the weaknesses and their threats were pointed out. From then on, it focused on action, by proposing executable measures to achieve the idealized city, in addition to inserting a longer deadline in the Plan.

According to Affonso (2002), in the 2015 Agenda, scenario technology was used, assuming an integrated and participatory character, according to the City Statute, as it considered the relationships between the various urban functions and activities, in addition to the participation and commitments assumed by individuals, entities and public authorities at the three levels. However, there are authors such as Façanha and Viana (2012), who even agree with the strategic character assumed in the elaboration of the Teresina Agenda 2015, but disagree that it has managed to fully comply with the Statute of the City, especially regarding the participatory character, which according to the authors, did not exist.

Rezende and Ultramari (2007) consider that, in the action of planning, the process of elaboration of the municipal master plan or the municipal strategic plan is no less important than the results, considering relevant the learning of popular participation, technical understanding of reality and dialogue between actors with different interests. Therefore, it can be seen, based on Façanha and Viana (2012), that in the Teresina Agenda 2015, it was not possible to articulate this popular participation, defended by the Statute of the City.

For Façanha and Viana (2012), the process occurred in a fragmented and centralized way, because the Teresina society did not participate in the construction, it only became aware of the

Agenda, when the City Congress took place, after the need to carry out its legalization, as a matter of urgency.

After analyzing the Teresina Agenda 2015 document, the elements of the SWOT methodology can be perceived, with "the Teresina we have", "the Teresina we want" and "the Teresina we will make". Initially, he presented the diagnosis of reality, with the chapter "The Teresina we have" (TERESINA, 2002). The chapter "The Teresina we want" was outlined based on the technology of scenarios, the inertial and the desirable (TERESINA, 2002). Considering the desirable scenario, the objectives, strategies, programs and projects that would lead to a sustainable Teresina were outlined, proposing better conditions for citizens, and that could be carried out (TERESINA, 2002).

At the end of the process of elaboration of the Teresina Agenda 2015, in which the guidelines of the city planning were defined, based on the methodology of strategic planning, presenting in its structure several themes related to the urban environment, a set of 11 laws was produced, counting on the law of the Master Plan itself, reinstituted by law nº 3.558 of 20/10/2006 (TERESINA, 2006a), according to the new precepts stipulated by sustainability and the City Statute.

In the law of the Master Plan of Teresina, in its article 8, it is defined that for its objectives to be achieved, the following are necessary (TERESINA, 2006a, p. 3):

> [...] works, services and standards that comply with guidelines relating: economic development, consolidation of the health center, rural development, job and income generation, the environment, sanitation, use and occupation of urban land, the circulation and transportation system, revitalization of the urban center, housing, social assistance, health services, education, cultural activities and sports and leisure activities.

With the new Master Plan, trends from this historical period were incorporated, adopting the methodology of strategic planning to formulate its Agenda, in addition to inserting sustainability precepts, when proposing intervention programs in the city aimed at this area.

Coutinho *et al.* (2015) highlight that there is a lack in Brazilian municipalities in the use of instruments, such as the mapping of risk areas to support the planning of risk spaces. In this sense, in Teresina, with the institution of the Teresina Agenda 2015 in 2006 (TERESINA, 2006a) and with the mapping of risk areas in 2008 (TERESINA, 2013), several programs began to be conceived and developed by the Municipality of Teresina (PMT), with a view to complying with the proposed guidelines, thus making use of the planning instruments available at that time.

Among the laws created from the Master Plan, Complementary Law No. 3563 of 10/20/2006, which created environmental preservation zones, and instituted standards for the protection of assets of cultural value (TERESINA, 2006b); Complementary Law No. 3562 of 10/20/2006, which defined the guidelines for the occupation of urban land, guiding the occupation of land through densification, structuring and performance of urban functions (TERESINA, 2006c). From the laws arising from the

master plan, it was possible to identify the preservation areas, the zoning and regulation mechanisms of the road system, and also the allotment, which guided the interventions in the PLN.

The PLN consists of three basic requirements: Urban-Environmental Requalification, comprising the construction of sanitary infrastructure works, water supply, water drainage, urbanization, landscape transformation and population resettlement; Social, community and economic development; Municipal Management and Program Management (TERESINA, 2007). These interventions could be configured as urban marketing, which would translate into the revitalization of historic centers, beautification of flowerbeds and facades, serving to promote the "sale" of the city (SILVA, 2012). In addition to being able to identify this bias in the PLN, it is also possible to establish a parallel between the PLN and the first phases of Brazilian urbanism, such as beautification and sanitation and mobility works addressed by Villaça (1999).

The PLN is, therefore, the result of the strategic planning assumed by the city of Teresina, the result of the national context itself, related to the Statute of the City, Sustainability and Brazilian Agenda 21, being part of the urban interventions proposed in the 2015 Agenda, in the search for sustainable urban development, although this may have remained at the document level, without actually materializing in the actions.

URBAN PLANNING AND THE LAGOAS DO NORTE PROGRAM

Alvim, Kato and Rosin (2015) point to the conflict between urban policies, which aim at the territorial planning of cities, and environmental policies, which prioritize the protection and recovery of natural resources, constituting a difficulty in the management of areas of protection of springs or watercourses.

In this sense, it was sought to understand how the PLN planning process occurred, from the perspective of Strategic Planning and the elements of Sustainable Urban Development, and articulating with the other plans of the city of Teresina.

Through the analysis of the official documents of the PLN, it was possible to identify the same elements of strategic planning, the use of the SWOT methodology, adapted to urban planning, and also sustainability, explored in the Teresina Agenda 2015. As it is possible to verify, the approximation of the components involved in the PLN to the elements identified by Lourenço (2003), reality (definition of the problem), structuring, alternatives, evaluation, uncertainties, plan (planning, commitment and actions).

The first point identified was the production of the diagnosis, carried out of the neighborhoods of the PLN, showing the location on the map, its area of coverage and the population directly involved, the relief, the history of social, flooding, environmental and urban planning problems, and

which, later, was incorporated and improved in the elaboration of the Urban Drainage Master Plan (PDDrU).

In the other stage, based on scenario technology, the weaknesses to be repaired in the sense of strengthening were identified, highlighting: improvements in environmental conditions, quality of life and income of the population in the intervention area; improvement of the management capacity of the City Hall in the financial, urban, environmental, provision of basic services and economic development (TERESINA, 2007). And also the strengths of the area, such as taking advantage of the landscape and leisure potential of the lagoon area, to achieve an improvement in the quality of life and income (TERESINA, 2007).

In this aspect, it is possible to reconcile urban planning, with a view to the future, with the practices of urban management and governance defined in the City Statute, discussed by Goulart, Terci and Otero (2015) and Faria (2009).

When comparing the goals and strategies focused on the Environment and Sanitation, present in the Teresina Agenda 2015, with the elements and measures contemplated by the PLN, the following relationship is found (Chart 1):

Table 1. Comparison between the proposals of the 2015 Agenda and the objectives and measures of the PLN

Agenda 2015	Elements of the 2015 Agenda contemplated by the PLN	NLP Measures
Macro-objectives	Valuing environmental heritage	Depollution of the lagoons.
		Preservation of its banks.
		Increase in green areas.
	Reduction of flood risk areas	Improvement of the drainage system.
	Water supply system for the entire population	Improvement and reinforcement of the water supply system.
	The sewage collection system for the entire population	Expansion of the sewage network.
Strategies	Promote environmental education	Promotion of environmental education in neighborhood workshops.
	Structuring of the public power to execute the municipal environmental policy.	Restructuring and Training of the Municipal Agency for the Regulation of Public Services – ARSETE.
		Preliminary study for the Administrative Reform and Modernization of the City Hall.
		Acquisition of computer equipment and software for the departments involved.
		Assembly of the database with physical and socioeconomic information of the Neighborhoods of Teresina, especially the 13 neighborhoods of the PLN.
		Preparation of some Sectoral Plans
	Monitor the availability and quality of water resources.	Monitoring of the waters of the lagoons, after the implementation of the first phase.
Actions	The promotion of revegetation in river terraces	Urban interventions that included revegetation.
	Recovery of the vegetation of the streams valleys	Cleaning and displacement of houses on the banks
	Relocation of buildings that occupy risk areas	Resettlement of families in the Zilda Arns Residential, located in an area close to the intervention that is part of the Program, or payment of compensation.

Source: Teresina (2002; 2014).

A relationship is observed between what was defined in the Teresina Agenda 2015, referring to the macro-objectives, strategies and actions, and the measures adopted by the PLN, thus confirming the need and importance of urban planning, with a strategic bias, and, in the specific case, the effective articulation between planning and action, as defined in Faria (2009). Although it cannot be said that the measures adopted in the PLN, in fact, have achieved total effectiveness, in the sense of solving the problems diagnosed in the neighborhoods.

The neighborhoods in which Lagoas do Norte are located, at the time of the drafting of the PLN, were marked by inadequate buildings and lack of sanitation. After the implementation of the first phase of the PLN, it is possible to verify, in images from June 2016, the changes brought about by the urban requalification carried out, especially in relation to the cleaning and preservation of the banks (Figure 1) and sanitation works carried out (Figure 2).

Figure 1 – Cleaning and preservation of the lagoons

Source: Photo by the authors (2016)

Figure 2 – Sanitation works

Source: Photo by the authors (2016)

When comparing the previous situation with the situation after the intervention, there were improvements in particular, preservation and expansion of green areas and improved sanitation, although for this, it was necessary to remove some families, which could be considered a negative point, as it involves issues of territoriality, sense of belonging and construction of neighborhood and social relations with the place.

Eight programs were proposed in the Teresina Agenda 2015: Legal Nature Program; Green and Beautiful City Program; Clean City Program; Solar Energy Harnessing Program; Sanitary Sewage Program; Water Supply Program; Solid Waste Management Program; Urban Drainage Program (TERESINA, 2002).

When analyzing the actions proposed in the various programs of the 2015 Agenda, it is possible to perceive an approximation with those of the PLN, in more than one program (Chart 2).

Table 2 – Comparison between the Agenda 2015 Programmes and the actions of the PLN

Programs Agenda 2015	Actions	NLP Actions
Legal Nature	Create a body with specific attribution to execute the municipal environmental policy.	Preliminary study for the Administrative Reform and Modernization of the City Hall.
Green and Beautiful City	Create new parks, squares and gardens.	Lagoas do Norte Linear Park: Monumental Square, playgrounds, kiosks, contemplation areas, outdoor gyms, courts, cleaning of lagoons and canals.
	Promote revegetation and containment works on slopes, slopes and river terraces.	Urban interventions that included revegetation.
	Promote the relocation of buildings that occupy risk areas.	Resettlement of families to the Zilda Arns Residential, or payment of compensation.
Clean City	Promote the urbanization of lagoon areas for use with cultural, sports, leisure and tourism activities.	Lagoas do Norte Linear Park: Monumental Square, playgrounds, kiosks, contemplation areas, outdoor gyms, courts, cleaning of lagoons and canals.
	Prevent the deliberate grounding of ponds and their use as domestic or industrial sewage dumping areas.	Creation of the linear park and expansion of the sewage network.
	Develop a specific environmental education program for the population around the lagoons.	Promotion of environmental education in neighborhood workshops.
Harnessing Solar Energy	-	He did not contemplate.
Sanitary Sewage	Develop and implement a new project for the sanitary sewage system for the entire population of Teresina.	He expanded the sewage network. The Zilda Arns residential has already been built with a sewage collection network.
Water Supply	Develop and implement a new project for the water supply system to serve the entire urban and rural population uninterruptedly.	Reinforcement of the water supply network.
Solid Waste Management	Set up selective collection structures.	Construction of the Carroceiros transshipment station for selective collection.
Urban Drainage	Prepare and implement the Urban Drainage Master Plan (PDDrU) for Teresina.	Macro drainage works: expansion of the pump houses, improvement of the rainwater pumping station and construction of the drainage system. He prepared the PDDrU.

SOURCE: Teresina (2002; 2014)

It was also found the presence of elements of Sustainable Urbanism, defined in Farr (2013) and Sustainable Urban Development, contained in United Nations (2015), as it involved environmental requirements such as environmental protection and preservation, represented by depollution actions and increase of the green area. Also, social requirements were found, from the insertion of leisure areas and cultural activities, in addition to the citizenship actions promoted in the

Lagoas do Norte Park; governance requirements verified with the restructuring of some administrative sectors of the Municipality of Teresina, focused on urban planning and environmental policies (Chart 1) and (Chart 2).

It was possible to establish a link between the main documents prepared during the conception and monitoring of the PLN, in its first phase, with the documents of the other sectoral plans, related to or that supported the PLN, and also with those that originated from it, considering, therefore, the factor that generated or influenced the PLN, or the product, resulting from the PLN (Chart 3). In addition, the existence of articulation of the planning, as well as of an integrated process, between the master plan and the sectoral plans, in the process of formulation and execution of the PLN (Chart 1), (Chart 2) and (Chart 3) was identified. Thus, the PLN, as a program, was able to add elements of the various programs proposed in the Teresina Agenda 2015, to the extent that the actions of the PLN addressed the actions present in the Teresina Agenda 2015.

Table 3 – The factors influencing the PLN and the documents produced after the PLN

Document	Year	Factor / Productb	Objectives
Teresina's Sustainable Development Plan, Agenda 2015	2002	Factor	Discuss and chart a course for the future of the city of Teresina, thus elaborating its Agenda 21. Established the Teresina Master Plan
Law No. 3558/2006	2006	Factor	Reinstitute the Teresina Master Plan, called Sustainable Development Plan – Teresina Agenda 2015.
Environmental Assessment Report (AAR)	2007	Factor	Present an environmental assessment of the components of the NLP, in Teresina, PI, aimed at preparing the Project for financing at the World Bank (IBRD).
Urban Drainage Master Plan (PDDrU)	2010	Product	Definition of institutional guidelines aimed at establishing conditions of sustainability for urban drainage policies; Characterization of the hydraulic operating conditions of the existing drainage system; Proposal, at the preliminary project level, of works necessary to solve the urban drainage problems found in Teresina.
Preparation of the Municipal Basic Sanitation Plan (PMSB)	2013	Product	Diagnosis of the basic sanitation situation to consolidate information on environmental health conditions and basic sanitation services, considering current data and projections such as the population profile, the epidemiological and health situation, socioeconomic and environmental indicators, performance in the provision of services and data from other sectors.
Urban Transport and Mobility Master Plan (PDTU)	2008	Product	Establish the guidelines for the organization of the implementation of urban transport infrastructure and services, in accordance with the objectives and assumptions of the Government and society. It aims to formulate public policies on the subject, which will later be implemented.
Urban Requalification Plan (PRU)	2011	Product	To constitute an instrument of planning and management of the municipality containing a set of structuring projects.
NLP Baseline Study	2012	Product	Research in the intervention area of the first phase of the NLP, identifying the housing conditions, urban infrastructure and available urban services.
PLN – Indicators and Targets	2014	Product	Identify the goals and values, in each year of the Program's execution, that remained, or were revised or created during the process.

Environmental Assessment of the Lagoas do Norte Program – Phase II, environmental and social assessment report.	2014	Product	Evaluate the implementation of the interventions of the Lagoas do Norte I Program regarding compliance with the Environmental and Social Management Plan (PGAS); Identify critical moments, benefits, alternatives and environmental risks in order to prevent and/or mitigate them; Ensure that environmental issues are assessed in the decision-making process; Understand and characterize the legal and institutional context in which the Program is inserted; Provide mechanisms for social control and dissemination of information about the Program;

SOURCE: Teresina (2002; 2006a; 2007; 2008; 2010; 2011; 2012; 2013; 2014).
[a] Fator – Taxable or influencing event of the Lagoas do Norte Program.
[b] Product – Subsequent product, deriving, or resulting from PLN.

The constant presence of references made to the Lagoas do Norte Program in the sectoral plans indicates a probable influencing role of the PLN, thus assuming a possible modifying character, which guides the actions of the City Hall. This can be evidenced from the analysis of the various sectoral plans: Urban Requalification Plan (PRU), Urban Drainage Master Plan (PDDrU), Municipal Basic Sanitation Plan (PMSB), Urban Transport and Mobility Master Plan (PDTU), produced or commissioned by the Municipality of Teresina. It should be noted that there are also legal determinants, belonging to the national policy, that define the existence of these sectoral plans, such as the Sanitation Law No. 11,445/2007 (BRASIL, 2013), the City Statute itself (BRASIL, 2001), the Manual for the Rehabilitation of Central Urban Areas (BRASIL, 2015), as well as the national considerations and studies on urban mobility.

By introducing a new form of urban requalification intervention, based on the sustainability criteria inserted by international organizations – the World Bank, an agency linked to the UN, and which finances the PLN – in those established by the national sanitation policy, in project management, and in the modification of urban governance, the PLN enabled a connection between the other sectoral plans and programs of the Municipality of Teresina.

The experience with the PLN allowed the Municipality of Teresina to insert new approaches and new principles used in other sectoral plans and intervention programs, even though it remained at the level of documents, without necessarily presenting actual results.

This can be perceived, for example, from the reading of the Teresina Urban Requalification Plan (PRU), which was based on Teresina's plans, prior to the City Statute, such as the Integrated Local Development Plan (PDLI), Teresina's Structural Plans (PET) and in the post-City Statute plan, the Sustainable Development Plan (PDS) – Teresina Agenda 2015, and that it constitutes an instrument of planning and management of the municipality, in which there are numerous structuring projects (TERESINA, 2011).

It was identified, in the ongoing programs of the Urban Requalification Plan (PRU), that the PLN was framed in the level of importance and local interest, embedded in the thematic axis of urban

requalification, in addition to the implementation of urban infrastructure and institutional services (TERESINA, 2011).

The document of the Urban Drainage Master Plan (PDDrU), carried out within the scope of the PLN, contains the physical characterization of the entire hydrographic basin, in which Teresina is inserted, in addition to other information of a social and environmental nature, referring to the sub-basins of Lagoas do Norte (LDN) and Mocambinho (MOC) (TERESINA, 2010). Direct information about the PLN area can be found in Tomo 3 and 5 of the Urban Drainage Master Plan (PDDrU) (TERESINA, 2010).

The Master Plan for Urban Transport and Mobility (PDTU), although it does not mention the PLN, included it in component 1 – within the strategic environmental attributes identified, such as the environmental quality of the waters of the Parnaíba River – defined in the PLN Evaluation Report, as a measure achieved (TERESINA, 2014).

The Municipal Plan for Basic Sanitation (PMSB) alludes to the PLN, when it characterizes the municipality, under the social, economic, cultural and environmental aspects. The PLN is treated as an intervention that will correct the damage caused by the extraction of clay, an economic activity characteristic of the region (TERESINA, 2013). In the diagnosis of the sewage system and in the projects in progress that deal with basic sanitation, the NLP is framed in the item of current investments in basic sanitation (TERESINA, 2013).

Regarding the first phase of the program, it was reported that there was difficulty in articulating, due to the separate contracting of the basic and executive projects, and that therefore in the next phases, the procedure should be remedied (TERESINA, 2014). The difficulty in complying with the planning provided for in the PLN shows that, even with the planning, the bureaucratic organization, represented by the separate contracting of the projects, and the political structuring, adopted by the government, directly interfere in the implementation of the plan.

TRANSFORMATIONS AND PERMANENCES IN THE MUNICIPAL MANAGEMENT OF TERESINA

According to Travassos (2012), administrative restructuring is a fundamental part of interventions involving urban drainage, and must be adequately addressed. And for this to occur, first of all, institutional changes must be made.

In order for the actions of the PLN, related to drainage and all others involved, to have support, technical guidance, and influences on other decisions, based on the principles of Sustainable Urban Development, it was necessary to reformulate the form of public management of the Municipality of Teresina. And that was what the PLN tried to promote, even though the program did not have the necessary strength to, in fact, change municipal governance.

On the official website of the Municipality of Teresina, it was possible to identify as a product of the PLN, elements of modernization of Municipal Management, Urban Development and Project Management, based on the following actions (TERESINA, 2011a):

1) Preparation of the Urban Drainage Master Plan (PDDUr), the Urban Transport and Mobility Master Plan (PDTU) and the Municipal Water and Sewage Plan (PMAE);
2) Restructuring project of the Municipal Superintendence of Transport and Traffic (STRANS);
3) Restructuring and training of the Municipal Agency for the Regulation of Public Services (ARSETE);
4) The study of the "Baseline" of the NLP area to measure economic, social and environmental impacts;
5) Acquisition of computer equipment and software for the Municipal Secretariat of Planning and Coordination (SEMPLAN), Municipal Secretariat of Finance (SEMF), Municipal Secretariat of Administration and Human Resources (SEMA), Municipal Secretariat of Education (SEMDEC), Teresinense Data Processing Company (PRODATER), Superintendencies of Urban Development (SDU's);
6) Preliminary study for the Administrative Reform and Modernization of the City Hall (to be implemented in the second Phase) and for the Database with physical and socioeconomic information of the Neighborhoods of Teresina, highlighting the 13 Neighborhoods of the PLN.

The PLN is a program with several partners, the World Bank and the Federal Government, which allowed the modernization of municipal planning, considered by the Technical Team of the Municipality of Teresina, as one of the points of improvement in the performance of the City Hall itself, because in the PLN, several consultancies were developed, which led to the elaboration of other plans, such as the Master Plan for Urban Transport and Mobility (PDTU) and the Master Plan for Urban Drainage (PDDUr).

The fact that the Municipality of Teresina organizes the social, economic and physical data of the neighborhoods, present in Teresina (2015a), would already be a step to instrumentalize the administrative management of the city, providing diagnostic material to support the essential and priority interventions of the city, thus designing programs of urban interventions.

Goulart, Terci and Otero (2015) identified that there is a limitation of participatory experience when preparing Master Plans. This fact occurs due to the inability of institutions to absorb this new model, or due to the lack of articulation of the majority of the population in exercising their citizenship. The authors also state that this finding contradicts the expectations created throughout the process of Brazilian redemocratization, that participation would automatically be adopted and would

represent democracy, by attenuating the political weight of the ruling elites and sufficient for the distribution of goods and services.

In Brazil in general, in programs of this nature, which involve environmental issues, housing and administrative reformulation of management agencies, conflicts occur. As found by Castro (2016), when he identified the need for greater discussion on the instruments used in the intervention of communities, in studies of involuntary resettlements in urbanization and sanitation programs, such as PROBACANGA, in São Luís, Maranhão, financed by the International Bank for Reconstruction and Development (IBRD); PROMABEN, in Belém, Pará, and PROSAMIM, in Manaus, Amazonas, programs supported by the Inter-American Development Bank (IDB).

These findings were used as a guide, as they allowed the analysis of the PLN, also financed by the IBRD, under the same arguments. Considering popular participation as one of the elements of the current urban planning model, adopted by Brazilian cities, under the bias of strategic planning and based on the City Statute, it is possible to identify some conflicts regarding this element in the elaboration and execution of the PLN.

For the Municipality of Teresina, there has always been constant dialogue, represented by the Lagoas do Norte Committee, created in 2008, and by the Lagoas do Norte Forum, created in 2011 (TERESINA, 2015b), both of which monitor and supervise the actions of the program, both with the City Hall team and with the World Bank's technical team. Despite this, part of the residents complain about the lack of information, clarification and discussions (TERESINA, 2015c). It is observed, then, that although the city hall maintains an open channel for dialogue, it may not have been enough to meet the expectations of the population involved.

The presence of the Socio-Environmental Project Unit (UPS) is considered an essential element in the dialogue with the local community, because according to the city hall it allowed dialogue, and continuous monitoring by community representatives, in the decisions and execution of interventions (TERESINA, 2014).

The incipient character of popular participation in the urban planning actions and policies developed by the Municipality of Teresina, still during the formulation of the Teresina Agenda 2015 (Façanha; Viana, 2012), was also found in the PLN. Popular and institutional resistance was identified through conversations with residents and also evidenced by reports at the local level, at the time of implementation of the actions proposed by the PLN and other plans.

It was reported by residents of the PLN neighborhoods that the technical team of the Teresina City Hall responsible for the PLN, even providing information about the Program, still does not all points are clarified or are not accepted by residents, requiring more discussions and adaptations of the interventions

Other points of disagreement were identified in the meetings, held to address essential issues that needed clarification, related to the PLN, such as the public consultation of November 2014 (TERESINA, 201-b), and the public hearings of April 2010 (CÂMARA..., 2010), February 2015 and March 2015 (TERESINA, 2015b). These hearings were motivated by interference, from residents and the State Public Prosecutor's Office, in search of answers, clarifications and positions on the actions of the PLN.

At the beginning of 2014, according to information from the local press, the Lagoas do Norte Committee, composed of the 13 neighborhoods, social organizations of potters, carters, collectors, artisans and others, through a report generated after inspections carried out in the works, requested interventions by the City Hall, in order to adapt the Program to the economic and cultural characteristics of the region (COMMITTEE..., 2014). Among other demands, the construction of the "Praça dos Orixás", the installation of ecological signs, training of carters, construction of more popular academies and regional characterization of markets were requested (COMITÊ..., 2014). The report also found that only eight requests were met, while 11 were partially met and 35 have not yet been met (COMMITTEE..., 2014).

The residents' claims reflect what Penna and Ferreira (2014) argued, about the need for incentives through public policies and resource allocation, aimed at information, professional training, income and work formation, education, health, exercise of citizenship, so that this population has access to professional and technical skills, equipping themselves to overcome social vulnerabilities.

The residents' claims, contained in the public hearings, and the negative effects may represent failures in the process of developing the PLN proposals, or the absence of conversations, in which the residents' demands have been defined, at the time of PLN planning.

Even though the program is important for the population, it is necessary to reach an agreement between the parties in order to make the intervention actions compatible with the community's desires, that is, that the relationships performed over the years by that community are respected, and that the recreated space contemplates neighborhood, economic and cultural relations. and that the population understands and appropriates the benefits acquired. These actions were highlighted by Penna and Ferreira (2014), when analyzing the interventions promoted by the Social and Environmental Program of the Manaus streams (PROSAMIM), which are areas similar to the neighborhoods of the PLN.

In this sense, it is important to highlight, as stated by Duarte and Malheiros (2012), that the population involved does not always recognize the existing environmental problems, relating them to the form of occupation, as well as do not realize that anthropic actions cause an impact on water resources. Therefore, in order for there to be popular acceptance, the confrontation of the

environmental problem, which also involves the housing issue, involves the adoption of an integrated strategy with other sectors (Duarte; Malheiros, 2012),

For Gadens, Hardt and Frey (2012), the relationship between politics and society is a challenge for urban managers in the search for legitimacy, especially in large urban projects, in which the insertion of participatory practice is essential for minimizing the risks involving this type of intervention, as well as its externalities and negative impacts.

Thus, it is understood that there is much to be developed and built, in order to reconcile the desires of the population with the management practices of the public power, at least at the municipal level, in the city of Teresina, both in the practices of construction of master plans and in the execution of intervention programs.

FINAL CONSIDERATIONS

The Lagoas do Norte Program (PLN) is the result of the Teresina Agenda 2015, which in turn followed the trends of the moment experienced in the country, redemocratization, strategic urban planning, the influences of Global Agenda 21 on public policies, the approval of the City Statute and the elements of Sustainable Urban Development.

The process of elaboration of the Teresina Agenda 2015 explains the origin of the PLN. As well as, from the laws arising from the master plan, it was possible to identify the preservation areas, the zoning and regulation mechanisms of the road system, and also the allotment, which guided the interventions in the PLN.

The PLN used the same methodology as the Teresina Agenda 2015, in addition to fitting into the guidelines of the master plan, related to the environment and sanitation. The phases implemented by the PLN have been contemplating exactly these guidelines, through the execution of urban drainage actions, sanitation, requalification of degraded areas, creation of a linear park around some lagoons and removal of buildings on the immediate banks of the lagoons. There is, therefore, a relationship of approximation between the Teresina Agenda 2015 and the PLN, which corroborates the influence of the City Statute, Strategic Planning and Sustainability.

It should be noted that the experience and importance assumed by the PLN influenced the preparation of later plans for the city of Teresina, among them the Urban Transport and Mobility Master Plan (PDTU) and the Urban Drainage Master Plan (PDDUr). The PLN also contributed to the process of modernization of municipal planning, as it restructured administrative sectors, focused on planning and finance, in addition to producing a database, social, economic, urban and risk area information, which can be used to support future decisions and interventions.

At the same time, it was observed that the PLN presented conflicts of interest and disagreement between the actors involved, to the extent that, throughout the process of its

implementation, it was possible to make this finding, through the local press, official documents, speeches by the technical team of the city hall and conversation with the residents.

The proposals and actions promoted by the PLN involved elements of Sustainable Urban Development, to the extent that urban planning aimed at facing the urban, social and economic problems of poor neighborhoods and with environmental problems in the city of Teresina was present, seeking to mitigate the negative effects of human occupation.

It was possible to verify in the PLN the existence of proposals and actions that contemplated transformations of adverse situations involving environmental, social and governance issues, finding, then, elements of Sustainable Urbanism.

The importance of the NLP is associated with its potential to contribute to the solution of problems not only of urban drainage, but also of sanitation, environmental degradation and also those related to the social area.

It is emphasized the need and importance of urban planning and initiatives such as those being implemented in Teresina, which aim to improve urban, social and environmental living conditions in the city. Although the popular participation in the planning and decision-making process, of the PLN and the city hall, still needs to have its approach improved and effectively adopted, starting to play the role expected and guided by the City Statute and Sustainable Urban Development.

REFERENCES

1. Affonso, C. A. A. (2002). Planejamento estratégico e o plano Agenda 2015. *Scientia et Spes*, 1(2), 71-92.

2. Alvim, A. T. B., Kato, V. R. C., & Rosin, J. R. G. (2015). A urgência das águas: intervenções urbanas em áreas de mananciais. *Cadernos Metrópole*, 17(33), 83-107.

3. Brasil. Ministério das Cidades. (2015). *Manual Reabilitação Urbana com foco em Áreas Centrais*. Brasília.

4. Brasil. Ministério das Cidades. (2013). *Plansab – Plano Nacional de Saneamento Básico: mais saúde com qualidade de vida e cidadania*. Secretaria Nacional de Saneamento Ambiental. Brasília.

5. Brasil. Senado Federal. (2001). Lei n. 10.257, de 10 de julho de 2001. Estabelece diretrizes gerais da política urbana e dá outras providências. *Diário Oficial da União*, 133, Seção 1, 1-5.

6. Câmara realiza audiência pública sobre o Programa Lagoas do Norte. (2010, abril 10). *180graus*. http://180graus.com/banda-larga/camara-realiza-audiencia-publica-sobre-projeto-lagoas-do-norte-314766.html

7. Castro, R. A. (2016). Os reassentamentos involuntários em programas de urbanização e de saneamento: os casos Promaben, Prosamim e Probacanga. *Urbe. Revista Brasileira de Gestão Urbana*, 8(3), 425-437.

8. Comitê Lagoas do Norte apresenta relatório e cobra auxílio da Prefeitura. (2014, janeiro 20). *180graus*. http://180graus.com/politica/comite-lagoas-do-norte-apresenta-relatorio-e-cobra-auxilio-da-prefeitura

9. Coutinho, M. P., Londe, L. R., Santos, L. B. L., & Leal, P. J. V. (2015). Instrumentos de planejamento e preparo dos municípios brasileiros à Política de Proteção e Defesa Civil. *Urbe. Revista Brasileira de Gestão Urbana*, 7(3), 383-396.

10. Duarte, C. G., & Malheiros, T. F. (2012). Habitação e gestão ambiental em áreas de mananciais: o caso do município de Santo André. *Saúde e Sociedade*, 21(supl. 3), 82-95.

11. Façanha, A. C., & Viana, B. A. S. (2012). Planejamento e gestão urbana em Teresina (PI): notas da agenda 2015 como plano diretor. *Revista Equador*, 1(1), 60-78.

12. Faria, L. (2009). Planejamento estratégico, estatuto da cidade e plano diretor: métodos e instrumentos de organização e gestão do espaço urbano. *Caminhos de Geografia*, 10(32), 162-170.

13. Farr, D. (2013). *Urbanismo Sustentável: desenho urbano com a natureza*. Bookman.

14. Gadens, L. N., Hardt, L. P. A., & Frey, K. (2012). Das práticas de gestão de Grandes Projetos Urbanos. *Saúde e Sociedade*, 21(supl. 3), 21-32.

15. Goulart, J. O., Terci, E. T., & Otero, E. V. (2015). Participação política e gestão Urbana sob o Estatuto da Cidade. *Urbe. Revista Brasileira de Gestão Urbana*, 7(1), 122-135.

16. Instituto Brasileiro de Geografia e Estatística. (2022). Teresina Panorama. Disponível em: https://cidades.ibge.gov.br/brasil/pi/teresina/panorama. Acesso em: 15 dez. 2022.

17. Jacobi, P. R., Fracalanza, A. P., & Silva-Sánchez, S. (2015). Governança da água e inovação política de recuperação de recursos hídricos de São Paulo. *Cadernos Metrópole*, 17(33), 61-81.

18. Martine, G., & McGranahan, G. (2010). A transição urbana brasileira: trajetória, dificuldades e lições aprendidas. In R. Baeninger (Org.), *População e Cidades: subsídios para o planejamento e para as políticas sociais* (pp. 11-24). Campinas: Núcleo de Estudos de População – Nepo/ Unicamp; Brasília: UNFPA.

19. Penna, N. A., & Ferreira, I. B. (2014). Desigualdades socioespaciais e áreas de vulnerabilidades nas cidades. *Mercator*, 13(3), 25-36.

20. Rezende, D. A., & Ultramari, C. (2007). Plano diretor e planejamento estratégico municipal: introdução teórico-conceitual. *Revista de Administração Pública*, 41(2), 255-271.

21. Silva, E. R. (2012). O planejamento estratégico sem plano: uma análise do empreendedorismo urbano no Brasil. *Revista de Geografia e Ordenamento do Território*, (2), 279-306.

22. Teresina. Secretaria Municipal de Planejamento e Coordenação (SEMPLAN). (2014). *Avaliação Ambiental do Programa Lagoas do Norte – Fase II, relatório de avaliação ambiental e social*. Prefeitura Municipal de Teresina.

23. Teresina. Secretaria Municipal de Planejamento e Coordenação (SEMPLAN). (2013). *Plano municipal de saneamento básico de Teresina*. Prefeitura Municipal de Teresina.

24. Teresina. Secretaria Municipal de Planejamento e Coordenação (SEMPLAN). (2010). *Plano Diretor de Drenagem Urbana de Teresina*. Prefeitura Municipal e Concremat Engenharia.

25. Teresina. Superintendência Municipal de Transporte e Trânsito (STRANS). (2008). *Plano Diretor de Transportes Urbanos e Mobilidade*. Prefeitura Municipal de Teresina.

26. Teresina. Secretaria Municipal de Planejamento e Coordenação (SEMPLAN). (2007). *Relatório de Avaliação Ambiental do Programa de Melhoria da Qualidade Ambiental de Teresina: Programa Lagoas do Norte*. Prefeitura Municipal de Teresina.

27. Teresina. (2006a). Lei nº 3.558 de 20 de outubro de 2006. Reinstitui o Plano Diretor de Teresina. *Diário Oficial do Município (DOM)*, nº 1124, 27 out. 2006, 1-8.

28. Teresina. (2006b). Lei Complementar nº 3.563 de 20 de outubro de 2006: cria zonas de preservação ambiental, institui normas de proteção de bens de valor cultural. *Diário Oficial do Município (DOM)*, nº 1124, 27 out. 2006, 54-59.

29. Teresina. (2006c). Lei Complementar nº 3.562 de 20 de outubro de 2006. Define as diretrizes para a ocupação do solo urbano. *Diário Oficial do Município (DOM)*, nº 1124, 27 out. 2006, 48-54.

30. Teresina. Secretaria Municipal de Planejamento e Coordenação (SEMPLAN). (2002). *Teresina: Agenda 2015. Plano de Desenvolvimento Sustentável*. Prefeitura Municipal de Teresina.

31. Travassos, P. (2012). Inundações urbanas: uma questão socioambiental. *Revista de Gestão Ambiental e Sustentabilidade*, 1(1), 88-105.

32. United Nations. (2015). *Third united nations conference on housing and sustainable urban development (Habitat III): Guidelines and format for the preparation of national reports: on six key topics, thirty issues and twelve indicators*. United Nations.

33. Villaça, F. (1999). Uma contribuição para a história do planejamento urbano no Brasil. In C. Deák & S. R. Schiffer (Orgs.), *O processo de urbanização no Brasil* (pp. 170-243). São Paulo: Editora da Universidade de São Paulo.

34. Viola, H., & Nunes, R. T. S. (2014). Medidas de adaptação para áreas vulneráveis a eventos hidrológicos: ensaio para a gestão das águas no estado do Rio de Janeiro. In M. F. R. Ribeiro, M. A. V. Freitas, & L. P. Rosa (Orgs.), *Vulnerabilidade e ações de adaptação dos recursos hídricos às mudanças climáticas no Brasil* (pp. 123-137). Rio de Janeiro: Interciência.

Perineal abscess in pediatrics

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ABSTRACT

Perineal abscess is a clinical condition that involves the formation of purulent collections in the perineal region, presenting significant debilitating potential due to its high vascularization, which favors the spread of infection and can progress to serious complications such as sepsis and Fournier's syndrome. This article reviews the complexity of the management of perineal abscess in children, highlighting its multifactorial etiology and the need for an individualized approach in diagnosis and treatment, also exposing a case report of perineal abscess in a pediatric patient. The current literature indicates that the appropriate choice of antibiotics, such as ceftriaxone, metronidazole, amoxicillin/clavulanate, and trimethoprim/sulfamethoxazole, is crucial for infection control and prevention of complications, including recurrences and spread of infection. In addition to antibiotic therapy, early surgical drainage is often required for effective management. This study was conducted with a case report on the topic in question, followed up in a pediatric service of a teaching hospital,

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and through a literature review. To this end, recent scientific articles and theses were used, highlighting the importance of new research to broaden the understanding of the subject and improve clinical results in future cases.

Keywords: Perineal abscess, Perineal infection in pediatrics, Pediatric perineal abscess, Perineal injury.

INTRODUCTION

Perineal abscess is a clinical condition that is characterized by the formation of purulent collections in the perineal region and has great debilitating potential for affected patients. This is because this region is very vascularized, favoring the spread of the infection, which can progress to sepsis and/or in a more localized way, to Fournier's Syndrome, affecting anatomical structures in the region, which, once injured, can have alteration or loss of functionality or even tissue loss due to the necrosis and healing processes involved.

Although medicine has evolved a lot in recent years, this clinical condition presents itself as a challenge, which requires not only the treatment of the pathogen (emphasizing the fact that it is a site of easy contamination and recontamination), but also a more comprehensive look at each case, since it can be the result of multiple and different predisposing factors, including inflammatory bowel diseases (IBD), glandular obstruction, local trauma, among others.

Based on the multifactorial etiology of perineal abscesses in children, their resolution and control are challenging, such as when there are associated IBDs or, depending on the affected site, due to local colonization, in addition to the extent of the perineal abscess; factors that directly influence the choice of initial treatment and the clinical evolution of the patient. Therefore, it is a complex approach that is extremely important for the survival and quality of life of these children. To this end, it is essential to have an individualized approach to diagnosis and treatment, which, in turn, may include surgical drainage, always associated with appropriate antibiotic therapy, with a view to controlling the infection and preventing recurrences (Geltzeiler; Wieghard; Tsikitis, 2014).

As discussed, proper understanding of its pathophysiology and effective clinical management are crucial to minimize complications, ensuring patient improvement. Thus, this article aims to gather and present the main topics on the subject in question, through a literature review, providing a critical analysis of the available evidence to be able to provide a comprehensive guide for health professionals in the effective clinical management of this challenging condition, evidencing the importance of the present work.

MEDOLOGY

The present study was carried out through a literature review, using as a basis, scientific materials of different formats, such as articles published in scientific journals, course completion papers, master's degrees, book chapters on the subject in question, among others, being accessed digitally, in addition to the presentation of a real clinical case followed in a teaching hospital, during an extracurricular internship in pediatrics.

To access the bibliographic reference content, the search was carried out for the keywords "perineal abscess", "perineal infection in pediatrics" and "pediatric perineal abscess", using the help

of the Google Scholar platform, directing to the database of the main Brazilian universities as well as other teaching and research institutions, in addition to other platforms of great prestige and focused on scientific content such as PubMed, SciELO, Medline, LILACS, among others.

The research for the topic in question continued throughout the preparation of the work, giving preference to more current references with publications from 2019 onwards. In addition, it also relied on the use of previous works, due to their notoriety and the scarcity of recent works in the scope of the theme in question.

CASE REPORT

JLCTM patient, male, 1 month and 26 days old, referred for hospitalization with a history of abscess in the perianal region that had started 20 days ago, shown in Figure 1, with no other associated complaints. She reported previous use of cephalexin for 10 days, but without improvement. In a hospital environment, it was decided to use amikacin and intravenous axacillin, associated with warm compresses, which had a great effect on the drainage of the abscess. After evaluation of the pediatric surgery, a perianal fistula was found and in order to avoid possible recurrences of this abscess, fistulectomy was performed, a procedure that occurred without complications. Subsequently, topical neomycin was associated with the aim of aiding healing by second intention. Postoperative care consists of family guidance regarding abundant cleaning with saline solution or running water of the site after evacuations and application of the ointment in question at the surgical site. The postoperative period is shown in Figure 2.

Figure 1: Perineal and perianal abscess of the breastfeeding patient at the time of admission.

Source: personal collection (photo authorized by the patient's guardian).

Figure 2: The abscess was located after surgery and antibiotic therapy.

Source: personal collection (photo authorized by the patient's guardian).

DISCUSSION

The perineal region is a region that is superficial to the pelvic floor muscles, medially to the thighs and contains noble anatomical structures. The male and female perineum have structures in common, such as the anus and the pudendal artery, and they differ in structures related to the genital organs, such as, for example, in men there is the penis, the levator muscles of the penis, the scrotal sac and, in females, there is the vagina and vulva, composing the organs of the urogenital system (Sobotta, 2023). Considering such structures of great importance for the patient's quality of life in their physiological and sexual functions and, when injuries occur in these areas, they can evolve unfavorably with impairment of the anatomical structures present in the region, thus interfering in addition to aesthetics, in the physiological functioning of urination and evacuation, and can cause impacts on mental development, and even compromising their ability to reproduce (Barber, 2024).

In addition, the contamination of perineal wounds in pediatric patients represents a significant challenge in clinical management, given the specific vulnerability of this age group, presenting several factors that have the potential for contamination of these wounds. Among them, the specific aspects of pediatric anatomy stand out, due to the fact that the perineal anatomy of pediatric patients presents distinct characteristics that can influence the risk of contamination. According to Franciozi *et al.* (2021), children are more prone to trauma and local infections due to the thinness of the skin and the incomplete development of immune function. This can result in a greater susceptibility to post-surgical infections or those resulting from trauma, since their immune system is still developing

According to the review by Couto and Carneirto (2017), the immune system of children is less mature compared to that of adults, which can impact the effectiveness of the inflammatory response and increase the risk of infections in perineal wounds. Such immunological immaturity, combined with the presence of wounds, may provide a greater probability of contamination, since

lesions in this region have a higher risk of contamination, due to the presence of the anus, a place that contains bacteria, due to contact with feces, in addition to the presence of the external urethral ostium, through which urine is released.

In these places, therefore, there is the deposit of substrates necessary for the proliferation of pathogens and, in addition, the perineal region of pediatric patients is more susceptible to their development due to favorable environmental conditions. This is because it consists of a hot and humid region, due to the presence of diapers, especially when kept for long periods, changed less frequently than necessary; providing the creation of a favorable environment for microbial growth (SBP, 2021). Studies highlight the importance of keeping the perineal area clean and dry, to reduce the risk of infections and promote adequate health in childhood (Aquino; Chianca; Brito, 2012).

Therefore, inadequate hygiene is an important risk factor for infections in pediatric perineal wounds. The literature suggests that the ability of parents and caregivers to maintain adequate hygiene practices may be limited, directly affecting wound health, and studies show that parental education on perineal care is essential for the prevention of infectious complications (Desalegn *et al.*, 2024).

However, in some cases, the maintenance of hygiene and the control of factors pointed out as substrates for the formation of abscesses are a real challenge for caregivers, as there is the presence of another factor, congenital anomalies that affect the anatomy and functionality of adjacent structures. Among these anomalies, the following stand out: i) malformations in the urinary tract, ii) defects in anal sphincter formation, iii) congenital fistulas, and iv) soft tissue anomalies that play significant roles in the predisposition to these infections (IHN *et al*., 2020).

These congenital anomalies (CA) are defined as functional or structural changes in fetal development that originate in the embryonic period. These conditions can be the result of genetic, environmental or unknown etiology causes. Among the main causes of anomalies are congenital and perinatal disorders, often associated with infectious agents that impair fetal organogenesis, such as rubella viruses, HIV, Zika, cytomegalovirus, as well as *Treponema pallidum* and *Toxoplasma gondii.* The use of licit and illicit substances, teratogenic medications, and maternal endocrinopathies also contribute to the development of CF (Mendes, 2018). Thus, the important role of parents in the child's health is observed, since maternal self-care in prenatal care, or the lack of it, can influence the development of the fetus. Therefore, the importance of adequate prenatal care in order to minimize the chances of CAs is ratified (PAHO, 2020).

Urinary tract malformations, in turn, lead to the presence of extravasated urine in adjacent areas, as well as anorectal anomalies to the presence of fecal content. The presence of both can create a favorable environment for the development of perineal abscesses, as already mentioned; these, in turn, when not corrected, can cause recurrent abscesses (Kołodziejczak *et al.*, 2017). Such congenital

malformations can vary in complexity from relatively simple deformities to conditions that present a high degree of difficulty to correct (Batista, 2017).

Anorectal anomalies (RAA) can be classified according to the Krickenbeck system as: i) perineal fistula, ii) urethral fistula (divided into bulbar and prostatic), iii) bladder fistula, iv) vestibular fistula, v) absence of fistula, vi) anal stenosis, and vii) cloaca. The initial diagnosis is usually made through physical examination of the newborn (NB), and may be supported by imaging tests such as radiographs, perineal ultrasound (USG), distal colostogram, and magnetic resonance imaging (MRI) (Carroll *et al*., 2016).

And according to Lowdermilk *et al*. (2012) Among the genitourinary anomalies, the most prevalent is the imperforate anus, an anomaly that is often associated with another malformation or genetic alteration. This anomaly is related to the persistence of the anal membrane, resulting in the lining of the anal canal by a thin membrane, with varied presentations, which can be complete or incomplete, with the presence of fistula or not, where the absence, atresia and stenosis of the anus are framed, being the most prevalent anorectal malformation.

Some anomalies are even rarer but important to consider. These result from an abnormal development of the urorectal septum, which is an embryological structure responsible for separating the cloaca into urogenital and anorectal portions, including cloacal exstrophy. In this syndrome, there is a malformation in the urinary and genital tract, causing there to be only a single hole for the elimination of urine, feces, and other fluids, which then drain from body fluids and increase the risk of frequent infections and other health complications (Manfroi, 2019).

In general, all newborns undergo a physical examination at birth, which can reveal and visually diagnose an anorectal malformation. However, it is essential to make an accurate diagnosis, including the complete definition of the anatomy before any intervention through complementary tests (Chan *et al*., 2014). In this sense, for the correction of these malformations, the treatment involves anatomical repair through surgery. These involve different techniques and surgical times that depend on the characteristics involved in the presentation of each case (Amorim *et al.*, 2022)element.

Thus, when performing the surgical procedure to correct anomalies, it is necessary to be even more careful with pediatric patients when using medical devices, such as catheters and drains, which can represent another risk for infection. The presence of urinary catheters and other devices, in addition to favoring communication between the external and internal environments, also favors the occurrence of friction and pressure with the skin, leading to the occurrence of dermatitis or other new lesions in the region (Brandão *et al*., 2018).

In addition to these, superficial cutaneous bacterial infections are other causes common to pediatric patients that can also progress to abscesses, as is the case of ecthyma, which is a bacterial

infection that affects the dermis and is characterized by ulcers covered by yellowish crusts, with raised borders and violet color, where the predominant etiological agent is *Streptococcus pyogenes*, while *Staphylococcus aureus* acts as a secondary agent with a synergistic effect on the perpetuation of the infection. There is a variant of this condition, called ecthyma gangrenosum, caused by *Pseudomonas aeruginosa*, which can affect individuals of any age group. This condition begins as a non-bullous impetigo, with a slower progression, with ulceration that gradually extends to the dermis, developing into a dark, dry, adherent, and eschar-like crust with raised edges (SBP, 2022). Although the lesions are usually few, they can be multiple and found at different stages of evolution, commonly affecting the areas of the perineum, buttocks, and distal extremities; they can also appear anywhere on the body and due to this presentation can evolve into perineal abscess (Torres *et al*., 2016).

Another pathology related to superficial cutaneous bacterial infection, very frequent in pediatric patients and which can progress to perineal abscess, is bullous impetigo, caused almost exclusively by exotoxin-producing *Staphylococcus aureus*. This condition represents a localized form of staphylococcal scalded skin syndrome and is more common in children under two years of age, who account for 90% of all cases (Nardi; Schaefer, 2023). The disease is manifested by superficial, thin-walled, flaccid blisters containing clear fluid that tend to rupture easily within 1 to 3 days, resulting in a bordered area around a moist, erythematous base, progressing to a brown lesion or with an appearance similar to scalded skin and, when scabs are removed, there is wet-based and hypermemic exposure. In infants, the lesions usually occur mainly in the limbs, while in newborns, the most affected areas are the perineum, the periumbilical region, the armpits, and the neck. These lesions tend to coalesce, forming extensive eroded areas (SBP, 2022).

Among the other causes of perineal injury, perineal trauma stands out, often resulting from falls or accidents during recreational activities, and is a common cause of injuries in this region in children, as they can form a solution of continuity allowing colonization of microorganisms (Filho *et al*., 2019). From an epidemiological point of view, studies indicate that falls are responsible for a substantial proportion of perineal injuries in children, with rates varying according to the environment and age group of the patients studied (Gill, Kelly, 2024).

In addition, bacterial infections of the anal glands represent another significant cause of perineal injuries. These infections can lead to the formation of perianal abscesses, especially in children with perianal abscess obstruction or predisposition to skin infections (Gong *et al*., 2018).

In addition to the causes already mentioned, when identifying the development of perineal abscess in older children, it is important to evaluate it in general, since this lesion can be the first sign of something systemic, such as IBDs, whether it is Crohn's disease (CD), ulcerative colitis (UC) or even immunodeficiencies, such as leukemia or AIDS (Carmona, 2023).

Although Crohn's disease occurs mainly in young adults, there are reports of manifestation in pediatric patients with the formation of perineal abscesses, as demonstrated in the study by Silveira *et al*. (2008), where the case of a newborn patient who presented such a manifestation on the third day of life is reported. It is also confirmed that IBDs that have a very early onset in childhood (under 6 years of age) are rare, very aggressive, difficult to control and have a poor prognosis, making it essential to have a correct diagnosis and appropriate treatment to prevent complications (Penatti, 2020).

Based on the above, it is important to observe the importance of managing comorbidities and the general condition of pediatric patients, in addition to caring for lesions. This is because conditions such as diabetes, IBDs, and immunosuppression are widely correlated with the incidence of perianal abscesses in the pediatric population; although inflammatory bowel diseases are less common conditions compared to adults (Adegbola *et al.*, 2018). Especially diabetes, when adequate glycemic control is not achieved, there is greater vulnerability to infections, affecting wound healing , and superficial infections can evolve more severely in these patients (Calliari; Almeida; Noronha, 2020).

The clinical presentation of perineal abscess, in many cases, as presented in the case report, begins with intense pain at or near the anal border, with a nodulation in the region, which becomes swollen and erythematous, and may be accompanied by general malaise and fever. Once the perineal abscess has formed, there may be local or systemic complications.

Local complications involve the nearby anatomical structures, leading to significant morbidity. The involvement of adjacent tissues, such as the ischiorectal fossa or the perianal region, can result in the formation of complex fistulas (Buchanan et al., 2004). That according to Afşarlar *et al.* (2011), the recurrence of anorectal fistulas after perineal abscesses can reach 30%, highlighting the importance of post-treatment clinical surveillance. These fistulas may require surgical intervention for resolution and are associated with prolonged healing times and a higher risk of recurrence (Jimenez, Mandava, 2023).

Treatment is predominantly done in the child's hospitalization, most of the time it is necessary to have a surgical approach with drainage of the abscess contents, correction of anatomical anomalies if present, associated with antibiotic therapy, analgesia, and control of gastrointestinal transit for postoperative recovery, when necessary (Sigmon, Emmanuel; Tuma, 2023).

In addition, untreated or inadequately drained abscesses can lead to the formation of chronic abscesses or even necrotizing fasciitis, an infection that can cause cutaneous and subcutaneous vascular thrombosis, resulting in skin necrosis in the affected region, as well as Fournier's Syndrome, a potentially fatal clinical condition characterized by rapid and intense tissue destruction of soft tissues, involving the subcutaneous tissue and fascia, of rapid progression, reaching the genital

region and nearby structures with a high possibility of systemic involvement (Leporaes *et al.,* 2015; Cardoso, Féres, 2007).

Considering systemic complications, the main one is the occurrence of bacteremia and sepsis, requiring urgent medical intervention, including broad-spectrum antibiotic therapy and intensive care management due to potential morbidity and mortality (Van Koperen *et al*., 2008)

In order to treat perineal abscess so that it can resolve without complications, whether systemic or local, it is necessary to evaluate the condition of each patient individually, identifying the factors and pathogens involved, and using transanal ultrasound and transcutaneous ultrasonography to identify, specify the extent of the abscess and assist in determining the surgical technique to be performed (Maconi, Greco, Asthana, 2017).

In addition to specifying the extent of the abscess to verify the surgical approach strategy for drainage that is most often necessary, it is necessary to properly define antibiotics to achieve complete cure and prevent complications, such as recurrences and spread of infection (Singh *et al*., 2021).

As pointed out, the occurrence of the lesion addressed in the present study involves different factors that often occur together, but depend on the colonization and action of microorganisms to trigger their formation and evolution. And these microorganisms, more specifically bacteria, are differentiated according to their structural and functional characteristics (aerobic, anaerobic, or facultative (Varela, 2018).

Structurally, most bacteria are differentiated mainly by the structure of the cell wall, a structure responsible for the shape, rigidity, cell division and osmotic maintenance of the bacteria, presenting a macromolecular complex, known as mucocomplex (also called peptidoglycan or glycopeptide), which is of great importance for the classification of bacteria by the Gram staining method. In the so-called gram-negative bacteria, this complex represents a smaller fraction of the total wall in relation to the gram-positive ones. The cell wall of gram-negative women is chemically more complex, with a higher amount of amino acids and lipids. Its external lipopolysaccharide (LPS) fraction determines its toxigenicity and antigenicity. However, there is a group of bacteria called mycoplasmas, which do not have a cell wall or peptidoglycan, although molecular studies classify them close to gram negative, they are unable to be stained by the classical Gram method, since they do not have a wall, as exemplified in tables 1 and 2 (Nogueira, Miguel, 2013).

Table 1: Examples of aerobic bacteria, grouped according to Gram staining and morphology.

Classificação das bactérias pelo coloração de Gram (em negrito estão as mais encontradas)

Bactérias Aeróbias					
Gram Positivos		Gram Negativos			
Cocos	**Bacilos**	**Cocos**	**Bacilos**		**Coco-bacilos**
Aerococcus	***Actinomyces spp***	***Moraxella catarrhalis***	**Enterobactérias**	**Fermentadores**	*Actinobacillus spp*
Alloiococcus	***Arcanobacterium***	***Neisseria spp.***	*Buvdica aquatica*	*Aeromonas spp*	*Afipia spp*
Dolosigranulum	*Aureobacterium*		*Cedecea spp*	*Chromobacterium*	*Arcobacter spp*
Enterococcus spp	***Bacillus spp***		***Citrobacter spp***	*Plesiomonas*	***Bartonella spp***
Gemella	*Corynebacterium*		*Edwardsiella spp*	***Pasteurella spp***	***Brucella app***
Globicatella	*Dermabacter*		***Enterobacter spp***	***Vibrio spp***	***Bordetella spp***
Helcococcus	*Erysipelothrix*		***Escherichia coli***	**NÃO fermentadores**	*Calymmato bacterium*
Lactococcus	***Gardnerella***		*Escherichia spp*	***Acinetobacter spp***	***Campylobacter spp***
Leuconostoc	*Gordona*		*Ewingella*	*Agrobacterium*	*Capnocyto-phaga spp*
Micrococcus spp	*Kurthia*		*Hafnia alvei*	*Alcaligenes sp*	*Cardio-bacterium*
Pediococcus	*Lactobacillus*		***Klebsiella spp***	*Bergeyella*	***Chlamydia spp***
Staphylococcus spp	***Listeria spp***		*Kluyvera spp*	*Brevundimonas spp*	***Coxiella bunetii***
Stomatococcus	*Microbacterium*		*Leclercia*	***Burkholderia spp***	*Eikenella corrodens*
Streptococcus spp	***Mycobacterium spp***		*Leminorella spp*	*Chryseobacterium spp*	*Ehrlichia spp*
Tetragenococcus	***Nocardia spp***		*Moellerella*	*Chryseomonas luteola*	*Francisella spp*
Vagococcus	*Oerskovia*		***Morganella spp***	*Comamonas spp*	***Haemophilus spp***
	Rhodococcus		*Pantoea*	*Empedobacter brevis*	***Helicobacter spp***
	Rothia		***Proteus spp***	*Flavimonas*	*Kingella spp*
	Tsukamurella		***Providencia***	***Flavobacterium spp***	***Legionella spp***
	Turicella		*Rahnella aquatilis*	*Methylobacterium*	*Psychrobacter*
			Salmonella spp	*Moraxella spp*	***Rickettsia spp***
			Serratia app	*Ochrobactrum*	*Streptobacillus*
			Shigella spp	*Oligella spp*	*Suttonella*
			Tatumella ptyseos	***Pseudomonas spp***	
			Trabulsiella	*Roseomonas spp*	
			Yersinia spp	*Shewanella spp*	
			Yokenella	*Sphingobacterium spp*	
				Stenotrophomonas	
				Weeksella virosa	

Source: Taken from "Rational use of antimicrobials", by Mota *et al*., 2010, Revista Medicina (Ribeirão Preto), volume 43, n. 2, 167-168.

Table 2*: Examples of anaerobic bacteria, grouped according to Gram staining and morphology.*

Classificação das bactérias pela coloração de Gram (em negrito estão as mais encontradas)	
Bactérias Anaeróbias	
Gram Positivos	**Gram Negativos**
Cocos	Cocos
Gemella	*Acidaminococcus*
Peptococcus	*Megasphaera*
Peptostreptococcus	*Veillonella*
Reuminococcus spp	
Staphylococcus	
Streptococcus spp	
Bacilos	Bacilos
Actinomyces spp	*Anaerobiospirillum*
Atopobium spp	*Anaerorhabdis*
Bifidobacterium spp	***Bacterioides spp***
Clostridium spp	*Bilophila*
Eubacterium spp	***Campylobacter spp***
Filifactor	*Catonella*
Lactobacillus spp	*Centipeda*
Mobiluncus spp	*Desulfomonas*
Propionibacterium spp	*Desulfovibrio*
	Dialister
	Dichelobacter
	Fusobacterium spp
	Hallela
	Johnsonella
	Leptotrichia
	Mitsuokella
	Porphyromonas spp
	Prevotella spp
	Selenomonas spp
	Tissierela

Source: Taken from "Rational use of antimicrobials", by Mota *et al*., 2010, Revista Medicina (Ribeirão Preto), volume 43, n. 2, 167-168.

Some of these bacteria, thanks to their structural characteristics, have greater resistance compared to others. In addition, over the years, they have undergone adaptations and mutations, providing increased virulence, resistance to the environment and resistance to the most used antimicrobials, thus impairing the therapeutic process and making them have a greater potential to establish themselves and cause more serious infections (Cunha, 1998).

This resistance to antimicrobial drugs is a genetic phenomenon associated with the presence of specific genes that encode several biochemical mechanisms capable of neutralizing the action of drugs. This resistance may arise due to mutations that occur in the microorganism during the

reproduction process, resulting from errors in the replication of the base sequence of chromosomal DNA, which encodes genetic information. Another form of resistance is the acquisition of genes responsible for this trait, a process known as transferable resistance (Tavares, 2000).

The pathogens present in perineal abscesses have a great relationship with the gastrointestinal tract, due to the presence of the anus, as well as the presence of the fecal content itself, and microorganisms are frequently found in the gastrointestinal flora, including facultative and obligate anaerobic bacteria, gram-negative aerobic bacteria and gram-positive aerobic bacteria. And with regard to hospital infections, there is a predominance of a more resistant flora, which include *Pseudomonas aeruginosa*, *Enterobacter* sp., *Proteus* sp., methicillin-resistant *Staphylococcus aureus*, enterococci and *Candida* sp. (Coelho, Baretta, Okawa, 2007).

Looking at the pathogens involved in these types of infections, studies highlight *Staphylococcus aureus* as one of the main pathogens involved (as seen in the aforementioned skin infections), along with *group A* Streptococcus and *Escherichia coli*, reflecting a predominance of gram-positive and gram-negative bacterial infections in this age group (Yang *et al*., 2024).

When it comes to the microbiology of perineal abscesses, more specifically in children, there is often the presence of anaerobic bacteria such as *Bacteroides* spp. and *Prevotella* spp., as well as *Peptostreptococcus* spp., which are commonly found in the intestinal microbiome. In specific clinical settings, *Enterococcus* spp., Pseudomonas aeruginosa, and *methicillin-resistant Staphylococcus aureus* (MRSA) may also be present, especially in hospital settings or in immunocompromised patients (Hong *et al*., 2024).

The most frequently recommended antibiotics for the treatment of perineal abscesses include ceftriaxone, a third-generation cephalosporin effective against a wide range of gram-positive and gram-negative bacteria; metronidazole, which is active against anaerobic bacteria common in anorectal perineal abscesses; the amoxicillin/clavulanate combination, which provides coverage against gram-positive, gram-negative, and anaerobic bacteria, and is useful in polymicrobial infections; and trimethoprim/sulfamethoxazole, effective primarily against gram-negative bacteria such as *Escherichia coli,* often associated with urinary tract infections complicated by perineal abscesses (Lichtenstein, O'brien, 2018; Thabit *et al.*, 2016; Tamma, Cosgrove, Maragakis, 2012).

However, the beginning of antibiotic therapy is empirical. The choice of antibiotic should take into account factors such as the local susceptibility of the bacteria, the severity of the infection, and the patient's clinical conditions. Cultures and sensitivities of the causative organism are rarely useful at first when community infection is suspected, and are more useful when the patient does not improve after initiation of empirical therapy or when multidrug-resistant or nosocomial bacteria are suspected. In cases of polymicrobial infections or suspected bacterial resistance, antibiotic

combination or therapeutic adjustments based on microbiological cultures may be necessary (World Health Organization, 2023; Lee, Tan, 2018; Xu, Tan, Chong, 2016).

Once not treated in an ideal way initially, perineal abscess can evolve in an even more severe form, called Fournier's gangrene or Fournier's Syndrome, an infection that can affect deeper structures, even if the skin manifestations do not appear initially. It has high morbidity and mortality due to affecting subcutaneous tissues, pelvic muscle phacia, scrotum, perineum, and external genitalia (de Souza *et al*., 2020; Tikami *et al*., 2020).

Fournier's gangrene should be diagnosed and treated urgently due to its high potential for severity. The diagnosis is based on the patient's clinical practice, imaging and laboratory tests in a complementary way. However, these should not delay the onset of debridement, since the early approach is related to a better prognosis of treatment (Moreira, 2022).

Of the imaging tests, computed tomography (CT) is the most cost-effective test, being useful in identifying the site of origin of the infection, as well as determining the extent, inflammation and emphysema when present. Radiography can be useful to identify edema and subcutaneous emphysema, whereas magnetic resonance imaging (MRI) is rarely used, given its high cost and more restricted access, and CT and radiography are more cost-effective. Ultrasonography is a great option for early stage evaluation of the condition, due to its high effectiveness, low cost, and does not use radiation, with the disadvantage of being operator-dependent (Inácio *et al*., 2020; Fonseca *et al*., 2018).

Laboratory tests are nonspecific for the diagnosis of Fournier Syndrome. The presence of leukocytosis, anemia, electrolyte disturbances, elevated serum creatinine, thrombocytopenia, and hypoalbuminemia is routinely observed (de Souza *et al*., 2020).

The treatment of Fournier's gangrene (FG) consists of vigorous hydration of the patient, restoration of fluid and electrolyte balance, drainage of collections, debridement, broad-aspect antibiotic therapy, and the use of skin grafts may be added to the closure of wounds for more extensive lesions (Lohsiriwat, 2016).

The main treatment measure for GF is debridement, and the use of broad-spectrum antibiotics with coverage for gram-positive, gram-negative, and anaerobic drugs should be employed. In cases where the hypothesis of community infection is raised, according to the literature, the choice is often made of the concomitant use of clindamycin, gentamicin and ampicillin associated with sulbactam or a third-generation cephalosporin administered intravenously. Chloramphenicol is shown to be an alternative when clindamycin is not effective. In cases where the causative agents are fungi or other hospital pathogens, the application of fluconazole, vancomycin or piperacillin associated with tazobactam is considered as treatment. And in 2014 the use of a carbapenem was added as an option

of choice for monotherapy by the Infections Diseases Society of America (IDSA) (Hagedorn; Wessells, 2017).

However, the use of antibiotics in pediatric patients can significantly influence the incidence of perineal infections, since the human body has its own colony of diverse microbiota in places such as the gastrointestinal tract, skin and genitalia that in normal situations is in balance, but with the inappropriate or excessive use of antibiotics can lead to imbalances of this normal microbiota, potentially promoting the proliferation of pathogenic microorganisms, such as fungi and resistant bacteria, which often cause perineal infections. In addition, the elimination of protective bacterial flora due to the use of antibiotics inappropriately can reduce the body's natural resistance to pathogens, increasing susceptibility to new infections, morbidity of patients, prolonging the length of hospital stay, and generating a new infection. extra costs for health services, which could be avoided with the rational use of antimicrobials. Therefore, the prescription and use of antibiotics should be carefully managed to minimize the risk of complications and secondary infections in the perineal region in children (Mota *et al.*, 2010).

FINAL CONSIDERATIONS

Finding specific general and epidemiological data on perineal abscesses in pediatric patients due to the specificity of the theme proved to be a challenge for the elaboration of the work and evidenced the need for a greater approach to the theme correlating with the age group in focus, also leading to the use of literature that has been published for a longer time.

Furthermore, as pointed out, although perineal abscess is a complication of infectious processes that could often be treated with antibiotic therapy even at home, in case of early treatment, it can still evolve into severe complications and great risk for the patient, which can course with the injury or even the loss of important organs as in the case of the male genitals in the case of the sequelae of Furnier's Syndrome that translates into aggravations in their psychosocial development and in the future in the impairment of sexual practice and consequently may even make it impossible to reproduce, causing not only physical but also psychological damage.

However, the importance of the rational choice of antibiotics, based on local evidence and guidelines, is extremely valuable, as a fundamental measure, associated with a surgical approach to drain the content, in order to achieve therapeutic success and improve clinical results, avoiding losses. As presented, antibiotic therapy is an important tool in the fight against infection by microorganisms, however, if done wrongly, it can cause future damage, such as due to the imbalance of the patient's physiological flora, as well as the inappropriate management of the case can allow the evolution of the condition in a severe way.

Considering that the high risk of contamination of perineal wounds in pediatric patients is intrinsically linked to anatomical, immunological and environmental factors specific to this age group, in combination with an immature immune response, the need for intensive care and the proper management of wounds and medical devices are fundamental for the prevention and treatment of infections. It has been shown that continuous studies and improvements in care practices are essential to reduce the incidence of infectious complications in children.

Thus, the importance of conducting more research on the subject is evidenced, and it is of great value and as a suggestion to carry out a quantitative research with data on different clinical cases and with a large sample. Likewise, the importance of greater dissemination and awareness in the academic and professional environment of professionals working in the health area is latent.

REFERENCES

1. Adegbola, S. O., Pisani, A., Sahnane, K., Tozer, P., Ellul, P., & Warusavitarne, J. (2018). Medical and surgical management of perianal Crohn's disease. *Annals of Gastroenterology*, 31(2), 129-139. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5825943/. Acesso em: 20 jul. 2024.

2. Afşarlar, C. E., Karaman, A., Tanır, G., Karaman, I., Yılmaz, E., Erdoğan, D., Maden, H. A., Cavuçoğlu, Y. H., & Ozgüner, I. F. (2011). Perianal abscess and fistula-in-ano in children: clinical characteristic, management and outcome. *Pediatric Surgery International*, 27(10), 1063-1068. Disponível em: https://pubmed.ncbi.nlm.nih.gov/21785979/. Acesso em: 21 jul. 2024.

3. Amorim, G. de A. S., Vieira, G. N., & De Azevedo, S. G. H. (2022). Abordagem diagnóstica e cirúrgica das malformações anorretais: Revisão da Literatura. *Brazilian Journal of Case Reports*, 2(5), 17. https://doi.org/10.52600/2763-583X.bjcr.2022.2.Suppl.5.17. Disponível em: https://bjcasereports.com.br/index.php/bjcr/article/view/gastro22_17. Acesso em: 10 set. 2024.

4. Aquino, A. L. de, Chianca, T. C. M., & Brito, R. C. S. (2012). Integridade da pele prejudicada, evidenciada por dermatite da área das fraldas: revisão integrativa. *Revista Eletrônica de Enfermagem*, 14(2), 414-424. Disponível em: http://dx.doi.org/10.5216/ree.v14i2.149773. Acesso em: 11 ago. 2024.

5. Barber, M. D. (2024). Surgical female urogenital anatomy. *UpToDate*. Disponível em: https://www.uptodate.com/contents/surgical-female-urogenital-anatomy. Acesso em: 21 jul. 2024.

6. Batista, E. C., & de Oliveira, C. M. (2017). Maternidade e anomalia anorretal: um estudo de caso. *Revista InterScientia*, 5(2), 183-198. Disponível em: https://periodicos.unipe.edu.br/index.php/interscientia/article/view/495. Acesso em: 10 set. 2024.

7. Brandão, A. et al. (2018). Adaptação do instrumento "Perineal Assessment Tool" para a cultura brasileira. *Revista ESTIMA*, 16. Disponível em: https://www.researchgate.net/publication/324508934_Adaptacao_do_instrumento_Perineal_Assessment_Tool_para_a_cultura_brasileira. Acesso em: 10 set. 2024.

8. Buchanan, G. N., Halligan, S., Bartram, C. I., Williams, A. B., Tarroni, D., & Cohen, C. R. (2004). Clinical examination, endosonography, and MR imaging in preoperative assessment of fistula in ano: comparison with outcome-based reference standard. *Radiology*, 233(3), 674-681. Disponível em: https://pubmed.ncbi.nlm.nih.gov/15498901/. Acesso em: 21 jul. 2024.

9. Calliari, L. E., Almeida, F. J., & Noronha, R. M. (2020). Infecções na criança com diabetes. *Jornal de Pediatria*, 96(S1), 39-46. Disponível em: https://www.scielo.br/j/jped/a/v3NTYhpbKP4kMBWpKP58Sxg/?lang=pt. Acesso em: 04 set. 2024.

10. Cardoso, J. B., & Féres, O. (2007). Gangrena de Fournier. *Revista da Faculdade de Medicina de Ribeirão Preto*, 40(4), 493-499. Disponível em: http://www.revistas.usp.br/rmrp/article/view/345. Acesso em: 21 jul. 2024.

11. Carmona, L. (2023). Abcesso Perianal. *Pedipedia - Enciclopedia Pediátrica Online*. Disponível em: https://pedipedia.org/artigo/abcesso-perianal. Acesso em: 11 set. 2024.

12. Carroll, A. G., Kavanagh, R. G., Ni Leidhin, C., Cullinan, N. M., Lavelle, L. P., & Malone, D. E. (2016). Comparative effectiveness of imaging modalities for the diagnosis of intestinal obstruction in neonates and infants: a critically appraised topic. *Academic Radiology*, 23(5), 559-568. http://dx.doi.org/10.1016/j.acra.2015.12.014. Acesso em: 10 set. 2024.

13. Chan, K. W. E., et al. (2014). Outcome of patients after single-stage repair of perineal fistula without colostomy according to the Krickenbeck classification. *Journal of Pediatric Surgery*, 49(8), 1237-1241. Disponível em: https://pubmed.ncbi.nlm.nih.gov/25092083/. Acesso em: 11 set. 2024.

14. Coelho, J. C. U., Baretta, G. A. P., & Okawa, L. (2007). Seleção e uso de antibióticos em infecções intra-abdominais. *Arquivos de Gastroenterologia*, 44(1), 85-90. Disponível em: https://www.scielo.br/j/ag/a/zNhBqBFVTdZcs89c4sTM4km/?lang=pt. Acesso em: 12 set. 2024.

15. Couto, C. M. F., & Carneirto, M. do N. F. (2017). Prevenção do traumatismo perineal: uma revisão integrativa da literatura. *Enfermería Global*, 16(47), 539-564. Disponível em: https://scielo.isciii.es/pdf/eg/v16n47/pt_1695-6141-eg-16-47-00539.pdf. Acesso em: 13 set. 2024.

16. Cunha, B. A. (1998). Antibiotic resistance. *Drugs of Today*, 34, 691-698. Disponível em: https://pubmed.ncbi.nlm.nih.gov/14988775/. Acesso em: 12 set. 2024.

17. de Souza, N. S., et al. (2020). Fournier's gangrene by perianal abscess. *Journal of Coloproctology*, 40(4), 334-338. Disponível em: https://www.scielo.br/j/jcol/a/BpnJGHSj6Vj7czmxKTTQJTD/#. Acesso em: 21 jul. 2024.

18. Desalegn, M., et al. (2024). Parental knowledge and attitude of postoperative paediatric pain: stepwise linear regression analysis. *Frontiers in Pain Research*, 5. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10993867/. Acesso em: 11 ago. 2024.

19. Filho, J. E., Borel, W. P., Diz, J. B. M., Barbosa, A. W. C., Britto, R. R., & Felício, D. C. (2019). Prevalência de quedas e fatores associados em uma amostra comunitária de idosos brasileiros: uma revisão sistemática e meta-análise. *Cadernos de Saúde Pública*, 35(8), e00115718. https://doi.org/10.1590/0102-311X00115718. Disponível em: https://www.scielo.br/j/csp/a/76NtZ6L3vbyTfgFSs5pHjYC/?lang=en. Acesso em: 21 jul. 2024.

20. Fonseca, E. K. U. N., et al. (2018). Ultrasound evaluation of inguinoscrotal pain: an imaging-based review for the ultrasonographer. *Radiologia Brasileira*, 51(3), 193-199. Disponível em: https://www.scielo.br/j/rb/a/84ZYRy68bPCPVpzMRpjJSdP/#ModalHowcite. Acesso em: 12 set. 2024.

21. Franciozi, C. E. da S., et al. (2008). Trauma na infância e adolescência: epidemiologia, tratamento e aspectos econômicos em um hospital público. *Acta Ortopédica Brasileira*, 16(5), 261-265. Disponível em: https://www.scielo.br/j/aob/a/CdTfJPsPzTBSNv6fW3YN63G/#. Acesso em: 11 ago. 2024.

22. Geltzeiler, C. B., Wieghard, N., & Tsikitis, V. L. (2014). Recent developments in the surgical management of perianal fistula for Crohn's disease. *Annals of Gastroenterology*, 27(4), 320-330. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4188928/. Acesso em: 20 jul. 2024.

23. Gill, A. C., & Kelly, N. R. (2024). Prevention of falls and fall-related injuries in children. *UpToDate*. Disponível em: https://www.uptodate.com/contents/prevention-of-falls-and-fall-related-injuries-in-children. Acesso em: 21 jul. 2024.

24. Gong, Z., Han, M., Wu, Y., Huang, X., Xu, W., & Lv, Z. (2018). Treatment of First-Time Perianal Abscess in Childhood, Balance Recurrence and Fistula Formation Rate with Medical Intervention. *European Journal of Pediatric Surgery*, 28(4), 373-377. Disponível em: https://www.thiemeconnect.de/products/ejournals/abstract/10.1055/s-0037-1603092. Acesso em: 21 jul. 2024.

25. Goudouris, E., & Neto, A. C. (2024). Imunologia Clínica. Disponível em: https://www.sbp.com.br/especiais/pediatria-para-familias/cuidados-com-a-saude/imunidade-nas-criancas/. Acesso em: 11 set. 2024.

26. Hagedorn, J. C., & Wessells, H. (2017). A contemporary update on Fournier's gangrene. *Nature Reviews Urology*, 14(4), 205-214. Disponível em: https://www.nature.com/articles/nrurol.2016.243. Acesso em: 12 set. 2024.

27. Hong, J. C., Chen, J. S., Jiang, Z. J., Chen, Z. C., Ruan, N., & Yao, X. P. (2024). Microbiota in adult perianal abscess revealed by metagenomic next-generation sequencing. *Microbiology Spectrum*, 12(4), e0347423. Disponível em: https://pubmed.ncbi.nlm.nih.gov/38385739/. Acesso em: 20 jul. 2024.

28. IHN, K., et al. (2020). Clinical characteristics and conservative treatment of perineal groove. *Journal of Pediatric Surgery*, 55(8), 1507-1510. https://doi.org/10.1016/j.jpedsurg.2019.07.017. Disponível em: https://pubmed.ncbi.nlm.nih.gov/31443920/. Acesso em: 04 set. 2024.

29. Inácio, M. F., Lima, R. P., Rizzo Neto, S., Lopes, F. A., Pantaroto, M., & Sousa, A. V. de. (2020). Epidemiological study on Fournier syndrome in a tertiary hospital in Jundiaí-SP from October 2016 to October 2018. *Journal of Coloproctology*, 40(40), 37-42. Disponível em: https://www.scielo.br/j/jcol/a/8zJc9WDXgkLYC9Tpmmpg59Q/abstract/?lang=en. Acesso em: 21 jul. 2024.

30. Jimenez, M., & Mandava, N. (2023). Anorectal Fistula. In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. Disponível em: https://www.ncbi.nlm.nih.gov/books/NBK560657/. Acesso em: 21 jul. 2024.

31. Kołodziejczak, M., et al. (2017). Anorectal malformation as a cause of recurring perineal abscesses – value of anorectal endosonography and magnetic resonance imaging: a case report. *Medical Ultrasonography*, 19(2), 228-231. Disponível em: https://www.medultrason.ro/medultrason/index.php/medultrason/article/view/928. Acesso em: 04 set. 2024.

32. Lee, M. J., & Tan, K. K. (2018). Management of perianal abscesses: a systematic review. *World Journal of Surgery*, 42(4), 1087-1093. https://doi.org/10.1007/s00268-017-4327-4. Acesso em: 21 jul. 2024.

33. Leporaes, R. I., Pereira, J. N., Botelho, F. A., Barbosa, P. S., & Barros, M. G. C. R. M. (2015). Relato de caso: síndrome de Fournier em mulher jovem. *Revista Medicina*, 96(2), 116-120. Disponível em: https://clinicamedica2015.iweventos.com.br/upload/trabalhos/599KmDDWBZpfMYRsGOpBhDfVRSC2.pdf. Acesso em: 21 jul. 2024.

34. Lichtenstein, G. R., & O'Brien, C. R. (2018). ACG clinical guideline: management of Crohn's disease in adults. *American Journal of Gastroenterology*, 113(4), 481-517. Disponível em: https://pubmed.ncbi.nlm.nih.gov/29610508/. Acesso em: 20 jul. 2024.

35. Lohsiriwat, V. (2016). Anorectal emergencies. *World Journal of Gastroenterology*, 22, 5867-5878. Disponível em: https://pubmed.ncbi.nlm.nih.gov/27468181/. Acesso em: 21 jul. 2024.

36. Lowdermilk, D. L., et al. (2013). *Saúde da mulher e enfermagem obstétrica* (10. ed.). Rio de Janeiro: Elsevier. Disponível em: https://repositorio.usp.br/item/002494148. Acesso em: 20 jul. 2024.

37. Maconi, G., Greco, M. T., & Asthana, A. K. (2017). Transperineal ultrasound for perianal fistulas and abscesses – A systematic review and meta-analysis. *Ultraschall in der Medizin*, 38(03), 265-272. Disponível em: https://www.thieme-connect.com/products/ejournals/abstract/10.1055/s-0043-103954. Acesso em: 21 jul. 2024.

38. Manfroi, C. (2019). Extrofia de cloaca, DDS 46 XY: relato de caso. Florianópolis: Universidade Federal de Santa Catarina. Disponível em: https://repositorio.ufsc.br/handle/123456789/224512. Acesso em: 11 set. 2024.

39. Mendes, I. C., et al. (2018). Anomalias congênitas e suas principais causas evitáveis: uma revisão. *Revista Médica de Minas Gerais*, 28(1), 1-6. https://doi.org/10.5935/2238-3182.20180011. Disponível em: https://www.rmmg.org/artigo/detalhes/2329. Acesso em: 11 set. 2024.

40. Moreira, P. C., Frazão, L. F. N., Faria, S. C., & Maynart, M. M. (2022). Gangrena de Fournier - do diagnóstico ao tratamento. *A Assistência à Saúde na Contemporaneidade*, 1(1), 241-251. Disponível em: https://downloads.editoracientifica.com.br/articles/221211411.pdf. Acesso em: 21 jul. 2024.

41. Mota, L. M., Vilar, F. C., Dias, L. B. A., Nunes, T. F., & Moriguti, J. C. (2010). Uso racional de antimicrobianos. *Revista Medicina (Ribeirão Preto)*, 43(2), 167-168. Disponível em: https://www.revistas.usp.br/rmrp/article/view/175/176. Acesso em: 12 set. 2024.

42. Nardi, N. M., & Schaefer, T. J. (2022). Impetigo. In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. Atualizado em 31 jul. 2023. Disponível em: https://www.ncbi.nlm.nih.gov/books/NBK430974/. Acesso em: 11 set. 2024.

43. Nogueira, J. M. R., & Miguel, L. F. S. (2018). Bateriologia: conceitos e métodos para a formação de profissionais em laboratórios de saúde. Rio de Janeiro: Fundação Oswaldo Cruz/Instituto Oswaldo Cruz. 4, 227-229. Disponível em: https://www.epsjv.fiocruz.br/sites/default/files/cap3.pdf. Acesso em: 12 set. 2024.

44. OPAS (Organização Pan-Americana da Saúde). (2020). Nascidos com defeitos congênitos: histórias de crianças, pais e profissionais de saúde que prestam cuidados ao longo da vida. Publicado em 2 mar. 2020. Disponível em: https://www.paho.org/pt/noticias/3-3-2020-nacidos-con-defectos-congenitos-historias-ninos-padres-profesionales-salud-que. Acesso em: 11 set. 2024.

45. Organização Mundial da Saúde (OMS). (2023). WHO Model List of Essential Medicines. Disponível em: https://www.who.int/groups/expert-committee-on-selection-and-use-of-essential-medicines/essential-medicines-lists. Acesso em: 21 jul. 2024.

46. Penatti, D. A. (2020). Características clínico-patológicas e evolução da Doença Inflamatória Intestinal Idiopática de início muito precoce na infância: Análise de uma série de casos. Tese de doutorado. Universidade Estadual Paulista (Unesp), Botucatu. Disponível em: https://repositorio.unesp.br/items/71f836c6-5fbd-4ba6-bf04-fa1e23ef0797. Acesso em: 11 set. 2024.

47. SBP (Sociedade Brasileira de Pediatria). (2021). Infecção do trato urinário em pediatria – Existe consenso entre os consensos? Departamento Científico de Nefrologia. Disponível em: https://www.sbp.com.br/fileadmin/user_upload/23183d-DC_Infec_TratoUrinario_Pediatria-Atualiz2021.pdf. Acesso em: 13 set. 2024.

48. SBP (Sociedade Brasileira de Pediatria). (2022). Infecções bacterianas superficiais cutâneas: Documento científico. Departamentos Científicos de Dermatologia e Infectologia. p. 2-3. Disponível em: https://www.sbp.com.br/fileadmin/user_upload/23597c-DC_Infeccoes_Bacterianas_Superficiais_Cutaneas.pdf. Acesso em: 11 set. 2024.

49. Sigmon, D. F., Emmanuel, B., & Tuma, F. (2023). Perianal abscess. In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. Disponível em: https://www.ncbi.nlm.nih.gov/books/NBK459167/. Acesso em: 12 set. 2024.

50. Silveira, R. C., et al. (2008). Doença de Crohn em recém-nascido. *Revista Brasileira de Coloproctologia*, 28(3), 338–341. Disponível em: https://www.scielo.br/j/rbc/a/JT8jffjhb8xvQt6mWFbYbBD/?lang=pt&format=html. Acesso em: 11 set. 2024.

51. Singh, B., May, K., Dowson, H. M., & Watkins, A. J. (2024). A systematic review and meta-analysis of the use of packing in the management of perianal abscesses. *The Royal College of Surgeons of England*, 90, 105953. Disponível em: https://publishing.rcseng.ac.uk/doi/10.1308/rcsann.2023.0108. Acesso em: 21 jul. 2024.

52. Sobotta, J., et al. (2023). *Atlas de anatomia humana* (24. ed.). Rio de Janeiro: Guanabara Koogan.

53. Tamma, P. D., Cosgrove, S. E., & Maragakis, L. L. (2012). Combination therapy for treatment of infections with gram-negative bacteria. *Clinical Microbiology Reviews*, 25(3), 450-470. https://doi.org/10.1128/CMR.05041-11. Disponível em: https://pubmed.ncbi.nlm.nih.gov/22763634/. Acesso em: 21 jul. 2024.

54. Tavares, W. (2000). Bactérias gram-positivas problemas: resistência do estafilococo, do enterococo e do pneumococo aos antimicrobianos. *Revista da Sociedade Brasileira de Medicina Tropical*, 33(3), 281–301. Disponível em: https://www.scielo.br/j/rsbmt/a/TnCJBpNHSZm5XdSgbhNG6Rn/#. Acesso em: 12 set. 2024.

55. Thabit, A. K., Fatani, M. I., Bamakhroma, M. S., Barnawi, O. A., Basudan, L. O., & Alhejaili, S. F. (2016). Antibiotic resistance profile and virulence genes of uropathogenic *Escherichia coli* isolates in relation to phylogeny. *Tropical Medicine and International Health*, 21(4), 478-488. Disponível em: https://pubmed.ncbi.nlm.nih.gov/24862040/. Acesso em: 21 jul. 2024.

56. Tikami, K. F., Simão, J. C., Passerotti, L. C., & Barbosa, A. S. A. A. (2020). Perfil dos pacientes com gangrena de Fournier utilizando a oxigenoterapia hiperbárica como tratamento adjuvante. *Medicina (Ribeirão Preto)*, 53(1), 21–25. Disponível em: https://revistas.usp.br/rmrp/article/view/162794. Acesso em: 12 set. 2024.

57. Torres, et al. (2016). Ecthyma gangrenosum: A warning sign of immunodeficiency. *Acta Pediátrica Portuguesa*, 47, 172–176. Disponível em: https://www.researchgate.net/publication/303686523_Ecthyma_Gangrenosum_A_Warning_Sign_of_Immunodeficiency. Acesso em: 11 set. 2024.

58. Van Koperan, P. J., et al. (2008). Long-term functional outcome and risk factors for recurrence after surgical treatment for low and high perianal fistulas of cryptoglandular origin. *Diseases of the Colon & Rectum*, 51(10), 1475-1481. Disponível em: https://pubmed.ncbi.nlm.nih.gov/18626715/. Acesso em: 21 jul. 2024.

59. Varela, E. M. M. (2018). Deteção de bactérias anaeróbias em amostras biológicas por técnicas de biologia molecular. Tese de mestrado. Nova Medical School/Faculdade de Ciências Médicas. Disponível em: https://run.unl.pt/bitstream/10362/114991/1/Dissertacao%20MMMVII%20Eneida%20Varela%20Final.pdf. Acesso em: 12 set. 2024.

60. Xu, R. W., Tan, K. K., & Chong, C. S. (2016). Bacteriological study in perianal abscess is not useful and not cost-effective. *ANZ Journal of Surgery*, 86(10), 782–784. Disponível em: https://pubmed.ncbi.nlm.nih.gov/27226422/. Acesso em: 12 set. 2024.

61. Yang, J., Li, L., Su, W., Zhang, S., Xu, H., Wang, M., & Shen, W. (2024). Microbiomic signatures of anal fistula and putative sources of microbes. *Frontiers in Cellular and Infection Microbiology*, 14. https://doi.org/10.3389/fcimb.2024.1332490. Disponível em: https://pubmed.ncbi.nlm.nih.gov/38312743/. Acesso em: 20 jul. 2024.

The importance of functional taping in preventing wrist injuries in boxing: A medical view

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ABSTRACT

Background: Functional bandages are a therapeutic tool widely used worldwide, not only for treatment, but also for injury prevention. Preventing extreme ranges of motion and reducing abnormal joint movement is the most obvious function of functional taping. The wrist is frequently injured in boxing, which often forces the athlete to abandon training and competitions. The study is necessary because there are few studies in Brazil that seek to compare the importance of functional taping as a measure to prevent wrist injuries in boxers. Objective: To analyze the importance of functional wrist taping, as a measure for preventing injuries in practitioners of this activity, as well as to relate the incidence of injury, the time of practice and the use or not of the bandage. Methodology: This was a cross-sectional study of an experimental nature, where 34 practitioners were evaluated, among them, 9 had wrist injuries and 25 did not have wrist injuries. Results: The study found that 77.8% of the practitioners had some injury and did not use the functional bandage, while 72% of the practitioners who did not have any type of injury used the bandage. Conclusion: In view of the results presented, the importance of the use of functional bandaging as an instrument to prevent wrist injuries was highlighted, as well as the need to deepen the application of the technique by medical professionals who work in sports medicine.

Keywords: Boxing, Wrist injury, Functional taping, Sports medicine.

INTRODUCTION

Boxing is the physical ability to fight with your fists. It is believed to have originated as a sport around 800 BC.[1], with the first historical reference in the 23rd ancient Olympic Games in 688 BC. Modern sport has developed from established rules and norms since then and, despite the perception of brutality associated with sport, a minority of injuries affecting boxers are serious or disabling2.

Medical supervision was incorporated by the main world boxing associations from the 1950s onwards, with the aim of bringing improvements in the care provided to athletes and the adoption of prophylactic measures4. Measures such as the use of head, hand and wrist protectors were adopted in order to minimize the rates of injuries and sports absences5. Each sport has its own characteristics of space, time, dynamism and physical demand, which can determine the most frequent type of injury in each of them. In the case of boxing, physical contact predominates6.

Most pathologies that affect boxing athletes are of traumatic origin, mainly in the upper limbs, head and face. Sometimes, an athlete's career can be compromised due to the severity of these injuries7.

Injuries can be considered as the main factor that leads athletes to abandon their sport. This absence is detrimental, as it directly influences their physical and technical performance, as well as possible psychological damage, as recovery can be slow, requiring patience and caution to return to activity: and consequently, the team is also harmed6.

Functional bandages (BP) are therapeutic instruments widely used by healthcare professionals. Sports Medicine is a medical specialty that includes theoretical and practical segments of medicine with the aim of investigating the influence of exercise, training and sport on healthy or sick people, with the aim of preventing, treating and rehabilitating. In other countries, BFs are called Taping or Strapping (USA) or functional bandages (Portugal), Functional Bandages (Germany) and Contentions Souples (France and Switzerland)[8].

It can be defined as a technique that aims to modify the mechanics of altered and/or non-rigid segments, providing rest to damaged structures, reinforcing aspects with structural and/or physiological changes, improving the functionality of the segments, thus recovering function. deficit without cancelling out other natural mechanics linked to the segments treated with bandages9.

Many athletes use duct tape not only as a treatment, but also to prevent injury. It is very common to apply bandages, for example, to athletes before participating in their sport; This has been the subject of scientific scrutiny in a growing body of research that has aimed to investigate the effects and basis through its application10.

Preventing extreme ranges of motion and reducing abnormal joint movement is the most obvious function of functional taping11.

The hand and wrist are frequently affected by trauma in various sports, which often takes the athlete away from training and games, causing distress to the athlete and coaching staff. Therefore, although the diagnosis and treatment of sports injuries follows practically the same pattern as the injuries observed in the general population, it must be taken into account that the time of absence of the athlete is an important factor to consider. The incidence of hand and wrist injuries in sports varies from 3% to 9% of all sports injuries12.

The present study is necessary because there are few studies in South America that seek to compare the importance of functional taping as a measure to prevent wrist injuries in boxers. As well as observing the importance of functional wrist bandaging as a measure to prevent injuries in those who practice the activity. Since the wrist is a very vulnerable joint to injury. The assimilation of this study by boxing teachers, professors and practitioners may be useful in setting a precedent for the use of functional bandaging as a way to prevent injuries and remove practitioners from their activities.

METHODOLOGY

The research was carried out among boxers from the Pernambuco Federation of Independent Kick Boxing – FPKBI, based in the city of Recife – PE.

This is a cross-sectional study, with FPKBI boxing practitioners, who were practitioners at the levels; 1) beginners, 2) intermediate and 3) advanced.

The inclusion criteria were boxers who are duly registered in the FPKBI, who are beginners, intermediate and advanced in boxing and agree to participate in the study.

The exclusion criteria were being boxers not registered in the FPKBI, clinical instability or discomfort on the day of the evaluation, lack of collaboration at the time of the analysis and not agreeing to participate in the study.

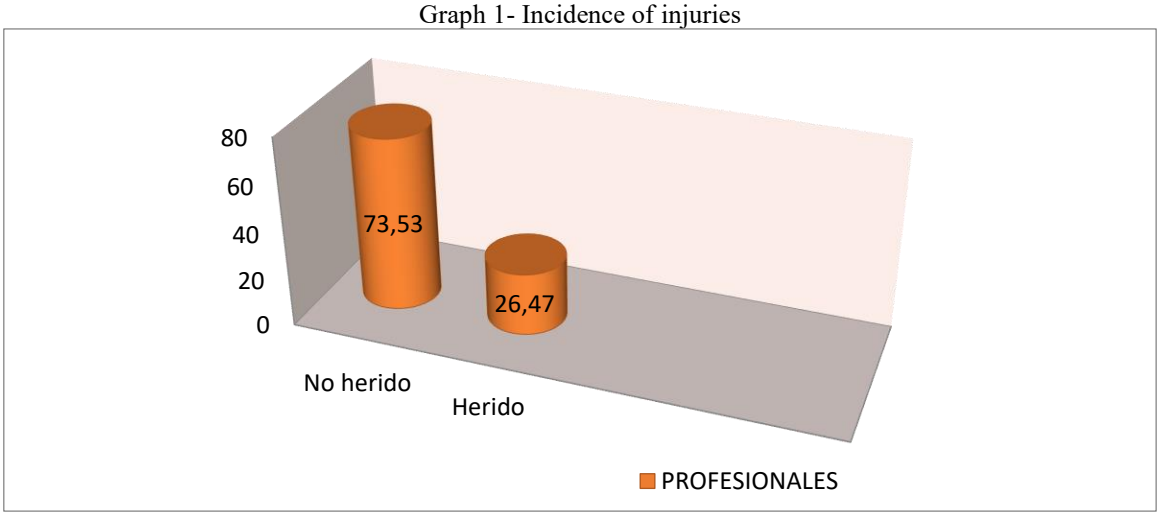
All volunteers were subjected to the questionnaire, which aimed to: 1) the incidence of wrist injuries; 2) verification of the practitioners who suffered and did not suffer wrist injuries and their relationship with the use or not of functional bandages; 3) the incidence of the injury related to the time of practice and the use or not of functional bandage.

To analyze the results, descriptive statistical techniques were used, where the calculations were analyzed by the researcher himself using Microsoft Office Excel 2024.

RESULTS

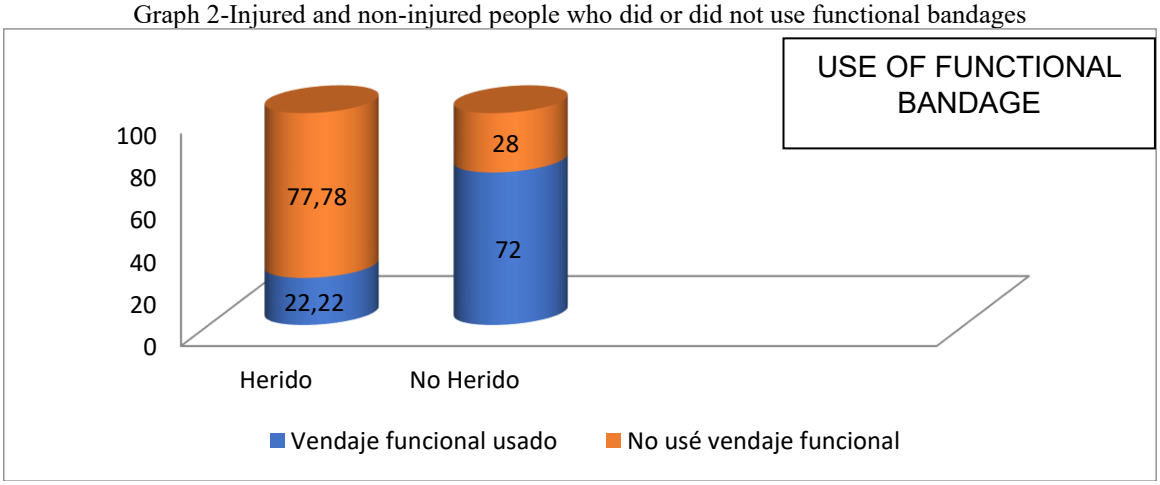
A total of 34 boxers aged between 14 and 49 years were studied, with 9 (26.47%) having some type of wrist injury and 25 (73.53%) not having an injury (Figure 1).

Graph 1- Incidence of injuries



Regarding the practitioners studied who had a wrist injury, 77.8% did not use the functional bandage in training, while 22.2% did. As for the practitioners who did not have any type of wrist injury, 28% did not use the functional bandage in training, while 72% did use it (graph 2).

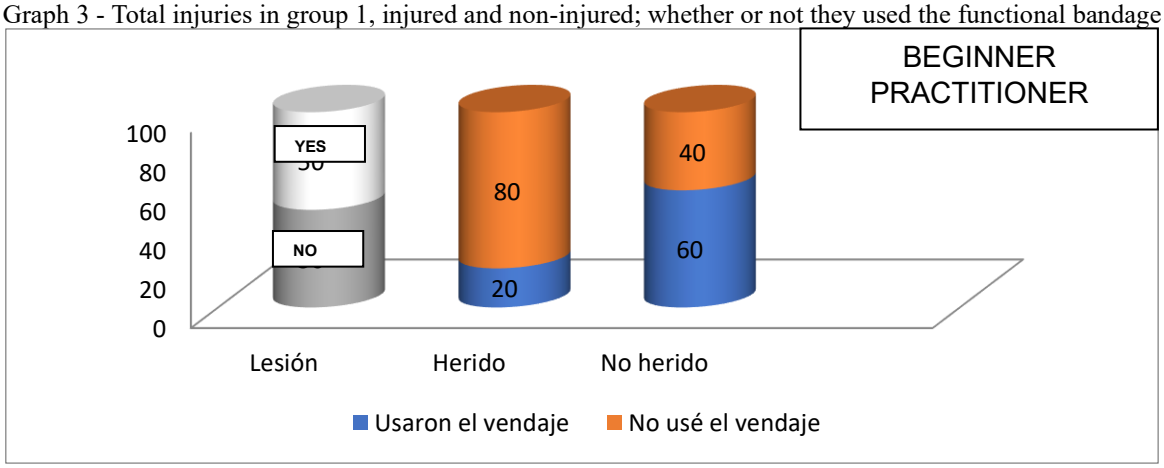
Graph 2-Injured and non-injured people who did or did not use functional bandages



As for the population of practitioners evaluated, it was classified into three groups; 1) beginner (up to 6 months), 2) intermediate (up to 12 months) and 3) advanced (from 12 months).

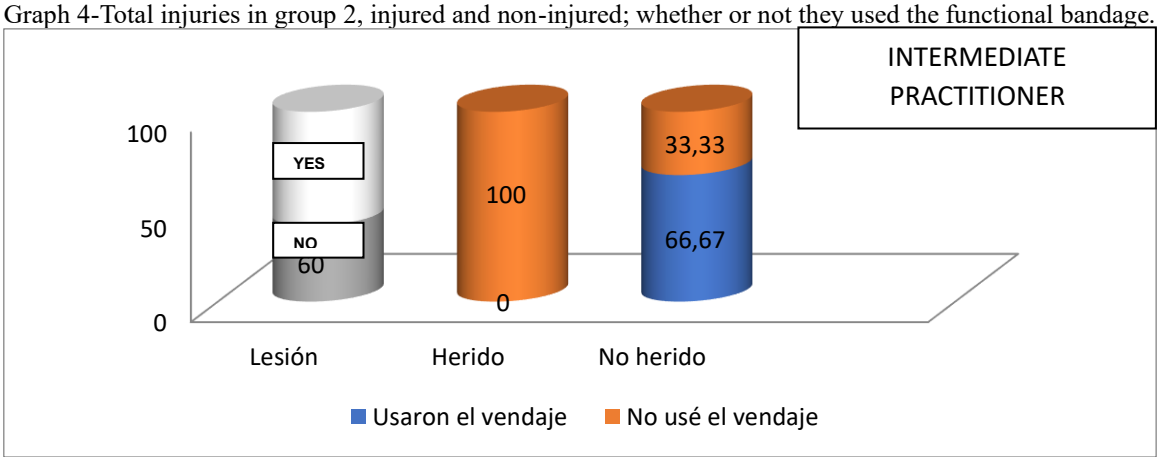
In the first group (n=10) it was observed that 50% of the practitioners had some type of wrist injury and 50% had no type of injury. Of those who suffered injuries, 20% used functional bandages and 80% did not. Of those who did not have an injury, 60% used bandages and 40% did not (Graph 3).

Graph 3 - Total injuries in group 1, injured and non-injured; whether or not they used the functional bandage



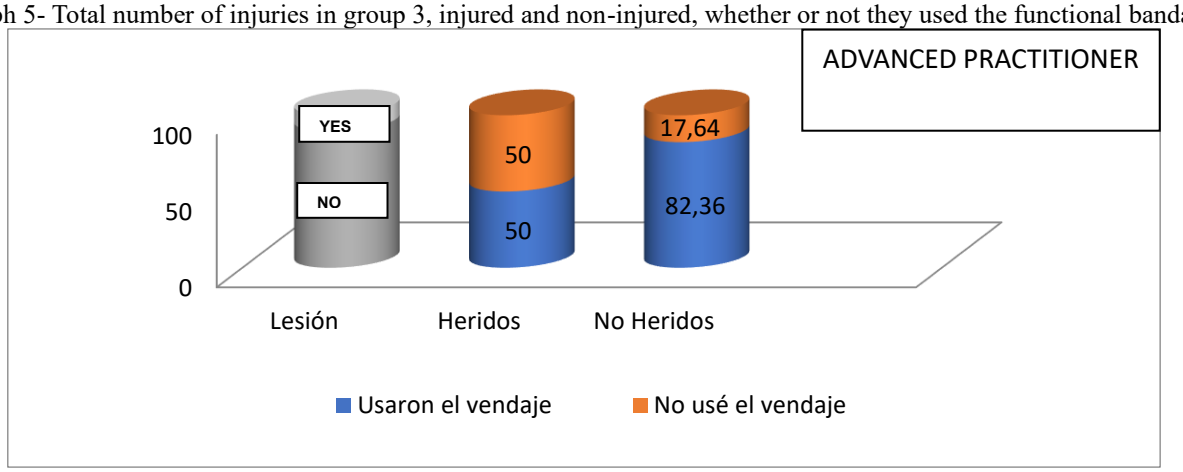
In the second group (n=5) it was observed that 40% of the practitioners had some type of wrist injury and 60% had no type of injury. Those with 100% lesions did not use bandages. Of those who had an injury, 66.67% used functional bandages and 33.33% did not (Graph 4).

Graph 4-Total injuries in group 2, injured and non-injured; whether or not they used the functional bandage.



In the third group (n=19) it was observed that 10.52% of the practitioners had some type of wrist injury, and 89.48% did not have any type of injury. Of those who suffered injuries, 50% did not use bandages and 50% did. Of those who did not have an injury, 82.36% used functional bandages and 17.64% did not (Graph 5).

Graph 5- Total number of injuries in group 3, injured and non-injured, whether or not they used the functional bandage



DISCUSSION

According to the first specific objective of the study presented in the result of graph 1, we note that most of the practitioners found did not present any type of wrist injury, indicating that they, based on the knowledge acquired, established prophylactic measures to avoid the injury and consequent withdrawal from the sport. It was also necessary to identify within the sample which practitioners had or did not have an injury.

Analysing graph 2, we observe that most of the professionals who suffered injuries did not use functional bandages. Most of those who did not present injury used functional bandaging, corroborating the study by David Thompson13, who states that the use of the appropriate bandaging technique aims to change certain parameters of application and distribution of forces to avoid overloading the tissue, thus avoiding injuries13.

Regarding the time of practice and the third specific objective of the study, we defined the practitioners in three groups, we found in the 1st group (beginners) a greater number of injuries, compared to the other groups, since, in order to have a significant technical knowledge, the practitioner needs the automation of the movement, which, according to Robert14, It only occurs after systematic training of several consecutive years, which encompasses several factors including physical, technical and tactical preparation. This factor is the likely cause of the increased number of injuries in this group. The process of teaching a sports movement (technical gesture) to a beginner must be applied with care, since the consequences of faulty learning can result in problems in the mastery and variation of technique, resulting in a greater possibility of injury15.

In group 3, analyzing graph 5, the majority of the sample (n= 19) can be observed, where the vast majority (89.48%) did not present wrist injury. The technical and tactical level and a longer practice time, combined with greater learning of the sporting gesture, knowledge and performance of the modality, cause the practitioner to use less force in the application of the blows, as well as a greater awareness in the use of preventive measures. thus reducing the number of injuries15.

It was also observed that in group 3 most of the practitioners did not present injury, however, they used functional bandaging (82.36%). Since group 3 had the lowest injury rate (89.48%) and used functional bandage. Although these data are not conclusive, taking into account the multifactorial nature of injuries, it is suggested that injury rates are related to those who have not used protective equipment16.

FINAL CONSIDERATIONS

According to the results of the present study, the importance of the use of functional bandages in the prevention of wrist injuries is confirmed, since practitioners with less time practicing sports, and who did not use functional bandages, were more likely to suffer injuries, while practitioners with more sports practice. time and who used functional bandaging had a lower incidence of injuries.

It is also necessary to delve into the technique of applying functional bandaging for practitioners, and the need for the presence of a qualified professional to apply the technique, a doctor's work focused on the prevention of sports injuries, thus configuring an important base for coaches. and athletes.

REFERENCES

1. New York State Athletic Commission. (1995). Professional boxing: experience of the New York state athletic Commission. In R. C. Cantu (Ed.), *Boxing and medicine* (pp. 1950–0). Champaign, IL: Human Kinetics. Disponível em https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1070930/

2. Gambrell, R. C. (2007). Boxe: assistência médica dentro e fora do ringue. *Current Medical Sports Reports*, 22(4), 1950–0. Disponível em https://pubmed.ncbi.nlm.nih.gov/17883967/

3. Blonstein, J. L., & Clarke, E. (1954). Os aspectos médicos do boxe amador. *British Medical Journal*, 22(4), 1950–0. Disponível em https://pubmed.ncbi.nlm.nih.gov/13209167/

4. Blonstein, J. L., & Clarke, E. (1957). Novas observações sobre os aspectos médicos do boxe amador. *British Medical Journal*, 22(4), 1950–0. Disponível em https://pubmed.ncbi.nlm.nih.gov/13396258/

5. Schmidt-Olsen, S., Jensen, S. K., & Mortensen, V. (1990). Amateur boxing in Denmark: O efeito de algumas medidas preventivas. *American Journal of Sports Medicine*, 22(4), 1950–0. Disponível em https://pubmed.ncbi.nlm.nih.gov/2301696/

6. Beltrani Filho, C. A., Vivácqua Neto, I., Navarro, M. S., Fujiki, E. N., Valenti, V. E., Abreu, L. C., & Milani, C. (s.d.). Sports injuries during fights in amateur boxing.

7. Timm, K. E., Wallach, J. M., Stone, J. A., & Ryan, E. J. (1993). Quinze anos de Amateur Boxing Lesões / Doenças no Centro de Treinamento Olímpico dos Estados Unidos. *Journal of Training Athletes*, 22(4), 1950–0. Disponível em https://pubmed.ncbi.nlm.nih.gov/16558249/

8. Salgado, A. S. I., Parreira, R. B., & Ceci, L. A. (s.d.). Aplicação de Bandagens Funcionais como recurso no tratamento de lesões nos atletas tratados na Clínica de Fisioterapia Salgado – Clinique du Sport, Londrina – PR.

9. Duarte, M., & Fornasari, C. (2004). Bandagem funcional e fotometria. *Revista Fisio e Terapia*, (46), 12-14.

10. Thompson, D. (s.d.). Bandagem Funcional – aspectos teóricos. *Manip M. Phty*. Disponível em https://docplayer.com.br/30901643-Bandagem-funcional-aspectos-teoricos.html

11. Laughman, R. K., Carr, T. A., Chao, E. Y., et al. (s.d.). Three-dimensional kinematics of the taped ankle before and after exercise. *American Journal of Sports Medicine*, 8, 425–431.

12. Caporrino, F. A., & Albertoni, W. M. (2008). Lesões da mão e do punho. In *Medicina do esporte* (p. 503). Barueri, São Paulo.

13. Poletini, L. D., Neto, J. M. F. A., & Campos, M. F. (2020). Uso de kinesio taping na melhora da extensão de punho de membro superior espástico: estudo de caso. *Consciesi*, 2(2), 185–194.

14. Santos, S. G. S., Duarte, M. F. S., & Galli, M. L. (s.d.). Estudo de algumas variáveis físicas como fatores de influência nas lesões em judocas.

15. Greco, P. J., Benda, R. N., & Chagas, M. H. (2001). A aprendizagem do gesto técnico esportivo. *Revista Brasileira de Cineantropometria e Desempenho Humano*, 3(1).

16. Souza, G. M., & Almeida, F. S., & Nunomura, M. (2002). Lesões na ginástica artística: Principais incidências e medidas preventivas. *Motriz*, 8(1), 21–29.

Procedures for BIM modeling of reinforced concrete ribbed slabs in buildings

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ABSTRACT

It is impossible not to admit that commercial computational tools for structural analysis and detailing have become indispensable in the various applications of Structural Engineering nowadays. The importance of these tools equipped with graphical interfaces based on the BIM (*Building Information Modeling*) environment, is verified, above all, due to the flexibility and ease in making corrections and common changes during the elaboration stage, as well as the proposition of different structural conceptions, not always innovative, but almost always bold, as in the case of reinforced concrete ribbed slabs.

The use of ribbed slabs in reinforced concrete is an old practice in Structural Engineering, which has encouraged the adaptation of commercial computational tools, both in the development of structurally consistent mathematical formulations, as well as in the development of specific databases, equipped with information from mold manufacturers and materials intended for the execution of this type of slabs.

It is highly efficient in building structures in which there are numerous problems of interference of structural elements with elements of installations, such as large-diameter pipes for wastewater, sewage, gas, fire, and even air conditioning ducts, exhaust and architectural elements.

This efficiency is mainly due to the fact that large beams are not considered in their supports, making the lower face of the slab practically without obstacles to the building pipes, and is also due to the low average thickness of concrete used in the pavement compared to conventional rectangular supported slabs and flat mushroom slabs.

However, it is not always possible to obtain an optimal final result, even with all the adaptations previously described, mainly due to executive and computational modeling problems.

This work intends to present a possible structural modeling methodology, which provides results within the limits of the feasibility of the slab, both in the construction aspect of the computational structural model, as well as the possibility of using materials from manufacturers and labor, using a commercial computational tool for structural analysis and detailing.

Keywords: BIM, Reinforced concrete ribbed slab.

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INTRODUCTION

As is well known, the thickness of a reinforced concrete slab depends, in addition to the overload for which it is intended, on the span to be overcome.

This thickness must be sufficient to avoid major deformations or undesirable vibrations.

However, in the case of large spans, solid slabs can reach such great thicknesses that most of their strength would be used to combat the stresses due to their own weight, which can cause a costly practice, from an economic point of view.

In this way, the alternative of reducing the structure's own weight was started, suppressing the part of the concrete that does not work, that is, using only the sufficient amount of concrete, in order to envelop the reinforcements in the tensile areas.

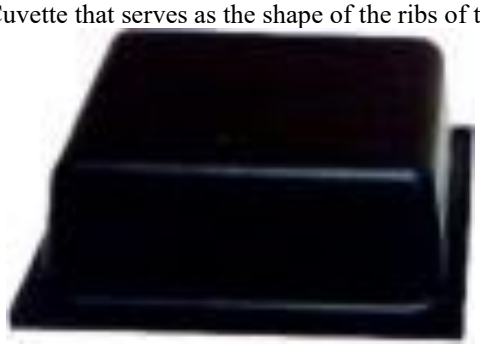
The traction regions with armor concentrated in bands are called ribs. In the space between the ribs, low self-weight materials are usually placed, with the ability to simultaneously allow a flat finish of the roof and serve as forms for the ribs.

The total savings are a function not only of the relief of self-weight, but also of the difference in costs (including execution) between the concrete and the inert material that has the function of replacing it.

Ribbed slabs have their application in residential or commercial buildings, especially in floors intended for garages, which usually require large spans and higher overloads.

For the execution of the ribs, reusable forms of polypropylene are usually used, as shown in Figure 1.

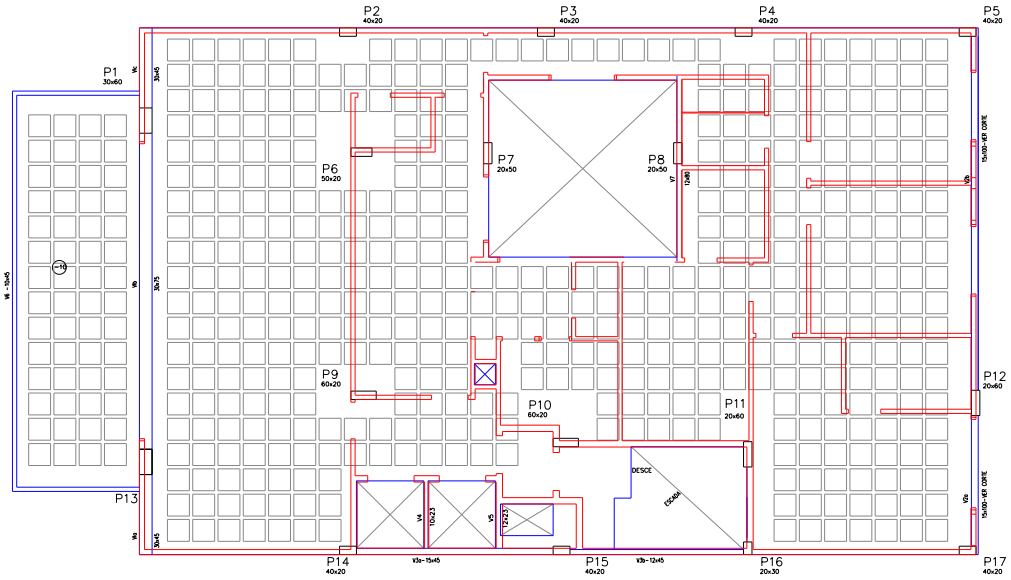
Figure 1 – Cuvette that serves as the shape of the ribs of the Atex slab



STRUCTURAL MODEL PROJECT DATA

In order to have an idea of how to design a ribbed slab in reinforced concrete with the Cypecad software [1], let's take as an example the formwork plan shown in Figure 2. It is a structure with only one roof, equipped with capitals on the pillars and thickening in the regions where it was not possible to place the forms due to geometric limitations. The use of capitals in the columns is justified by combating the efforts of punching the columns on the slabs when they are devoid of beams in these regions.

Figure 2 – Formwork Plan / Location of the masonry



As can be seen, the plan of forms shown in Figure 2 above already has the masonry of the architectural project positioned. To facilitate modeling, the columns and beams are already pre-dimensioned. In this way, we can devote our attention only to the design of the ribbed slab.

For the launch of the structure, several characteristics of the project are defined, such as: fck of concrete (adopted 25MPa), steel grade (adopted 50A), utilization overload (adopted 200 kg/m2) and coating (adopted 150 kg/m2). The contour beams are rectangular in section and at some ends no beams were arranged, leaving the support due to the thickening of the slab in these regions. The self-weight will depend on the value informed by the manufacturer in its catalog, as will be seen in Figure 4, and will be automatically generated in the structure.

BIM MODELING

The structure is modeled exactly like a solid slab structure. The difference arises when we choose the type of slab that will fill the empty panels, as shown in Figure 3. There is the option of automatic generation of the massive regions, in space around the pillars, in order to mitigate the effects due to the punching.

Figure 3 – Structure modeled in Cypecad 3D before filling the panels

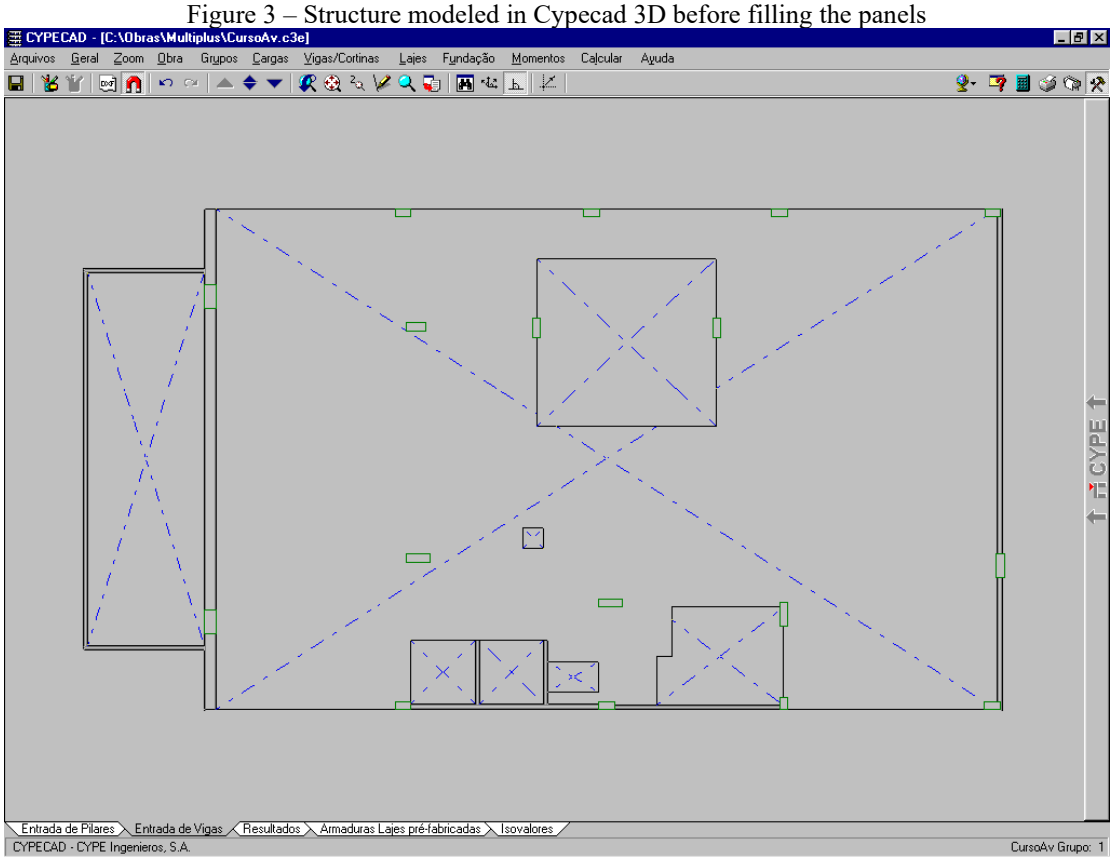
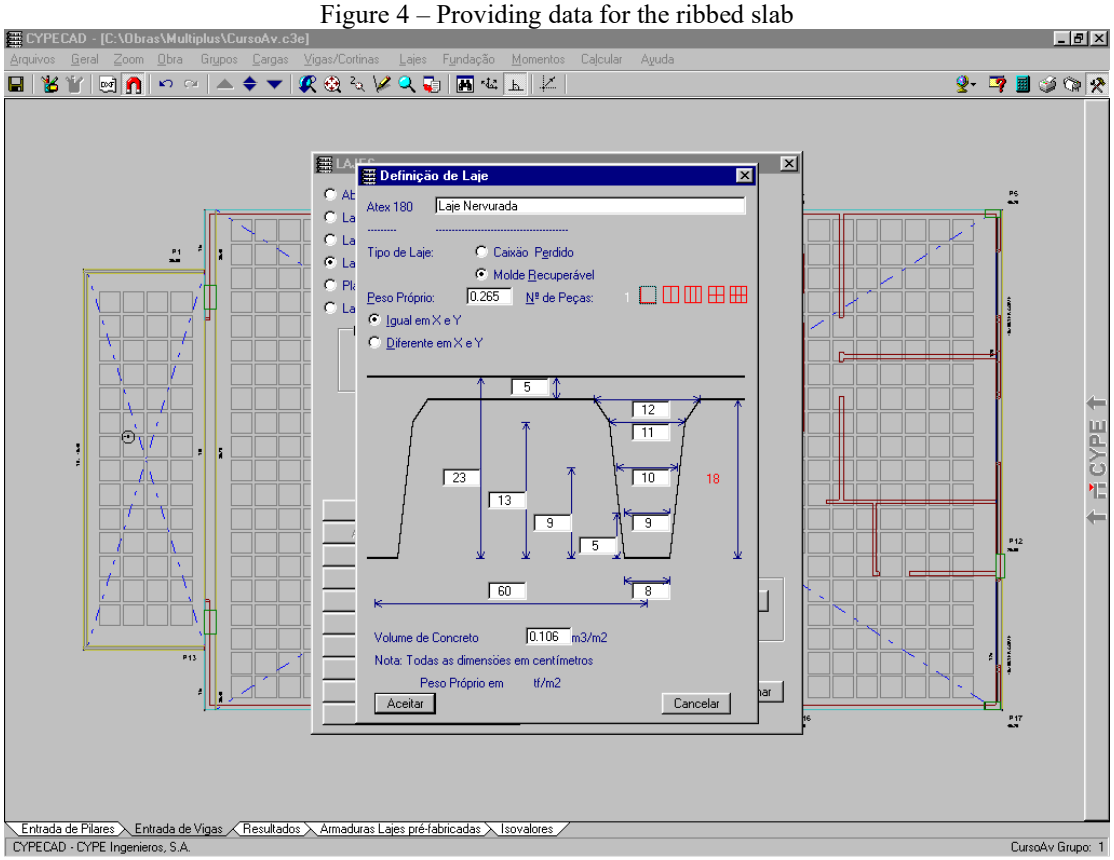


Figure 4 – Providing data for the ribbed slab



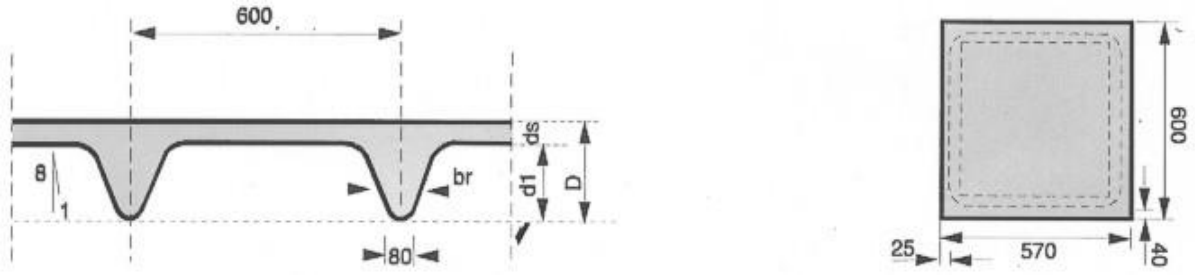
Therefore, it is necessary to create patterns of ribbed slabs with its mechanical characteristics, such as geometric data, between rib axes, self-weight of the slab, as shown in Figure 4

As can be seen in figure 4b above, it is enough to collect data on the properties of the slabs, taking as a reference the catalog of a manufacturer, which in this particular case is that of the company Atex.

It should be noted that the number of elements into which the ribbed slab bowl is divided is variable, from one element per bowl to 6 elements per bowl. Due to the computational effort required for a very large number of elements, it is very reasonable in vats of up to 1.00m of interaxis, the use of only 1 element per tub

These data are taken from the tables provided by the mold manufacturers [2], as shown in Figure 5.

Figure 5 – Example of ribbed slab data, taken from the manufacturer's catalog [2]



USE OF WELDED MESH REINFORCEMENT

In order to obtain a more homogeneous result of the reinforcements during the execution of the work, it is advisable to use a base reinforcement for the ribs (positive reinforcement). To do this, it is enough that the reinforcement table that will be used in the calculation is equipped with these meshes and that they are assigned before the calculation as shown in Figure 6.

It is customary to use superior mesh reinforcement in the ribs and masses of 4.2mm, in order to combat minimal (negligible) moments and that induce the software to make reinforcement reinforcement in these regions, despite the little need, and therefore discard it from the final detailing.

The final detail of the reinforcement in a ribbed slab (typical) can be observed, for example, in Figure 7, shown below.

In some cases, it is interesting to calculate the same structure with different base reinforcements and check the list of quantities of the work that provides the lowest reinforcement rate per m3 of concrete. It is important to remember to consider the additional weight of the mesh considered in each round, as it is not considered in the list of quantities of the work by the software.

After the calculation with the configuration that is understood as optimal (both from the point of view of structural safety and from the economic point of view), it is enough to make the final

optimizations in the reinforcement, punching and shear reinforcement of the ribs, so that the definitive reinforcement drawings can be generated.

Figure 6 – Reinforcement table for positive reinforcement in the ribs [3]

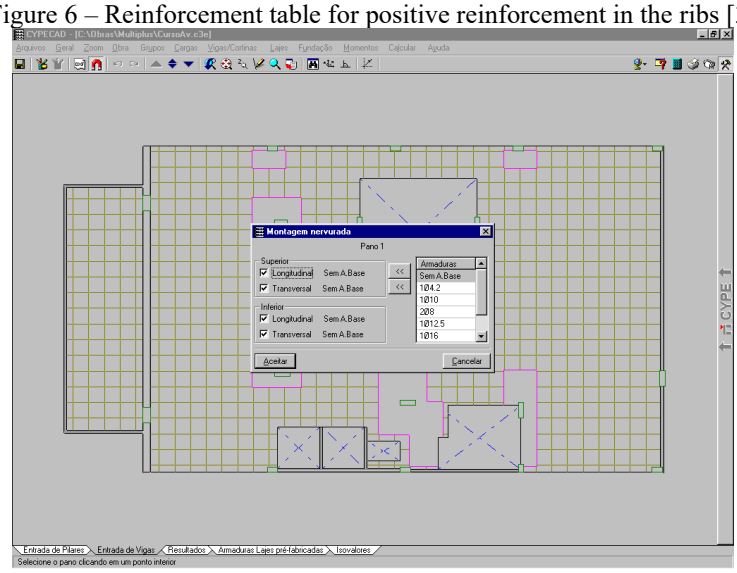
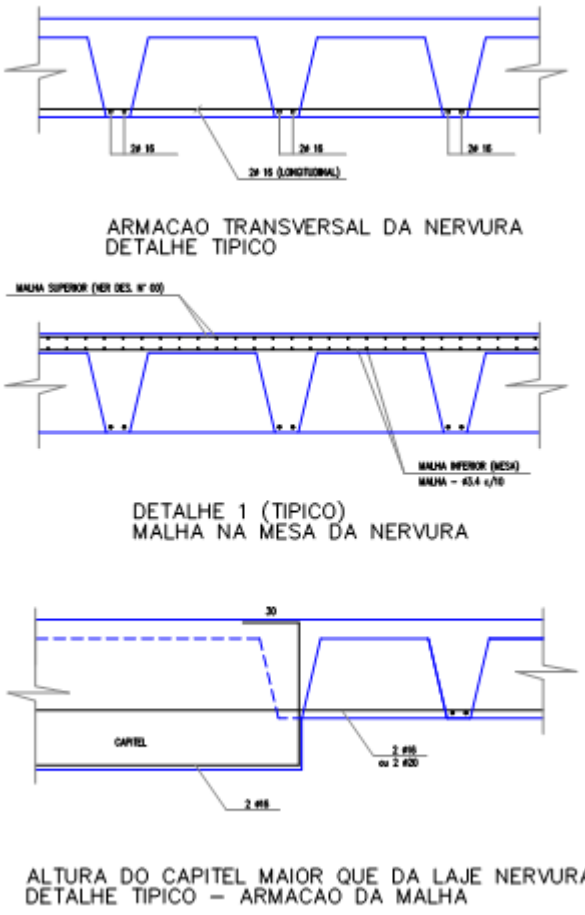


Figure 7 – Detailing of the reinforcements of the ribs



CONCLUSIONS

The advent of the BIM methodology in structural projects with the use of software such as Cypecad [1], has enabled the calculation engineer to innovate his design criteria in order to design increasingly economical structures, taking full advantage of the properties of the materials used (concrete and steel).

At the same time, suppliers such as Atex [2] presented their system that, constructively, meets the economic requirements mentioned above.

In this way, project engineering moves simultaneously with the development of construction techniques, in order to obtain final results with increasingly better quality.

REFERENCES

1. Cype Ingenieros. (2024). *Software Cypecad Espacial: Módulo de lajes nervuradas* (Versão 2024). Cype Ingenieros.

2. ATEX. (n.d.). *Formas para lajes nervuradas* [Catálogo Técnico].

3. Gerdau. (n.d.). *Telas soldadas* [Catálogo Técnico].

Perceived social support among adolescents in public schools in areas of social vulnerability

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ABSTRACT

Adolescence is a time of intense change, where emotional support from friends, family, and teachers plays a crucial role. Mental health problems are common at this stage, highlighting the importance of social support in promoting well-being. The objective of this study was to describe the social support perceived by high school adolescents in public schools located in an area of social vulnerability in the city of Bauru, São Paulo. This was a cross-sectional study. Data collection was carried out through forms through Google Forms. Support was measured using the Social Support Appraisals (SSA) instrument and the gender of the participants was self-reported. The results show that family support is the source most valued by adolescents, followed by friends and, to a lesser extent, teachers. Friendships are highlighted as an important source of emotional support, evidencing reciprocity and trust among young people. However, teacher support was the least noticed, indicating a disconnect that can impact school wellbeing. Therefore, it is necessary to strengthen social support networks, especially in the school environment of adolescents in contexts of social vulnerability.

Keywords: Social support, Adolescents, Mental health.

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INTRODUCTION

Adolescence is a period of intense physical and emotional changes, in which relationships move from the family nucleus to friends, seeking social and emotional support. These relationships are especially evident in the school environment, where adolescents spend much of their time and form stronger bonds with classmates and teachers (Neri; Ville 2008).

Between 10 and 20% of children in the world face mental health problems, with almost half developing these problems by the age of 14. Suicide is the second leading cause of death among young people aged 15 to 29 (UNICEF). Adolescents also face challenges such as long distances to school, unfavorable economic conditions, direct educational costs, lack of support for special educational needs, precarious school conditions, and frequent teacher absences (Mined, 2013). Adolescent girls are particularly affected, facing early pregnancy and early marriage, making it difficult for them to stay in school, especially in high school.

In this sense, social relationships, or social support, built throughout life, promote health and better quality of life (Pattussi et al., 2001; Drukker et al., 2003; Drukker et al., 2005; Pattussi et al., 2006; Aida et al., 2009; Furuta et al., 2012; Vasquez et al., 2015; Tomazoni et al., 2016). Furuta et al. (2012) evaluated the social relationships of adolescents at school and in the family and their relationship with self-assessed oral health. Adolescents with lower trust in teachers and family had greater impacts on quality of life, highlighting school as an environment capable of offering support and emotional support. Confidence can promote oral health through healthy behaviors and stress reduction.

Social capital and social support have been related to various aspects of health (Gilbert et al., 2013; Moore; Kawachi, 2017). These relationships probably occur due to the influence on the formation and dissemination of healthy behaviors, greater access to health services, and increased awareness of rights (Mcgrath; Bedi, 2002; Rouxel et al., 2015). Psychosocial processes also explain this relationship, promoting greater emotional support, self-esteem and protection against stress (Mcgrath; Bedi, 2002; Rouxel et al., 2015). The relationship between social capital and general health is widely discussed in the literature (Moore; Kawachi, 2017).

Understanding the perception of social support among adolescents generates data based on scientific evidence to guide actions to promote health, making the school environment an effective support for a happier life. Few scientific studies have analyzed adolescents' self-perception of social support. Thus, the objective of this study was to describe the perceived social support among high school adolescents in public schools located in an area of social vulnerability in the city of Bauru, São Paulo.

METHODOLOGY

STUDY DESIGN

This is a cross-sectional observational study conducted with high school adolescents in the northern region of Bauru, São Paulo – Brazil. *STROBE* (Cuschieri et al., 2019)

Ethical aspects

The present study was approved by the Research Ethics Committee of the Bauru School of Dentistry, University of São Paulo, under CAEE: 58865222.2.0000.5417**.** Data were collected after the guardians and adolescents consented and signed the Informed Consent Form (ICF) and the Consent Form (TALE).

Study location

The municipality of Bauru is located in the interior of the state of São Paulo, being considered the most populous municipality in the center-west of São Paulo. The city is located northwest of the state capital, about 326 km from it. It occupies an area of 673.488 km², of which 68.9769 km² are in the urban perimeter and the remaining 604.51 km² constitute the rural area. In 2015, its population was estimated by the IBGE at 366,992 inhabitants (Brasil, 2010). Bauru has 61 state high schools.

Sampling

The sample was selected by a two-stage cluster. Adolescents aged 15 and 16 years participated in the study in two high schools in the northern zone of Bauru. The participating schools were selected based on educational indicators, such as the Basic Education Development Index (IDEB).

For the selection of the region to which the schools were allocated, the criteria of social vulnerability were adopted, adopted by the Social Assistance Reference Center (CRAS) that serves populations in situations of social vulnerability due to poverty, deprivation and/or weakening of relational affective bonds and social belonging, primarily families benefiting from income transfer programs (Bauru, 2024).

Data collection

Data collection took place in the first half of 2023 through self-administered questionnaires on *Google Forms*. Students aged 15 and 16 who were attending the 1st and 2nd year of high school duly enrolled were invited to participate in the study. Students who had some physical, cognitive or psychological limitation and who did not answer any question were excluded.

TRAINING OF EVALUATORS

Two evaluators were previously trained by a gold standard researcher (SHCSP) experienced in epidemiological surveys. The training was important for the researchers to obtain mastery of the items researched and for standardization of the processes of interpretation of the results and approach of the participants.

MEASUREMENTS

DEMOGRAPHIC CONDITIONS

The adolescents were evaluated for gender.

Social support

Social support was assessed using the Social Support Appraisals (SSA) instrument, developed for adolescents (Vaux et al. 1986). The version adapted to the Brazilian population was used (Squassoni; Simões Matsukura, 2009). The questionnaire consists of 30 questions distributed in four dimensions: family, friends, teachers and others. The answer options are presented on a Likert scale with 6 points: "Strongly agree" (1), "Strongly agree" (2), "Somewhat agree" (3), "Somewhat disagree" (4), "Strongly disagree" (5) or "Strongly disagree" (6) and divided into 4 dimensions: family, friends, teachers, and others. The scores are inverted for questions with a positive connotation. The total score comprises the sum of the items, and can vary from 30 to 180, in which the highest score indicates greater social support.

Table 1 - Distribution of statements from the Social Support Appraisals (SSA) instrument according to dimensions.

	Statements
Friends	1) My friends respect me 8) In general, I can trust my friends 11) My friends don't care about me at all 14) I feel very connected to my friends 17) My friends like to be with me 24) Me and my friends are very important to each other 27) I help my friends and they help me
Family	3) I am very dear to my family 6) My family cares a lot about me 9) I am very admired by my family members 16) My family likes me a lot 19) People in my family trust me 22) I can't count on my family to support me 25) My family respects me a lot 30) I don't feel very connected to my family
Professor	2) I have teachers who care a lot about me 5) My teachers like me 12) My teachers admire me a lot 15) My teachers trust me 18) Overall, I can't count on my teachers to support me 21) Most of my teachers respect me a lot 28) I don't feel very connected to my teachers
Other people	4) I'm not important to others 7) People, in general, like me 10) I am respected by people in general

	13) I'm liked by people 20) I feel that people, in general, admire me 23) I feel good when I'm with other people 26) I feel that people value me 29) If I died tomorrow, few people would miss me

Source: Authors.

DATA ANALYSIS

The data were tabulated in Excel spreadsheets and later analyzed in the JAMOVI program, which were presented in a descriptive way about the adolescents' self-perception. The analysis was based on a series of statements, distributed on a 6-point Likert scale that measure their perception of the support received from each of these groups.

RESULTS

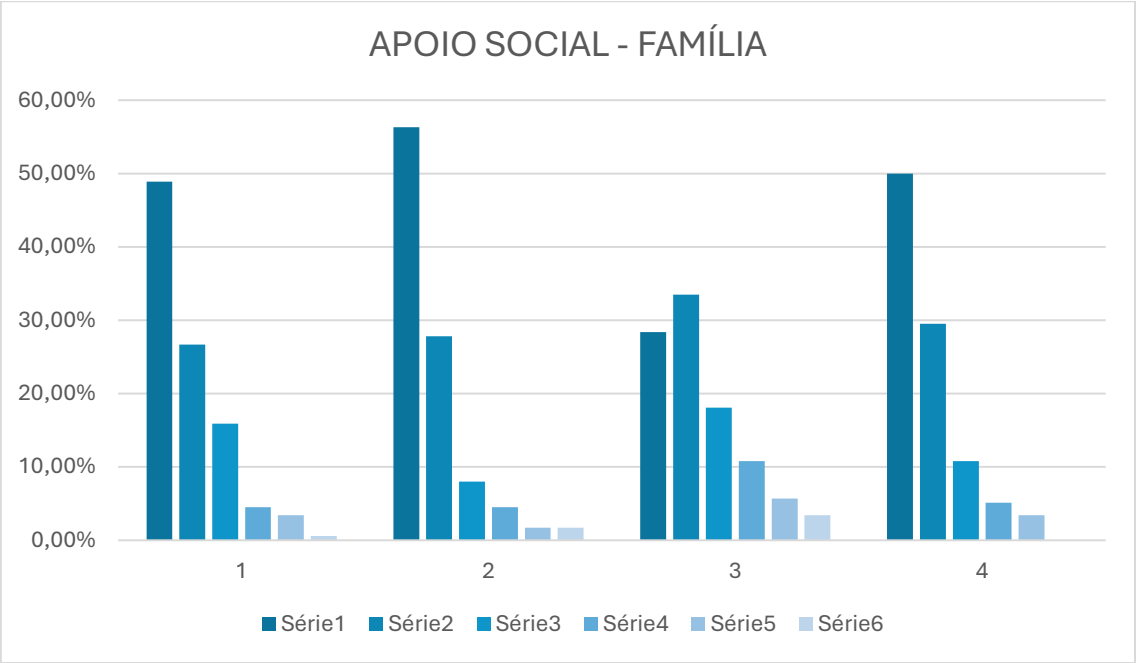
CHARACTERIZATION OF THE PARTICIPANTS

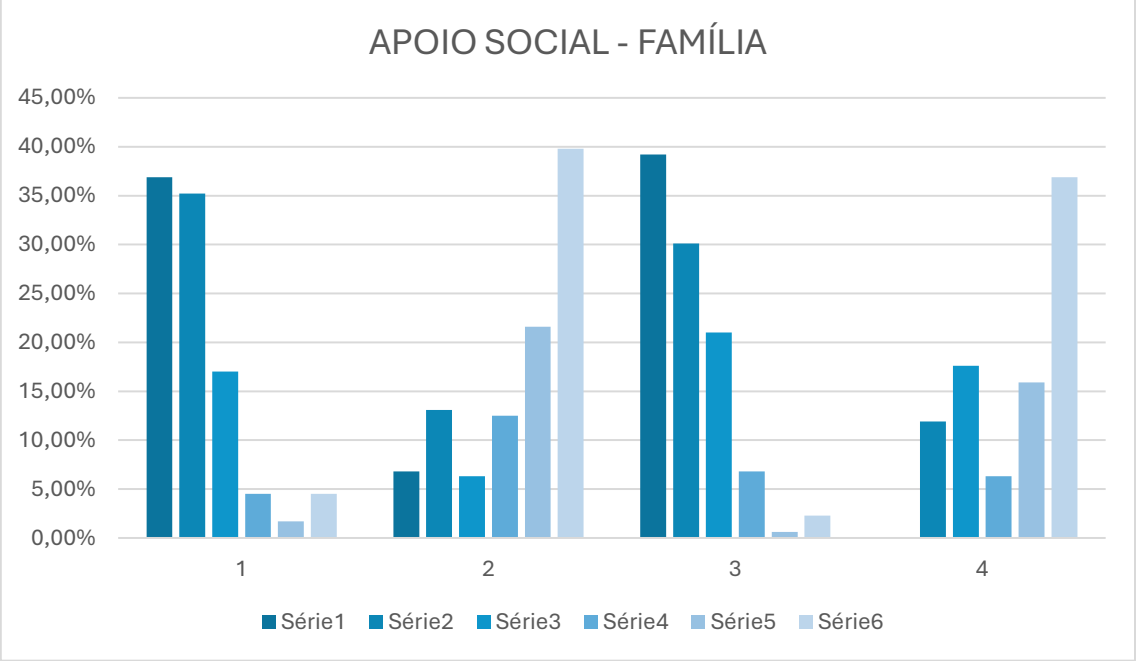
The study included 176 adolescents between 15 and 16 years of age, who at the time of the research were attending the 1st and 2nd year of high school. Most participants were female, 91 (51.7%), 83 (47.2%), and 2 (1.1%) others.

The results presented evaluate the perception of social support in adolescents in areas of social vulnerability, the questionnaire used evaluates three main sources of support such as family, friends and school, through the Likert scale.

FAMILY SUPPORT

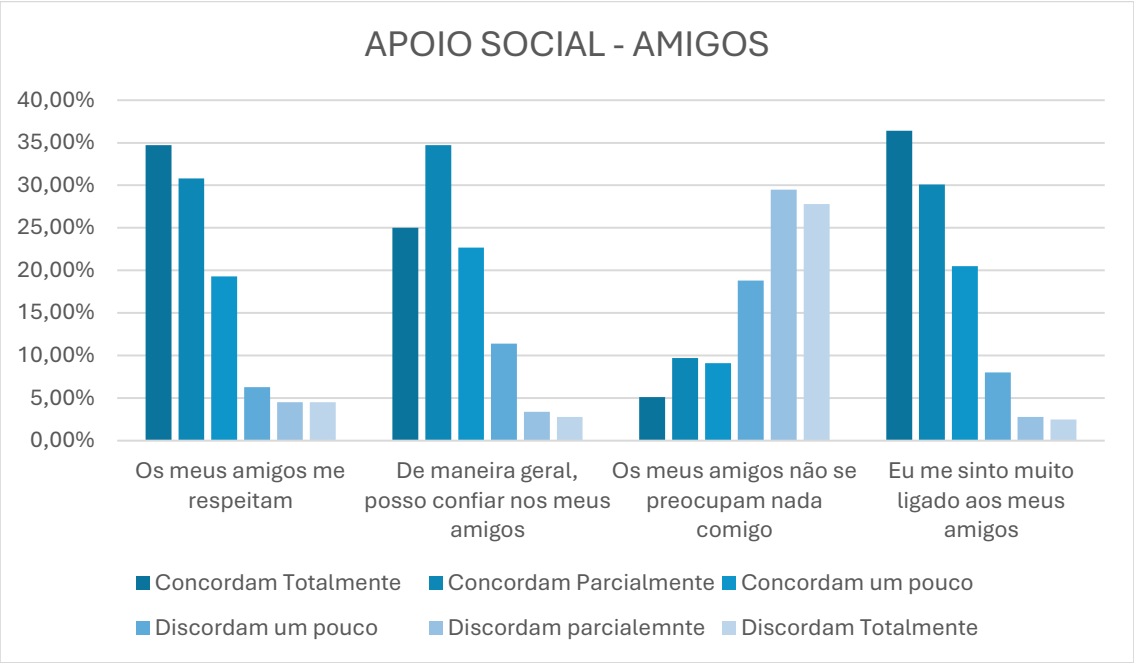
The items related to family support revealed that most adolescents feel wanted, respected and admired by their families. Statements such as "I am very dear to my family" and "The people in my family trust me" received positive responses, indicating a strong family bond that contributes to the adolescents' self-esteem and emotional well-being. However, negative items, such as "I can't count on my family to support me", suggest that there are still gaps in the support offered by some families, which can negatively impact the quality of life of these young people.

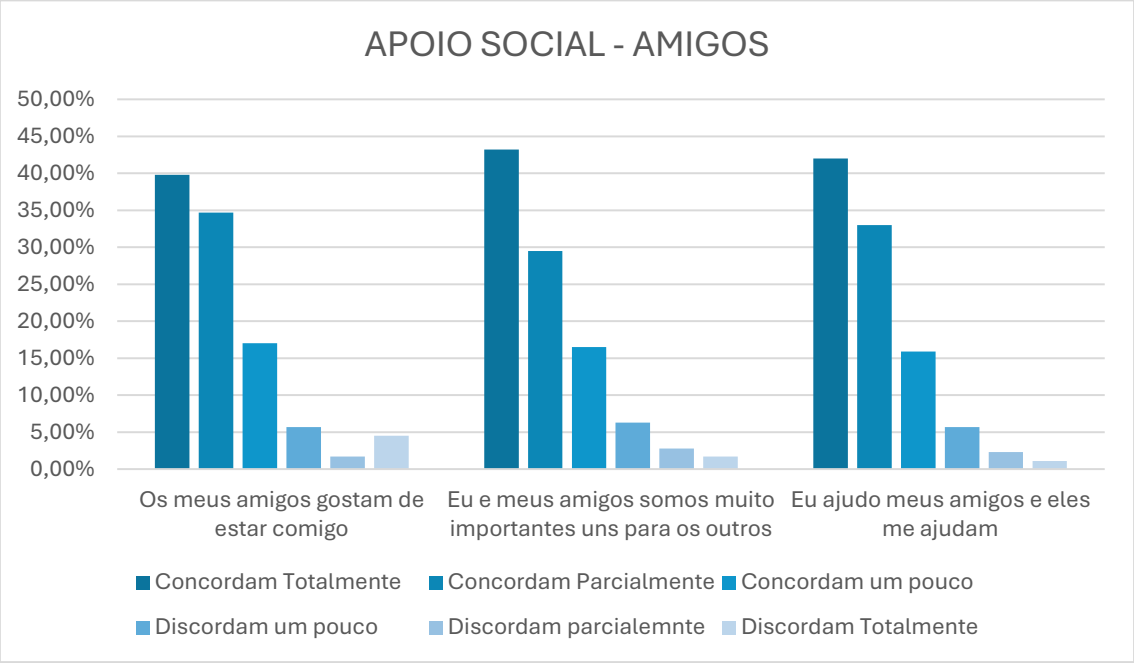




SUPPORT FROM FRIENDS

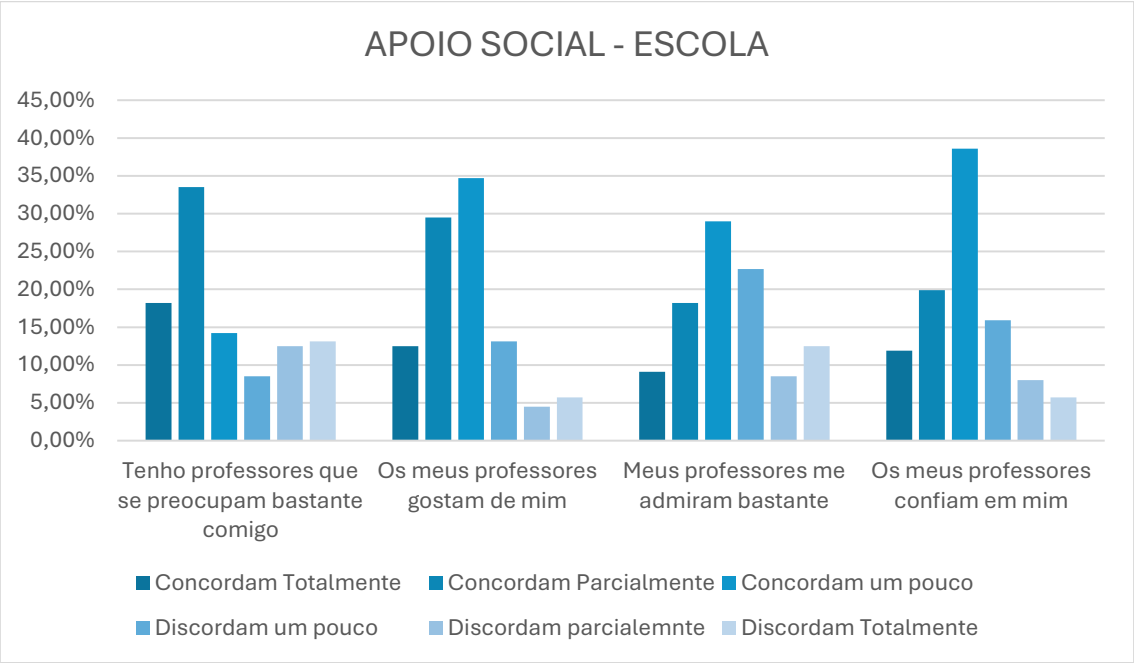
The perception of support among friends was also positively evaluated. Statements such as "My friends respect me" and "I feel very connected to my friends" demonstrate that adolescents find in friends a significant source of emotional and social support. The importance of friendship relationships is highlighted by the mutuality in support, as indicated in the statement "I help my friends and they help me", in which 74 (42%) totally agreed with the situation and 2 (1.1%) totally disagreed. When asked if they felt important to their friends and their friends had the same opinion, 76 (43.2%) totally agreed.

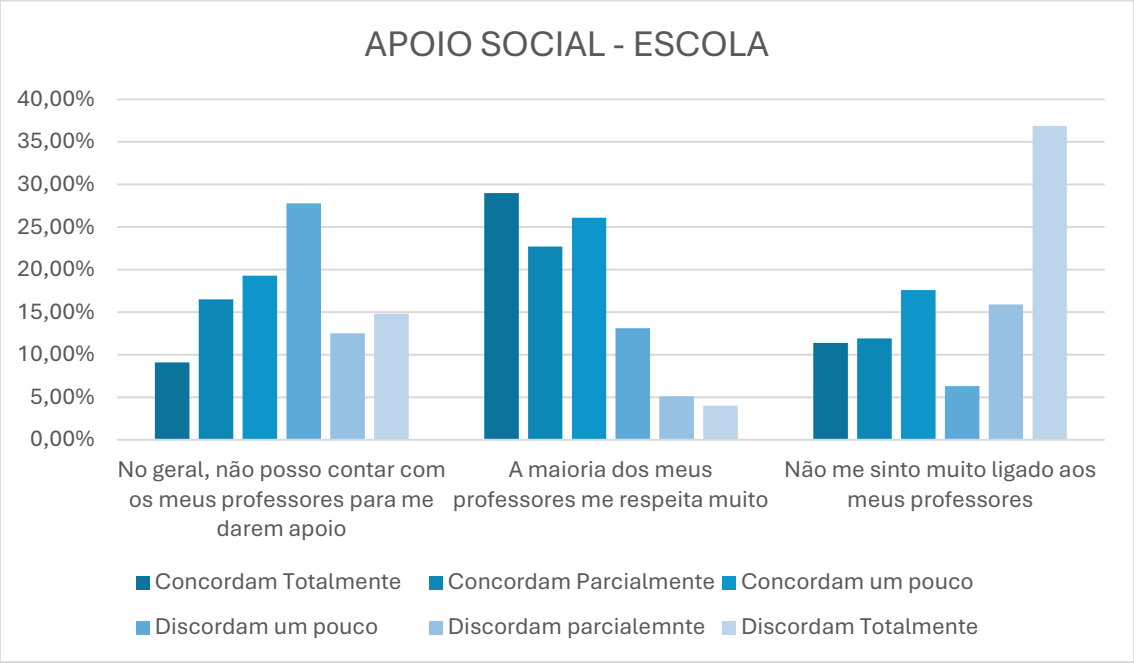




SCHOOL SUPPORT

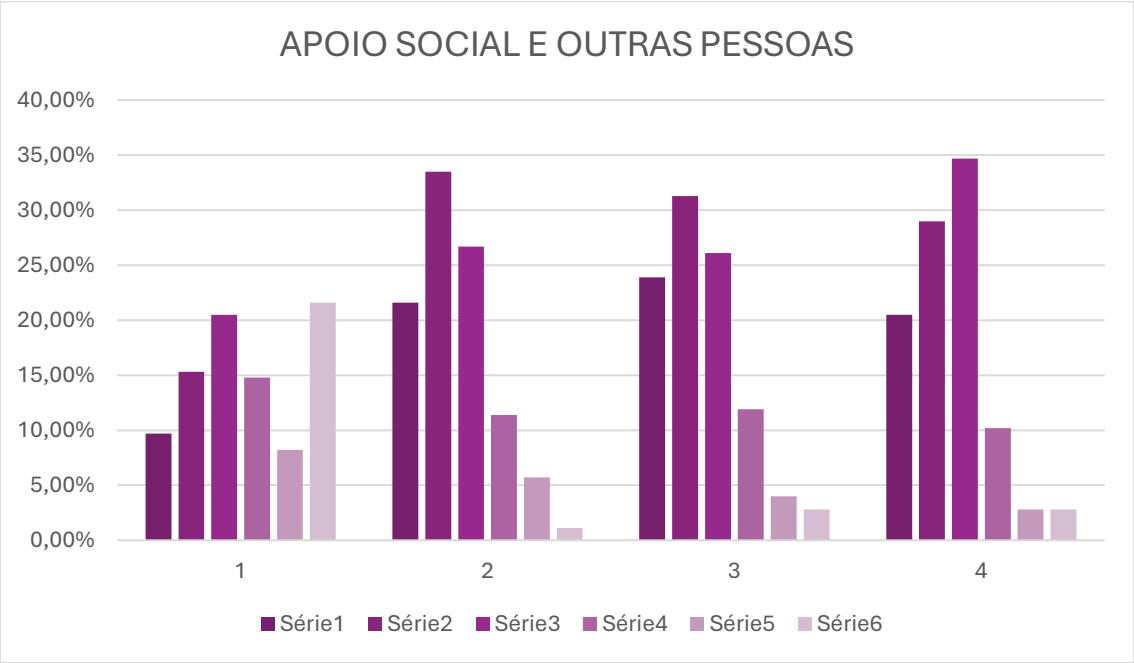
The school environment is another crucial source of support for adolescents, especially through teachers. Most responses suggest that teens feel respected and admired by their teachers. When asked if the teachers trusted them, only 21 (11.9%) totally agreed, 35 (19.9%) partially agreed and 68 (38.6%) somewhat agreed. However, most teenagers feel that they are admired by teachers. This indicates that teachers play a significant role in promoting students' self-esteem and well-being. However, the negative answer "I don't feel very connected to my teachers" indicates that some students may feel disconnected, highlighting the need for improvements in student-teacher relationships.

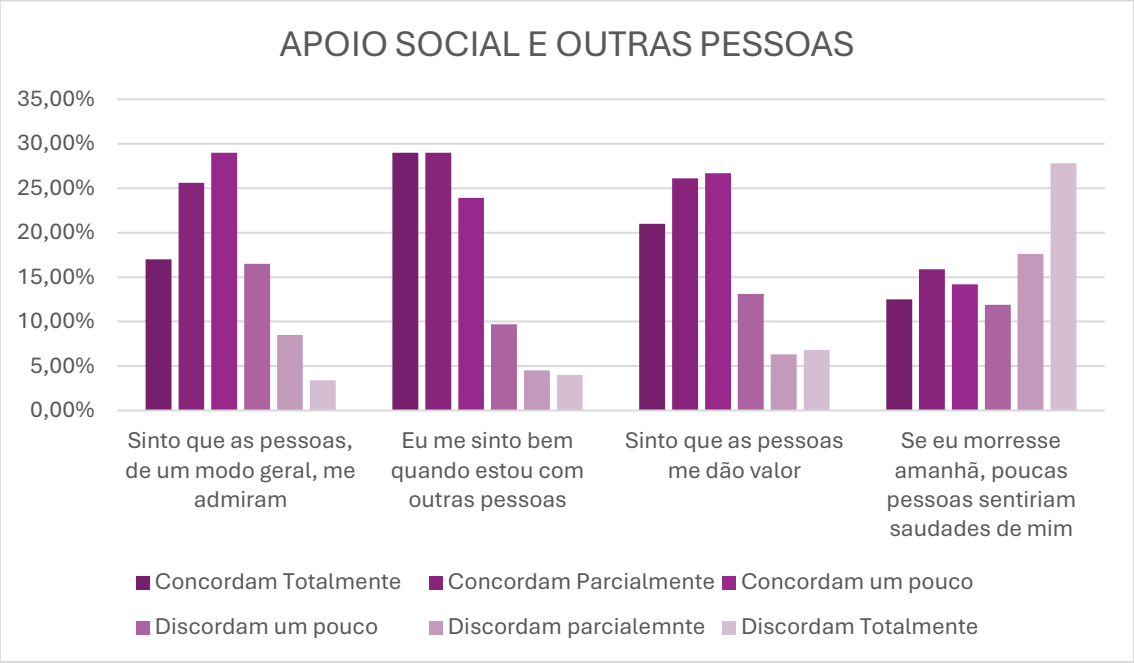




SOCIAL SUPPORT AND OTHER PEOPLE

In the domain of social support and other people, 34.5% of the adolescents partially agree with the statement: "people in general like me". It is worth mentioning that in this domain, the statement with the highest number of answers was the option I agree a little, in the statement: "I am loved by people"





DISCUSSION

The results of the present study showed that adolescents from public high schools in areas of social vulnerability are able to better perceive the social support received by family and friends, with school support being less perceived.

Thus, social support has been widely studied in the literature (Putnan, 1993; Pattussi et al., 2001; Meira et al., 2020; Knorst et al., 2022), especially in this population (Furuta et al., 2012), since adolescence is characterized by psychological, physical, and biological changes (Brasil, 2010), social relationships are no longer centered exclusively on the family and start to have greater trust in friends and colleagues (Topaktaş; Dündar; Pekşen, 2017).

Family support, evaluated by the relationship of trust in family members, influences attitudes and behaviors among adolescents (Drukker et al., 2003). This relationship was observed in the participants' answers, with regard to the family domain. Adolescents feel loved by their families, agree that these people like them, realize that they can trust, feel connected and receive support. It is worth noting that when asked if they are admired by their families, 40% of the participants partially agreed. Topaktas; Topaktaş; Dündar; Pekşen, (2017) found that adolescents who had greater perceptions of social support avoided risky behaviors such as alcohol intake, cigarette use, and practiced more physical exercise, in addition to having better expectations for the future.

Our data corroborate the findings of Gomes et al., (2019), that the greatest perception of support was in the family domain, among adolescents with low socioeconomic status. Socioeconomic status has been reported as a relevant determinant of health-friendly behaviors (Silva et al., 2021). Adolescents in low-income families or in areas of great social inequality are exposed to more risk factors for health and quality of life. It should be noted that social support can then strengthen individuals.

Thus, through these social relationships, people start to adopt healthy behaviors and start to trust each other, creating bonds of reciprocity and mutual support (Knorst et al., 2022). Our results confirm these relationships, in which participants fully agreed that they and their friends can trust each other.

Regarding the social support perceived in the school environment, adolescents do not feel supported by teachers, most agreed a little when asked about the teachers' confidence and feel loved by them. Similar data were found in Alves' study; Dell'Aglio, (2015) in which the lowest average of social support of adolescents was in the school domain. However, other authors included all the issues that involved the school environment.

Thus, studies have shown that the school, due to the role of teachers, is equally important for the school performance of adolescents (Coelho; D'Angello, 2018). When teens feel admired, respected, and supported by their teachers, they tend to have a better perception of themselves. This suggests that school can be an environment that offers emotional support and support that is essential for the health and well-being of adolescents.

The results suggest that families and schools should work together to provide a supportive and supportive environment for adolescents (Furuta et al., 2012). This can include mentoring activities, emotional support, and social inclusion programs. Additionally, it is important for teachers to be trained to recognize and deal with the emotional needs of adolescents.

Self-esteem and other people's positive perception of adolescents also influence their school routine, health and quality of life (SAKAI-Bizmark; Richmond; Kawachi, 2020). Participants stated that they feel good when they are with other people.

Our results suggest that schools, families, and society should work together to provide a supportive and emotionally supportive environment for adolescents. This can include mentoring activities, emotional support, and social inclusion programs. Additionally, it is important for teachers to be trained to recognize and deal with the emotional needs of adolescents.

Although these results demonstrate the importance of perceived social support during adolescence, it is important to consider that the present study was carried out with a sample of adolescents in areas of social vulnerability, where individuals are similar in terms of economic income. Even though it is not the objective of the study to make causal inferences, knowing the relationships that adolescents are exposed to helps to strengthen this population in this important phase of life. Therefore, future research can explore the relationship between social support in different contexts and with more representative samples, especially after the Covid-19 pandemic.

FINAL CONSIDERATIONS

The present research demonstrated that social support is a crucial factor for the well-being and quality of life of adolescents in areas of social vulnerability. Family and friends emerged as the main sources of support, contributing significantly to the self-esteem and emotional support of young people. On the other hand, school support, especially that provided by teachers, was perceived in a more limited way, evidencing a disconnection that can negatively impact the educational environment and the personal development of adolescents. These findings highlight the need for interventions that strengthen social relationships, especially in the school context, so that teachers can become a more effective source of support. The creation of programs that promote integration between school, family and community can expand the social support perceived by adolescents, contributing to a more welcoming and safe environment.

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REFERENCES

1. Alvarado, J. M., et al. (2015). Family support and its impact on adolescent health and wellbeing. *Journal of Youth and Adolescence, 44*(1), 1-13.

2. Prefeitura Municipal de Bauru. (n.d.). *Proteção social*. https://www2.bauru.sp.gov.br/sebes/protecao_social.aspx (Consultado em 16.09.2024).

3. Brasil. Ministério da Saúde. Secretaria de Atenção em Saúde. Departamento de Ações Programáticas Estratégicas. (2010). *Diretrizes nacionais para a atenção integral à saúde de adolescentes e jovens na promoção, proteção e recuperação da saúde*. Ministério da Saúde.

4. Cuschieri, S. (2019). The STROBE guidelines. *Saudi Journal of Anaesthesia, 13*(Suppl 1), S31-S34.

5. Coelho, C. C., & Dell'Aglio, D. D. (2018). Engajamento escolar: Efeito do suporte dos pais, professores e pares na adolescência. *Psicologia Escolar e Educacional*.

6. Drukker, M., et al. (2003). Social capital as a determinant of self-rated health. *Social Science & Medicine, 56*(4), 599-607.

7. Furuta, M., Ekuni, D., Takao, S., Suzuki, E., Morita, M., & Kawachi, I. (2012). Capital social e saúde bucal autoavaliada entre jovens. *Community Dentistry and Oral Epidemiology, 40*(2), 97-104.

8. Instituto Brasileiro de Geografia e Estatística (IBGE). (2010). *Censo Demográfico 2010*. Disponível em: http://www.censo2010.ibge.gov.br/

9. Knorst, J. K., Tomazoni, F., Sfreddo, C. S., Vettore, M. V., Hesse, D., & Ardenghi, T. M. (2022). Social capital and oral health in children and adolescents: A systematic review and meta-analysis. *Community Dentistry and Oral Epidemiology*.

10. McGrath, C., & Bedi, R. (2002). The association between dental anxiety and oral health-related quality of life in Britain. *Community Dentistry and Oral Epidemiology, 30*(5), 309-312.

11. Meira, G. F., Knorst, J. K., Maroneze, M. C., Ortiz, F. R., & Ardenghi, T. M. (2020). Effect of dental caries and socioeconomic status on social capital throughout adolescence: A 6-year follow-up. *Brazilian Oral Research*.

12. MINED. (2013). *Educational barriers and support needs for vulnerable youth*.

13. Moore, S., & Kawachi, I. (2017). Twenty years of social capital and health research: a glossary. *Journal of Epidemiology & Community Health, 71*(5), 513-517.

14. Putnam, R. D. (1993). *Fazendo a democracia funcionar: Tradições cívicas na Itália moderna*. Princeton University Press.

15. Pattussi, M. P., et al. (2001). The role of social capital in health promotion: A literature review. *Health Promotion International, 16*(1), 85-95.

16. Sakai-Bizmark, R., Richmond, T. K., Kawachi, I., et al. (2020). School social capital and tobacco experimentation among adolescents: Evidence from a cross-classified multilevel, longitudinal analysis. *Journal of Adolescent Health, 66*(4), 431-438.

17. Squassoni, C. E., & Matsukura, T. S. (2014). Adaptação transcultural da versão portuguesa do Social Support Appraisals para o Brasil. *Psicologia: Reflexão e Crítica, 27*, 71-81.

18. Silva, A. N. D., Guedes, C. R., Santos-Pinto, C. D. B., Miranda, E. S., Ferreira, L. M., & Vettore, M. V. (2021). Demographics, socioeconomic status, social distancing, psychosocial factors, and psychological well-being among undergraduate students during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*.

Connecting young people with literature: An analysis of pedagogical practices and their impacts

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Luciana Carvalho dos Reis Fim[1]

ABSTRACT

This study addresses the distancing of high school students from Literature and the effectiveness of current pedagogical practices in teaching this field. The justification for the research stems from the growing perception that Literature, often approached in a fragmented and academic way, cannot engage students as it should. The main objective is to analyze how pedagogical practices influence the formation of readers and to explore alternatives to improve the engagement of young people with literary texts. To achieve these objectives, the methodology adopted included a theoretical review of the contributions of scholars such as Calvino and Todorov, in addition to the analysis of prevalent pedagogical practices. The research examines how these practices impact students' perception of Literature and evaluates the effectiveness of different educational approaches. The results show that current pedagogical approaches often lead to students' disinterest, highlighting the need for a reformulation of teaching strategies. The research suggests that more interactive and contextualized methods can improve young people's engagement with Literature and enrich their cultural and critical formation. It is concluded that a review of pedagogical practices is essential to revitalize students' interest in Literature and strengthen their connection with cultural heritage.

Keywords: Literature, Teaching, Pedagogy, Reading, Engagement, Education.

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INTRODUCTION

The present research aims to explore the theoretical and practical contributions of the inclusion of Literature in the school curriculum, focusing on how pedagogical practices influence the formation of readers. The relevance of this study is justified by the growing distancing of high school students from Literature, a phenomenon that can be attributed to pedagogical approaches that treat literary texts as mere objects of academic study, rather than vehicles for a deeper understanding of the human condition.

Theoretically, the research is based on the reflections of scholars such as Calvino (2013) and Todorov, who defend the centrality of literary texts in the educational process. Calvino highlights the importance of the classics as elements that connect readers to a rich cultural heritage, while Todorov argues that Literature must occupy a central place in education to play its full role in the critical and emotional development of students. Contemporary criticism also emphasizes the need to reconsider pedagogical practices that often result in aversion rather than appreciation of literature.

Practically, the research investigates how current pedagogical approaches may be contributing to students' demotivation in relation to literary reading. The impact of educational strategies used in schools and how they can be adjusted to promote more meaningful engagement with literary texts will be examined. The study aims to provide valuable insights for teaching practice, suggesting methods that can revitalize students' interest in Literature and improve their formation as critical and appreciative readers.

Therefore, this research not only seeks to understand the causes of young people's distancing from Literature, but also offers paths for a reevaluation of educational practices, with the aim of enriching the literary experience and promoting a greater connection with the texts.

THE RELEVANCE OF THE CLASSICS IN THE FORMATION OF READERS: THEORETICAL AND PRACTICAL ANALYSIS OF PEDAGOGICAL APPROACHES

The study aimed to address Literature in the context of High School, highlighting the importance of teaching this discipline in this phase, especially due to the proximity of the entrance exams and the ENEM (National High School Exam). However, this focus represents a failure of the educational system, since the student, when he reaches high school, should already have a well-developed reading competence, regardless of his affinity with the proposed literary works.

In this sense, the Ministry of Education and Culture has prepared several documents to guide the teaching of Portuguese Language and Literature at the national level, seeking to standardize pedagogical practices in Brazilian schools. Among these documents, the National Curriculum Parameters for Secondary Education (PCNEM, Brazil, 2000), the Educational Guidelines Complementary to the National Curriculum Parameters (PCN, Brazil, 2000), and the National

Curriculum Guidelines for Secondary Education (OCNEM, Brazil, 2006) stand out. Such documents highlight the role of language as a means of communication and the humanizing character of Literature.

These measures were necessary because external research and evaluations, such as the Program for International Student Assessment (PISA), show that Brazilian students face difficulties in achieving proficiency in reading, including literary reading.

The first more in-depth discussions about the concept of Literature date back to Ancient Greece. It was in this classical context that the first controversies and debates arose about the definition of what Literature would be (LAJOLO, 2000, p. 54).

According to Maingueneau (2009, p. 197), language is a tool shared by all, while Literature is an adornment that is added to language, whose basic function is communication. However, Literature is not just an ornament; it contributes to the very construction of the language, giving it quality and status.

> There have been many attempts to define Literature. It is possible, for example, to define it as imaginative writing, the sense of fiction – writing that is not literally veridical. But if we reflect, even if briefly, on what is commonly considered literature. Such a definition is not valid (EAGLETON, 2006, p.1).

This author suggests that a different approach may be necessary to define Literature, not by its fictional or imaginative character, but by the singular way in which it uses language. According to this theorist, "literature is the writing that, in words [...] transforms and intensifies the common language" (EAGLETON, 2006, p.2).

The teaching of Literature is inserted in the field of reading and the study of discursive genres, and therefore interacts with reviews, synopses, syntheses, reports, essays and other texts that discuss Literature and are essential for the young reader of High School.

It is essential to understand certain theoretical aspects about the way the author expresses his ideas, because only he knows the effect of meaning he wants to provoke in his readers.

In addition, when faced with a fictional literary narrative, the reader often needs to consult other texts to better understand certain linguistic, historical, political, and cultural aspects that are inferred or mentioned. An example is the novel *Posthumous Memories of Brás Cubas*, by Machado de Assis, published in 1881, which narrates the experiences of a young man from the Brazilian elite of the nineteenth century, Brás Cubas. The narrator, in the first person, begins the story from his death, describing the scene of his burial, the delusions before he died, until he returns to his childhood.

> For some time I hesitated whether I should open these memoirs from the beginning or the end, that is, whether I would put my birth or my death first. Supposing that the common usage is to begin with birth, two considerations led me to adopt a different method: the first is

> that I am not properly a deceased author, but a deceased author, for whom the grave was another cradle; the second is that the writing would thus be more gallant and newer. Moses, who also recounted his death, did not put it in the introit, but in the cape: a radical difference between this book and the Pentateuch (ASSIS, MACHADO, 2015, p.18).

It was found that, in this type of text, commonly found in high school, the reader needs to have a cultural and linguistic repertoire to understand it properly. Words such as "campa" and "introito", as well as references to "Moses" and "Pentateuch", are not explained directly in the text and represent advanced knowledge, not always accessible to all Brazilians.

It is essential, therefore, to create the appropriate conditions for reading this text, because by understanding it, the reader will acquire linguistic, cultural and discursive knowledge. This will facilitate the perception of the irony, pessimism and humor characteristic of Machado de Assis, aspects often highlighted in textbooks, but little understood by students. In pedagogical practice, a detailed study of the narrative is not always carried out that allows students to make inferences, recognize intertextuality and identify the characteristics that align the text with Realism.

The National Curriculum Parameters (PCNs) sought to clarify the concepts related to reading based on two main axes: representation and communication, and investigation and comprehension. These parameters approach Literature, in its strict sense, as an art constructed through words and defend the specificities inherent to Literature. They emphasize the importance of its presence in the High School curriculum and discuss its necessity, focusing on art and literature, as well as other forms of artistic expression, as fundamental knowledge for human beings, and not just as privileges of a minority.

> It has always enjoyed a *privileged status* in relation to the others, given the literate tradition of an elite that commanded the destiny of the nation. Literature was so privileged that it was even taken as a distinctive sign of culture, and therefore of social class (BRASIL, 2006, p.55).

The competencies and skills outlined in the National Curriculum Parameters (PCNs), the National Curriculum Parameters for Secondary Education (PCNEM) and the National Curriculum Guidelines for Secondary Education aim to foster in the student-reader the critical capacity, sensitivity to the various forms of linguistic expression and the ability to become a proficient reader of different texts that reflect our culture. This process ultimately seeks to expand or build the literacy of these student-readers, as discussed by Soares (2011).

> In addition to the mechanical memorization of grammatical rules or the characteristics of a certain literary movement, the student must have the means to expand and articulate knowledge and skills that can be mobilized in the countless situations of language use that he or she encounters in the family, among friends, at school, in the world of work (BRASIL, 2000, p.55).

The educational documents comprehensively discuss the student's formation as a reader of Literature, emphasizing the importance of literary literacy that enables young people not only to read literary works, but also to explore texts that discuss Literature itself. These documents guide teachers, indicating ways to follow to achieve the educational objectives related to the formation of readers in schools.

However, according to the guidelines established by the official documents of the Ministry of Education and Culture, it is not advisable to overload the student with mere information about eras, styles or characteristics of literary schools, a practice that still persists, despite the recommendations of the PCNs (notably the PCN of 2002, p.55), which highlight the secondary character of these contents, in addition to the mechanical memorization of grammatical rules or the characteristics of specific literary movements.

The theoretical-methodological principle ensures the student access to the necessary resources to expand and integrate knowledge, becoming a proficient reader. For this, it is essential that the student reads texts in a more meaningful way, with greater intensity and frequency, thus ensuring a quality reading experience.

> The PCNS insist that the formation of the reader and writer will only be possible to the extent that the teacher himself presents himself to the student as someone who lives the experience of reading and writing. The teacher, in addition to being the one who teaches content, is someone who transmits the value that the language has shown to him. If the teacher has a pleasurable relationship with reading and writing, he will certainly be able to work with measures for his students (ROJO, 2000, p.66).

Rojo (2011), in line with the guidelines established by the Portuguese language documents, emphasizes the need for the school not only to train readers and writers, but also to overcome the limitations restricted to exclusively school practices. This implies knowing and sharing the textual diversity that student-readers experience. The scholar points out that this transformation will only be effective if the teacher presents himself as a living example of someone who practices reading and writing. This involvement is manifested when the teacher comments, evaluates, cites excerpts from texts, recites poems and, in general, positions himself as a mature reader and model for students, a concept corroborated by Umberto Eco (2015), a renowned semiologist and linguist.

Soares (2011) offers valuable reflections on the relationship between Literature and teaching in the school environment, evidencing a certain mischaracterization of Literature in this context. The author points out that, due to this scenario, some theorists question the continuity of Literature as a subject in the school curriculum. His studies provoke discussions about the schooling process of children's literature, focusing on the formation of proficient and engaged readers, that is, students who practice reading as a social and cultural activity, regardless of academic demands.

Soares argues that the problem does not lie in the schooling of Literature, but in inadequate and mistaken pedagogical practices that often transform the literary text into a mere pretext to teach other contents, neglecting the specificities of literary narratives. This reductionist approach results in simplistic and superficial activities, such as filling out forms, reading only for dramatization, or taking tests that do not value the art of the word and its multiple meanings — the essence of Literature.

The reduction of Literature to an instrument for teaching moral values, social and linguistic issues reduces its aesthetic complexity and the humanizing character it brings. By reading only with the intention of identifying these issues, the intrinsic artistic value of different literary genres is lost, from a simple comic to a novel. This criticism of the schooling of Literature arises from the perception that it ceases to be art to adapt to the immediacy of school activities.

Rildo Cosson (2011), a professor at the Federal University of Minas Gerais, observes that if students finish school without appreciating literary fiction, it is likely that they will not incorporate this cultural practice into their lives. In school, reading is often limited to didactic purposes, such as presenting seminars, analyzing literary texts, or preparing for exams, which can negatively influence the way reading is perceived outside the school environment.

Literary reading is fundamental in people's lives, as it provokes sensibilities, rejections of certain ideologies, and involves emotions. The freedom to abandon a narrative when desired, without the pressure of objective evaluations, develops in the reader an autonomy that is not always promoted in school models of reading. School practice, in many cases, has not been able to develop in the student the skills and taste for literary reading, despite the fact that everyone has the potential to become readers.

Therefore, it is essential to value the student's potential readership, offering him a diversity of texts that both approach and distance himself from his historical and social reality. This will contribute to the construction of your identity as a reader, enabling you to act on the world based on reflection and transformation of yourself, avoiding alienation.

Eni de Lourdes Puccinelli Orlandi (2003, p.58), a professor at the University of Vale do Sapucaí, points out that "it is not only who writes that means; those who read also produce meanings, and they do so not in an abstract way, but in specific conditions, which are socio-historical". Literature, therefore, offers this ability to create meanings from reading, being a privileged language that, among other aspects, can foster the development of education and aesthetic sensitivity, as suggested by Antônio Cândido. These ideas are reflected in the official documents that deal with Literature, recognizing it as a fundamental tool for human formation.

> I understand here by humanization the process that confirms in man those traits that we consider essential, such as the exercise of reflection, the acquisition of knowledge, the good disposition towards others, the refinement of emotions, the ability to penetrate the problems

> of life, the sense of beauty, the perception of the complexity of the world and of beings, the cultivation of humor. Literature develops in us the quota of humanity to the extent that it makes us more understanding and open to nature, society, our fellow human beings (CÂNDIDO, 2009, p. 249).

The functions of Literature are deeply related to its complex nature, which encompasses the contradictory and, at the same time, humanizing role that the literary text plays. This role is manifested, among other ways, by the ability of literature to establish an emotional identification between the reader and the text, allowing the reader, inside or outside the school environment, to speculate and reflect, either individually or in dialogue with others, on the issues raised by certain narratives.

Within this context, we can distinguish at least three facets that make up the contradictory, but humanizing, role of Literature:

Emotional identification: Literature allows readers to connect emotionally with the characters, plots, and situations presented, enabling an experience of empathy and understanding of the various human realities.

Critical reflection: The literary text encourages the reader to question, analyze and reflect on the topics addressed, promoting a process of self-knowledge and critical awareness in relation to the world around them.

Personal and social transformation: Through literature, readers are able to revisit and reevaluate their own beliefs and values, which can lead to significant changes in both the personal and social spheres, highlighting the transformative potential of literary reading.

These facets show how literature, despite its contradictory nature, plays an essential role in human formation, both in individuality and in collectivity. As Cândido (2009) confirms,

> (1) it is a construction of autonomous objects as structure and meaning (2) it is a form of expression, that is, it manifests emotions and the worldview of individuals and groups; (3) it is a form of knowledge, even as a diffuse and unconscious incorporation (CÂNDIDO, 2009, p.176).

In this context, Literature exerts a significant influence on us by transmitting knowledge that results in learning. However, it is important to highlight that its performance goes beyond the simple transmission of knowledge, especially when it comes to literary productions. Literature also plays a crucial role in the articulation with human rights, as observed by Cândido (2009).

According to Cândido (2009), Literature meets a cultural and universal need, but it also has the potential to mutilate the personality. This is because literature gives shape to our feelings and our worldview, playing a humanizing role by organizing us and freeing us from chaos. When literary enjoyment is denied, we are, in a way, mutilating humanity itself.

In addition, Cândido states that Literature is a powerful instrument that awakens awareness and incites us to fight for our rights. It encompasses everything that can be considered poetic, fictional and dramatic creation, reaching all social and cultural strata, from folkloric manifestations to the most complex forms of written production of the great civilizations.

Cândido also reflects on Literature as a universal manifestation, essential for all human beings. He states that "there is no people and there is no man who can live without it, that is, without the possibility of coming into contact with some kind of fabulation" (CANDIDO, 2009, p.174). Cosson (2011) reinforces this idea, emphasizing the importance of literature in human life.

> Literature tells us what we are and encourages us to desire and express the world for ourselves. And this is because literature is an experience to be carried out, it is more than a knowledge to be re-elaborated, it is the incorporation of others in me without renouncing my own identity (COSSON, 2011, p.17).

According to Cosson's view, literary narratives encourage us to express our own desires and to interpret the world in a personal way. They function as a mirror of our experiences, but in a more elaborate way, allowing us to integrate other perspectives into our own identity without losing our individual essence.

Rojo (2011) argues that Literature accentuates the ambiguity of language, narrowing the distance between the name and the named object, while creating new meanings. For her, literary fiction opens the doors to an autonomous universe that does not dissolve with the end of reading, but continues to reverberate in the reader, becoming part of his experience and leaving a lasting mark on his literary path.

> Hence the mistake of those who think that the humanizing and formative character of literature comes from the nature of the amount of information it provides to the reader. Literature does not transmit anything. Creation gives full existence to what, without it, would remain in the chaos of the unnamed and consequently of the non-existent for each one. And, what is fundamental, at the same time that it creates, points to the provisional of creation: the world of Literature, like that of language, is the world of the possible (LAJOLO, 2000, p.43).

For Riter (2009), it is essential that the school reveals to students the importance of literary reading and the aspects that accompany it. The institution must present engaging and relevant narratives—whether they are controversial, mysterious, romantic, or epic—since, without the guidance of a teacher-reader, it is likely that many students will never have the opportunity to come across such works.

According to Aguiar and Silva (2007), the concept of Literature is intrinsically linked to language and the art of verbal expression. Reflections on Literature and teaching should start from this point. In other words, it is essential to approach the narratives, the words that make up the texts and the characters, avoiding an approach that is limited to fragments and excerpts from novels, short

stories and poems, whose only purpose is to illustrate characteristics of literary periods in a superficial way.

> If the teacher decides to escape from this restricted program and teach literary reading, he tends to refuse the canonical texts because he considers them unattractive, either because of the hermeticism of the vocabulary and syntax, or because of the old theme that would be of little interest to today's students (COSSON, 2011, p.22).

The stigma associated with the complex language of the classics and the false belief that young people reject these texts because they do not reflect contemporary issues is a misconception. While it is true that literary language may seem outdated and that many terms may be unfamiliar to younger readers, this does not justify the exclusion of universal and national classics from the curriculum. Issues related to the human condition—such as love, lovelessness, passion, death, sadness, adventure, serenity, and envy—are eternal and remain relevant regardless of the era.

Calvino points out that canonical texts have lasting value and that the role of the teacher is to ensure that these texts are kept in the educational repertoire. He argues that these texts transcend temporal barriers and still have much to offer, even in the changing circumstances of today.

> The classics are those books of which, in general, one hears it said: '*I'm reading...' and I'm never reading...' This* happens at least with those people who consider it great readers; it does not apply to youth, the age when the encounter with the world and with the classics as part of the world is worth exactly as long as the first encounter. The reiterative prefix before the verb to read may be a small hypocrisy on the part of those who are ashamed to admit not having read a famous book. To reassure them, it will suffice to observe that, no matter how great an individual's formative readings may be, there is always a huge number of works that he has not read (CALVINO, p.9, 2013).

Calvino (2013) highlights the importance of the classics as a way of connecting with the world, as they are essential parts of this cultural universe. He says that these books have the power to awaken a deep passion in reading and constitute a wealth for those who read them. However, for the current generation, immersed in smartphones and characteristics of a fast and fluid modernity, these texts are often not seen as attractive or productive. According to Calvino, the problem is not in the classical texts themselves, but in the "impatience, distraction, inexperience of institutions for use, inexperience of life" that marks the modern era (CALVINO, 2013, p.10).

By revisiting a classic book in maturity, one can rediscover aspects that previously went unnoticed and reflect on what was forgotten, because the work, although it can be forgotten, leaves a mark on readers. This suggests that it may be time for the school to reconsider the criteria for selecting the titles recommended for adolescents.

Riter (2009) observes that the school has the responsibility to provide adequate tools to make these choices. However, often the options chosen are influenced more by utilitarian objectives aimed at university entrance exams than by the real literary and educational value of the texts.

> Books, as facts, never speak for themselves. Those who make them speak are mechanisms of interpretation that we use, and most of them are learned in school. Then, the literary reading that the school aims to process, aims at more than simply the entertainment that fruition reading provides. In the school environment, literature is a locus of knowledge and, in order for it to function as such, it must be explored in an appropriate way (COSSON, 2011, p.26-27).

Books like facts do not speak for themselves, but through the interpretations we attribute to them, and in school, Literature is this privileged space of knowledge, it therefore needs to be explored in an interesting and appropriate way. The PCNEM insist that Literature is an artistic manifestation that has the word as its raw material, so its teaching consists of exploring the potentialities of this written word. Cosson (2011) reiterates:

> Literature tells us what we are and encourages us to desire and express the world for ourselves. And this is because literature is an experience to be carried out, it is a knowledge to be re-elaborated, it is the incorporation of the other in us without renouncing our own identity. In the exercise of literature we can be others, we can live as others, we can break the limits of time and space of our experience and still be ourselves, That is why we internalize more intensely the truths given by poetry and fiction (COSSON, 2011. p.17).

Still on the teaching of Literature, Solé (2012) advises that literary reading can be considered as one of the most important means in school for the appropriation of new learning. The author ratifies that the greatest danger that involves the teaching of Literature is not found in the fact that teachers do not work with the text in the classroom, but how this text is being worked on. Todorov states that:

> The danger that surrounds Literature today is not, therefore, in the scarcity of good poets or fiction writers, in the exhaustion of poetic production or creation, but in the way in which literature has been offered to young people from primary school to college: the danger lies in the fact that by a strange inversion, the student does not come into contact with literature through the reading of literary texts themselves, but with some form of criticism, theory or literary history (TODOROV, 2009, p.10).

The scholar's reflection is relevant, because pedagogical practices that introduce literary fictions as an object of teaching often result in more aversion than in contribution to the formation of readers. For many high school students, literature becomes a mere school subject to be studied according to its periodization, rather than a cultural asset that offers insight into the world, human emotions, fantasy, and aspects of personal and public life.

In this context, Todorov argues that the literary text should occupy the center of the educational process, especially in Literature courses, instead of remaining on the periphery. Although many students claim to enjoy reading and recognize the importance of reading and literature, teaching practice often distances them from books. In summary, in school, there is a lot of discourse about Literature, but the effective reading of literary texts is often scarce.

CONCLUSION

The analysis carried out in this study evidenced the urgent need to review the pedagogical practices associated with the teaching of Literature in schools. The results demonstrate that current approaches, often based on fragmentation and a strictly academic view, contribute to the disengagement of young people and the negative perception of Literature as a mere school obligation. On the other hand, the inclusion of practices that promote a richer and more contextualized interaction with classical texts can revitalize students' interest and enrich their cultural and critical formation.

The results of this research offer valuable contributions to society and academia. For society, the findings suggest that a reformulation of pedagogical practices can have a positive impact on the formation of more engaged and critical readers, capable of appreciating Literature as a means of deep understanding of the human condition. In addition, a more inclusive and meaningful approach can strengthen young people's connection with cultural and literary heritage, promoting a greater appreciation of reading and critical reflection.

For academia, this study provides a solid basis for discussion on the effectiveness of current pedagogical approaches and paves the way for new investigations into methods that may be more effective in training readers. The research also reinforces the importance of integrating literary theories and educational practices in ways that complement and support each other, creating a more dynamic and engaging learning environment.

RESEARCH LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORK

While the study provided significant insights, some limitations should be acknowledged. The research was restricted to a theoretical and practical analysis of pedagogical practices, without an extensive exploration of different school contexts or regional variations that could influence the results. In addition, the approach focused on a limited number of theories and practices may not capture the totality of the complexities involved in teaching literature.

For future work, it is recommended to conduct empirical studies that include a broader analysis of different educational contexts and pedagogical approaches. Further research could explore the effectiveness of specific methods in practice and assess the impact of different strategies on students' motivation and engagement with literature. In addition, it would be useful to investigate how teachers' and students' perceptions of Literature can vary and influence the effectiveness of the pedagogical practices adopted.

These investigations can provide a deeper and more comprehensive understanding of the role of Literature in the school curriculum and contribute to the development of more effective strategies to connect young people with the literary world.

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REFERENCES

1. AGUIAR, V. M. S. (2011). *Teoria da literatura* (8ª ed.). Coimbra: Almedina.

2. ASSIS, M. de. (2015). *Obra completa* (3ª ed.). Rio de Janeiro: Nova Aguilar.

3. BRASIL. Ministério da Educação. Secretaria de Educação à Distância. (1999). *Cadernos da TV Escola: v. 1 – Português* (R. Soligo, Ed.). Brasília.

4. BRASIL. Ministério da Educação. Secretaria de Educação à Distância. (1999). *Cadernos da TV Escola: v. 1 – Português* (R. Veliago, Ed.). Brasília.

5. BRASIL. (2000). *Parâmetros Curriculares do Ensino Médio*. Brasília: MEC.

6. BRASIL. (2006). *Parâmetros Curriculares Nacionais: Ensino Médio* (Ministério da Educação, Secretaria de Educação Média e Tecnologia). Brasília: MEC; SEMTEC.

7. BRASIL. (2002). *PCN + Ensino Médio: Orientações Educacionais complementares aos Parâmetros Curriculares Nacionais. Linguagens, códigos e suas tecnologias*. Brasília: MEC; SEMTEC.

8. BRASIL. (1996). Lei nº 9394, de 20 de dezembro de 1996. Estabelece as Diretrizes da Educação Nacional. Disponível em: [Acesso em: 15 ago. 2024].

9. BRASIL. Ministério da Educação. Secretaria de Educação à Distância. (1999). *Cadernos da TV Escola: v. 1 – Português* (C. R. do Nascimento & R. Soligo, Eds.). Brasília.

10. CALVINO, I. (2013). *Por que ler os clássicos* (N. Moulin, Trad.). São Paulo: Companhia das Letras.

11. CANDIDO, A. (2009). *Formação da Literatura Brasileira: momentos decisivos 1750-1880*. São Paulo: Ouro sobre Azul.

12. COSSON, R. (2011). *Letramento literário: teoria e prática* (2 ed.). São Paulo: Contexto.

13. COSSON, R., & SOUSA, R. (n.d.). *Letramento literário: Uma proposta para a sala de aula*. Disponível em: http://www.acervodigital.unesp.br/bitstream/123456789/40142/1/01d16t07.pdf. Acessado em 05 mar. 2024.

14. EAGLETON, T. (2006). *Teoria da Literatura: uma introdução* (6ª ed.). São Paulo: Martins Fontes.

15. ECO, U. (2015). *Os limites da interpretação*. São Paulo: Perspectiva.

16. LAJOLO, M. (2000). *Do mundo da leitura para a leitura do mundo*. São Paulo: Ática.

17. SOARES, M. (2016). *Alfabetização e letramento: Caminho e descaminhos*. Disponível em: http://www.acervodigital.unesp.br/bitstream/123456789/40142/1/01d16t07.pdf. Acessado em 05 mar. 2016.

18. MAINGUENEAU, D. (2009). *Discurso literário* (A. Sobral, Trad.). São Paulo: Contexto.

19. ORLANDI, E. P. (Org.). (2003). *A leitura e os leitores* (2ª ed.). Campinas, SP: Pontes.

20. RITER, C. (2009). *A formação do leitor literário em casa e na escola* (1ª ed.). São Paulo: Biruta.

21. ROJO, L. (n.d.). *Linguagens, códigos e suas tecnologias*. Disponível em: http://portal.mec.gov.br/seb/arquivos/pdf/02Linguagens.pdf.

22. ROJO, R. (2011). *A prática de linguagem em sala de aula: praticando os PCNs*. São Paulo: Mercado de Letras.

23. SOARES, M. (2024). *Letramento e alfabetização: as muitas facetas*. Disponível em: http://pt.scribd.com/doc/170014670/MAGDA-SOARES-letramento-e-Alfabetiza. Acessado em 05 set. 2024.

24. SOARES, M. (2011). *Letramento: um tema em três gêneros*. Belo Horizonte: Autêntica.

25. SOLÉ, I. (2012). *Estratégias de leitura* (C. Schilling, Trad.) (6ª ed.). Porto Alegre: Penso.

26. TODOROV, T. (2009). *A literatura em perigo* (C. Meira, Trad.). Rio de Janeiro: DIFEL.

Old and new friendships of Latin American immigrants

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ABSTRACT

In view of the growth of international migration, including in Latin America, the present investigation aimed to analyze the history of old and new friendships of Latin American immigrants throughout their lives in the new country (Brazil, other Latin American countries, Spain and Portugal). More specifically, it was intended to investigate how recent migration affects existing friendships and the formation of new ones, with people of any nationality and culture. 40 immigrants participated in this descriptive-qualitative study (70% women and 50% between 30 and 39 years old), divided into four groups: A) 20 Latin Americans who lived in Brazil; B) three Brazilians who lived in another Latin American country; C) 12 Brazilians who lived in Spain; and D) five Brazilians who lived in Portugal. The instrument used was a questionnaire with open questions, sent and received by *e-mail*, producing written reports. In total, direct contacts were made by *e-mail* with national and international universities and educational institutions, as well as by messages on social networks with approximately 1,000 people, between August 2014 and January 2016. A detailed analysis of the data was conducted with a coding process (interpretation of the statements), and subsequent organization of the material into categories, based on qualitative content analysis. The main results of the study pointed out that most of the close friends are of the same gender and of the same nationality, and most of them reside in the country of origin of the immigrant. The ties in the immigrant's country of origin are close friendships, of many years, whose main means of contact are *Facebook*, *Skype*, *WhatsApp*, telephone, *e-mail*, *internet* and in person, and the frequency of contacts varies from daily to monthly. According to the participants, it is very good to see friends from their home country, with the most common shared activities being eating or going to restaurants, drinking or going to bars and staying at home. Both old (compatriots) and new friends (usually natives of the new country or other immigrants) are important in the process of migration from one culture to another. The beginning of friendships in the new country happens, for the most part, in the academic environment, through other friends and through relatives. Finally, Latin American immigrants in Brazil and Brazilians in other Latin American countries demonstrated a mostly positive view of natives before establishing friendships with them; and Brazilian immigrants in Spain and Portugal a negative view.

Keywords: Friendship, Immigrants, Latin Americans, Cultural differences.

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INTRODUCTION

International migration has been growing in recent decades. According to the United Nations, there were more than 230 million people living outside their country in 2013. In reference to Latin America, it is estimated that about 30 million Latin Americans lived outside their country in 2010, with the significant increase in intra-regional migration, that is, Latin Americans starting to live in another Latin American country, whose number has already reached four million migrants.

In view of this growth in international migration, including in Latin America, the present investigation seeks to contribute to the knowledge of the friendships of Latin American immigrants who are living in contact with other peoples in Brazil (Brazilians or other immigrants) and of Brazilian emigrants (who are also Latin Americans) who are living in contact with other peoples in other Latin American countries. Spain and Portugal (natives or other immigrants), regions that currently receive a high number of immigrants (ECLAC, 2013; Gois, Marques, Padila & Peixoto, 2009; Hierro, 2013; Peixoto & Egreja, 2012).

One of the immediate effects of migration is exposure to new living conditions, with changes in social life and, consequently, in the friendships of those who migrate. In contemporary society, friendship relationships, whether in dyads or groups, have become increasingly important due to factors such as the growth of the human population, in terms of mobility and communicability, making human encounters and relationships more frequent and intense (Garcia & Miranda, 2008). Economic and cultural globalization has allowed greater contact between people of different nationalities and cultures, and the way in which these people establish and maintain friendships is an important research topic for understanding the peaceful and cooperative social coexistence between individuals, and even more so between social, cultural and scientific groups in these countries (Garcia, 2012a).

Some historical, cultural and technological transformations may be at the origin of new patterns of friendship. Among the most significant historical and social changes is the historical reduction in family size, urbanization, technological advances, with the growing use of the world wide web (the *internet*), advances in mobile phone services, increasingly early access of the child to school, the increasingly longer time in the school system, the growth of groups for the elderly, among others (Garcia, 2005). However, the theme of friendship relations in line with the migratory process still lacks investigative studies, especially with regard to the Latin American region. These studies would involve intercultural, international, inter-ethnic and interracial friendships, according to Garcia and Miranda (2012).

International or intercultural friendships are marked by differences between the cultures of individuals (Sias *et al*., 2007) and may result from the cultural diversity of the country itself, as in the case of South Africa (Collier & Bornman, 1999) or from recent immigration (DeBruin-Parecki &

Klein, 2003). Cultural identity is defined as a process historically constructed on the basis of the systems of symbols, meanings, and norms shared by a group of people in a specific context (Collier & Bornman, 1999).

Kao and Joyner (2004) examined differences in activities in the interracial and interethnic friendships of white, black, Hispanic, and Asian youth. According to the authors, best friends are more likely to be from the same ethnic group. In general, interracial friends reported fewer shared activities than intraracial ones. White, Asian, and Hispanic youth reported fewer activities with black friends. They suggest that even when young people break racial boundaries in friend selection, these friendships face greater challenges than those between individuals of the same race.

Britton (2011) investigated the effects of residential integration on inter-ethnic friendships in Houston, USA. The results obtained indicated inter-ethnic integration and friendship ranging between Anglos, whites and Latinos. According to the authors, more intense forms of intergroup contact are only positively associated with inter-ethnic friendships when integration allows exposure to groups that occupy privileged positions in the broader society.

Kouvo and Lockmer (2013) analysed the impact of the ethnic composition of the place of residence on inter-ethnic contacts and attitudes by comparing four Nordic countries. Compared with ethnically homogeneous neighborhoods, interethnic relationships are more common in ethnically mixed neighborhoods with ethnic minorities. Having friends of other ethnicities in combination with living in an ethnically mixed neighborhood is associated with the likelihood of having more tolerant attitudes toward immigrants.

The literature on immigrant friendships in Brazil, in general, is quite restricted, being practically non-existent when referring to Latin American immigrants. Souza and Sediyama (2012) carried out a qualitative research that had as one of its objectives to present a descriptive study on the perception of friendship in adults of foreign nationality residing in Brazil and to compare it with Brazilians. The main results of the study pointed out that same-sex friendships ended up prevailing; a higher average of friendships living in the same city was observed for the Brazilian participants; foreigners probably had close friendships in their home countries; and no foreign participants indicated a previous relationship from school, work or neighborhood.

Merizio, Garcia and Pontes (2008) investigated the memories of Lebanese immigrants living in Brazil about their friendships and games in their childhood, lived in Lebanon, and the friendships and games of their children's childhood, in Brazil. The authors concluded that, despite the similarities in some aspects of friendships and games, cultural differences are present in the structure of the network of friends and in the content of relationships. In addition, they concluded that play and friendship were directly affected by the environmental and sociocultural context, including religious factors and cultural practices linked to play behavior and friendship relationships.

Focusing on the native's view, Garcia, Bitencourt-Neto, Moura and Pepino (2010) conducted a qualitative study with the objective of investigating the nature of the international friendships of Brazilian university students, based on the remarkable episodes of these friendships, in the light of Robert Hinde's (1997) proposals. Three factors stood out in the answers given: relationships, social groups and culture. The episodes experienced in general were positive. Cultural differences were also seen as predominantly positive, linked to curiosity about the different. The study showed that friendships can remain even after separation. Cultural differences were not mentioned as insurmountable obstacles to communication and friendship, usually being circumvented and leaving positive memories.

Within an international context, several investigations published in the last ten years, mainly developed in Spain, have sought to address Latin American immigration to the country, including the study of social networks. According to Ávila-Molero (2008), the nationality of origin of the members of the social network of Latin American immigrants (Argentines, Spaniards and other nationalities) shows a multiethnic network, especially in its developed scope in Spain.

Although there is much discussion about cultural proximity, due to the common religion and language between Spain and Latin America (except Brazil), the distance between Spaniards and Latin American immigrants persists. Ecuadorians, for example, have dense, hermetic personal networks that are very dependent on strong ties, while the composition and structure are less compact and homogeneous for other groups of Latin American immigrants. Argentines, for example, have the largest number of Spaniards in their networks (Aparicio & Tornos, 2005; Domínguez & Maya-Jariego, 2008; Sans, Miguel-Luken & Solana-Solana, 2007).

Despite several investigations on Latin American immigration to Spain, there is little information about the friendships of these migrants, either in relation to what happens with previous friendships as well as in relation to the formation of new friendships, with Spaniards, people from the same country or other immigrants, Latin American or not. Miguel-Luken and Tranmer (2010) point out the need for further research on the social networks of Latin American immigrants in Spain, involving, for example, the differences between immigrants from different countries and their friendships.

With regard to Portugal, as many Brazilians seek it for the possibility of employment, unfortunately some friendship relationships of immigrants are considered ephemeral ties, born as a result of work relations or proximity to residence, without consolidating lasting ties of sociability and/or solidarity (Bógus, 2007). Even in the not very dense social networks, but with several contacts, composed of non-intimate friends and acquaintances, Peixoto and Egreja (2012) argue that information about the labor market circulates better.

In Padilla's (2007) study on the immigration of Brazilians to Portugal, the social networks of Brazilians included friends, acquaintances and family members who provided help in leaving the country (loans, moral support, etc.), in arriving in the new country (accommodation, resources of different kinds) and insertion in the labor market (help in finding employment, references, etc.). However, there was a difference among Brazilian immigrants in relation to gender: families were the most important support in migratory processes for women, while friends were the most important social support for men.

However, no studies were found that focused on and deepened the theme of friendship relations of Brazilian immigrants in Portugal. Therefore, this research aimed to analyze the history of old and new friendships of Latin American immigrants throughout their lives in the new country (Brazil, other Latin American countries, Spain and Portugal). More specifically, it was intended to investigate how recent migration affects existing friendships and the formation of new ones, with people of any nationality and culture.

The scientific relevance of the work lies in the expansion of knowledge on the theme of intercultural friendships or in the originality of producing studies in the area of friendly relationships focusing on Latin American immigrants in Brazil, as well as Brazilian emigrants in other Latin American countries, Spain and Portugal. It is understood that friendships between people from different cultures can promote greater integration between them. According to Adams and Bliezsner (1994), studies on friendships deal mostly with Caucasian, middle-class, adult university students living in the USA. This work would contribute, therefore, to the advancement of the Latin American literature on friendship relationships.

METHOD

40 immigrants participated in this descriptive-qualitative study (70% women and 50% between 30 and 39 years old), divided into four groups: A) 20 Latin Americans who lived in Brazil; B) three Brazilians who lived in another Latin American country; C) 12 Brazilians who lived in Spain; and D) five Brazilians who lived in Portugal.

Each participant was identified by the letter of the group to which he belonged (A, B, C, or D) and by a number, and their characterization was described below: **Group A: Latin Americans in Brazil:** A1, male, 40 years old, Colombia (country of origin), seven siblings, black, Colombian wife and Brazilian son, Catholic; A2, male, 30 years old, Peru, one brother, non-practicing Catholic; A3, male, 75 years old, Argentinean, married, one child from previous marriage, no religion; A4, female, 52 years old, Bolivia, two brothers, six-month-old son; A5, female, 40 years old, Argentinean, only child; A6, female, 30 years old, Peruvian, non-practicing Catholic; A7, male, 33 years old, Colombia, two brothers, lives with girlfriend, Catholic; A8, female, 37 years old, Colombia, one brother, non-

practicing Catholic; A9, male, 32 years old, Colombia, divorced, one daughter; A10, female, 32 years old, Colombia, four siblings, childless, Christian; A11, female, 25 years old, Mexico, three siblings, single, evangelical; A12, male, 27 years old, Chile, four siblings, one son, own beliefs; A13, female, 26 years old, Colombia, two sisters, Catholic; A14, female, 32 years old, Colombia, one brother, married, six-month-old daughter born in Brazil, non-practicing Catholic; A15, female, 55 years old, Argentine, one Argentine daughter, Catholic; A16, female, 36 years old, Mexico, four siblings, married, one Mexican son, atheist; A17, female, 29 years old, Cuban, one brother, Catholic; A18, male, 30 years old, Peru, two brothers, Seventh-day Adventist; A19, female, 65 years old, Panama, five siblings, married, two children (one Brazilian and one American) and three grandchildren; A20, female, 40 years old, Peruvian, married, one Brazilian son, Catholic. **Group B: Brazilians in Other Latin American Countries:** B1, female, 33 years old, lives in Chile, lives with a partner, has no children, has no religion; B2, female, 28 years old, resides in Mexico, married to a Mexican, one Mexican son, non-practicing Catholic; B3, female, 33 years old, lives in Mexico, a sister, married for the second time, has no children, agnostic. **Group C: Brazilians in Spain:** C1, female, 35 years old, seven siblings, divorced, two daughters, practicing Catholic; C2, female, 28 years old, only child, has no children, has no religion; C3, female, 33 years old, one sister, married, without children; C4, female, 30 years old, married, Catholic; C5, female, 37 years old, three siblings, single, childless, does not practice the Catholic religion; C6, female, 27 years old, only child, evangelical parents, doctrine with which she disagrees; C7, male, 28 years old, non-practicing Catholic; C8, male, 33 years old, only child, Protestant Christian; C9, male, 28 years old, lives with a friend, has no children, has no religion; C10, male, 36 years old, one brother, married, one Spanish son, no religion; C11, female, 41 years old, two sisters, Catholic, but identifies more with the Spiritist Doctrine, without children; C12, male, 54 years old, Brazilian children, agnostic. **Group D: Brazilians in Portugal:** D1, female, 36 years old, no religion; D2, female, 41 years old, no children, non-practicing Catholic; D3, female, 34 years old, one brother, divorced, childless, practicing Catholic; D4, female, 29 years old, married, without children, without religion, but does not consider herself an atheist; D5, female, 32 years old, one sister, single, no religion.

The instrument used was a questionnaire with open questions, sent and received by *e-mail*, producing written reports. In total, direct contacts were made by *e-mail* with national and international universities and educational institutions, as well as by messages on social networks with approximately 1,000 people, between August 2014 and January 2016. In all direct contacts made, the "snowball" technique was used, i.e., each potential participant was asked to indicate others, who, in turn, would indicate others, and so on (Alves-Mazzoti and Gewandsznajder, 1999). A detailed analysis of the data was conducted with a coding process (interpretation of the speeches), and

subsequent organization of the material into categories, based on qualitative content analysis (Flick, 2004; Flick, 2009).

The research project was approved by the Research Ethics Committee of the Federal University of Espírito Santo – Goiabeiras Campus, under the CAAE (Certificate of Presentation of Ethical Appreciation) number 34551714.5.0000.5542 on 08/29/2014.

RESULTS

HISTORY IN THE NEW COUNTRY

Regarding the length of stay, the vast majority of participants have been in their current country for less than 10 years. The main reason for going to the new country presented by groups A, C and D was to pursue *stricto sensu* graduate studies. Only for group B the most cited reason was relatives. When it comes to the opinion about the current country, most of the participants in groups A, C and D like, respectively, Brazil, Spain and Portugal. Most of the participants in group B did not mention their opinion.

Comparing the positive characteristics pointed out by participants from the four groups, it was found that immigrants from groups A, B and C like people from the destination country. A common aspect pointed out by groups A, C and D was the nature and beauty of the place, that is, of Brazil, Spain and Portugal. Cultural diversity was mentioned by participants from groups A and C.

Groups C and D highlighted that the destination countries, Spain and Portugal, have good organization and infrastructure, quality public services, cleanliness, safety and quality of life. As aspects that appeared separately in the groups, there are: quality higher education in Brazil; excellent food and pleasant weather in Spain; little economic disparity and low cost of living in Portugal.

In terms of unfavorable aspects found in the destination country, Brazil was considered a violent, disorganized country with precarious infrastructure and public services. Government problems in Brazil, such as corruption, were also pointed out by group B, specifically in Mexico.

Group A mentioned little interaction between Brazil and other Latin American countries. On the other hand, group D pointed out strong cultural links between Portugal and Brazil. Also, group A pointed out the bureaucracy for the legal procedures of immigrants and group C reported that in Spain there is a certain hostility to foreigners; on the contrary, in Portugal there are policies for immigrants, as pointed out by group D.

Prejudice, especially against women, was a common point mentioned by groups C and D. According to Padilla (2007), the difficulty of Brazilian women in making friends in Portugal is real due to the stereotype of prostitution that exists. Also in Spain, immigrant women in general still have the stereotype that includes, in addition to prostitution, poverty, passivity, victimization and vulnerability (Lirola, 2015).

RETURN TO THE COUNTRY OF ORIGIN

Most of the participants of all groups have already returned to their country of origin to visit it. In groups A and B, more positive than negative aspects were pointed out about the return. In group C there was the same number of positive and negative scores on return and in group D the participants pointed out more negative than positive factors in returning to Brazil.

A positive point placed by the four groups in relation to the return to the country of origin was to see family and friends again; in addition, groups A, C and D also mentioned killing the nostalgia for the culture of the country of origin. Among the negative aspects, groups B and C were shocked by the abusive prices of products in Brazil; on the other hand, groups C and D perceived poverty in Brazil and the poor quality of the supply of products and services in relation to Spain and Portugal.

The fact that Brazilian participants in Portugal indicate more negative than positive factors in returning to Brazil diverges from the literature, which points to a significant propensity for the return of Brazilian immigrants living in Portugal, due to the unfavorable Portuguese economic situation (Nunan & Peixoto, 2012). A possible explanation for this fact is the reason why most of the participants went to do a doctorate. This condition of university student is much less vulnerable than the situation of an immigrant who goes to Portugal in search of a job, for example.

CONTACT WITH RELATIVES

All study participants maintain contact with relatives in their country of origin, with the most cited being mother, father, siblings and uncles. The most used means of contact are via *the internet*, which facilitates contact between people who are physically distant. As participant A12 pointed out: "... Today this whole system of globalization allows us to keep in touch frequently."

Friendships until the end of the twentieth century did not use technology as much as they do today. Among the most used technologies today is the world wide web, or *internet*, which offers a range of social contact networks and may be interfering with friendship patterns. For example, contacts made virtually appear to be more susceptible to prejudice than in-person contacts (Crossman & Bordia, 2011). However, it is indisputable that the ease of access to physically distant people through the *internet* favors relationships.

CLOSEST FRIENDS

In the four groups, most of the closest friends are of the same sex, which converges with the literature (Souza & Sediyama, 2012). In addition, the four groups had a greater number of close friends of the same nationality, as in the study by Garcia and Rangel (2011), and most of these live in the participant's country of origin, and not in the current country. This data suggests that despite the physical distance, friendship lasts over time. In addition, as pointed out by the literature (Kao &

Joyner, 2004; Kao & Vaquera, 2006), best friends are more likely to be from the same ethnic and racial group, due to the greater identification between them.

All groups also mentioned closer friendships with natives of the new country, and groups A, B, and C reported close friendships with other Latin Americans, most of whom lived in the current country. In this case, physical proximity and conviviality seem to favor the establishment and maintenance of friendships.

A study by Garcia (2016), which analyzed the friendships of five Portuguese and Spanish immigrants living in Brazil, brings data that reveal that the participants' network of friends includes compatriots living in Brazil, in the country of origin and in a third country. They also mentioned Brazilian and foreign friends, residing in their country of origin or in Brazil.

FRIENDSHIPS IN THE COUNTRY OF ORIGIN

All participants maintain bonds of friendship in their country of origin. When it comes to what these friendships look like, most pointed out positive aspects, such as close and strong friendships and best friends. The four groups also pointed out the duration of many years of these friendships, and groups A, B and C mentioned friends from various stages of life, such as childhood, adolescence, high school, college, graduate school, etc. The most cited means of contact with friends in the country of origin were, in this order, *Facebook*, *Skype*, *WhatsApp*, telephone, *e-mail*, *internet* and in person. Regarding the frequency of contacts, most groups (A, B and C) reported daily to monthly contact with friends in the country of origin.

The most cited means of contact between friends in the studies by Garcia (2012b) and Garcia, Dettogni, Costa and Togatlian (2010) was also the *internet*, but both conclude that contact through computers does not replace personal contact. In the study by Garcia (2016), contact with friends who lived in the country of origin also occurred through virtual social networks and internet communication sources (such as *Skype*, *WhatsApp*, *Facebook*, *Messenger*, *emails)* and in person when they traveled.

According to Tajra (2015), from 1994 onwards, the *internet* went beyond academic boundaries in Brazil and was born as a new form of communication, which would connect, through computers, millions of people on a planetary scale. Considering the most current virtual social networks, the use of Facebook is notorious, which has been the focus of some studies on social interactions. According to Cáceres (2011) this network promotes new relationships and reinforces existing ones, but the most intimate relationships do not exceed 30 or 40 people. In another study (Park, Lee & Kim, 2012) the variables friend network density and race heterogeneity were positively correlated with time spent on *Facebook*. Also, according to Grieve, Indian, Witteveen, Tolan and

Marrington (2013), social interaction through *Facebook* is correlated with greater subjective well-being and lower levels of depression and anxiety.

MEETINGS WITH FRIENDS FROM THE COUNTRY OF ORIGIN

About what it is like when the participant meets their friends from their home country in their own country of origin, participants from the four groups mentioned that it is very good to see them again. For participants in groups C and D, friendship does not change, it is as if time has not passed and there is no physical distance.

Regarding shared activities, the four groups mentioned that when they are with friends in their country of origin, they usually eat or go to restaurants, drink or go to bars and stay at home. Two activities reported by groups A, B and C were going to parties or *concerts* and traveling. Groups A and C had several activities in common, suggesting a possible cultural approximation between other Latin American countries and Brazil: talking, dancing, watching movies or going to the movies, going to an event, such as birthdays, weddings, among others. Groups A and D mentioned leaving; and groups C and D mentioned drinking coffee.

Activities mentioned only by group A were: laughing, visiting friends, cooking, remembering the past, walking and listening to music, characterizing Latin American cultures well. Activities mentioned only by group C were: going to the beach, to church, taking courses, participating in scientific events, playing sports, drinking mate, going to the park, the *mall* and samba, making a secret friend and sunbathing, characteristically Brazilian activities.

The literature on activities shared between friends of different nationalities points to activities related to leisure, studies, scientific or cultural activities, sports, work, and religion (Garcia, 2012a; Garcia & Goes, 2010; Garcia & Rangel, 2011). Comparing these activities with those described in this subchapter, which involves friends of the same nationality, only those related to work were not mentioned by the participants, and shared leisure activities were highlighted.

NEW FRIENDSHIPS

The vast majority of the participants in the four groups made friends in the new country, with friendships with native people being more frequent. Then came friends from their home country for groups A and C. Group B mentioned only one Brazilian friend, and group D did not mention the number of Brazilian friends.

Still in descending order of frequency, foreign friends were mentioned by the four groups, and finally friends of another Latin American nationality, mentioned only by groups A and C. In the study by Souza and Hutz (2008), attributes of friendship reported in the international literature were identified, such as affective exchanges, help, companionship and fun in certain activities, intimacy

and self-validation. Probably these attributes of friendship are independent of the nationality or culture of the friends.

Beginnings of New Friendships

Regarding how the new friendships began, in descending order of citations, the academic environment appears in all groups and as a highlight in groups A, C and D. Another reason for the beginning of friendships often pointed out by groups A, C and D was the intermediation of other friends, suggesting a chain in friendships. According to a participant in group C: "... I have many Brazilian friends and usually the friendship starts because one introduces the other and we are all in the same group." (C3).

Neighbors and co-workers appeared as motivators for the initiation of friendships in the four groups, especially in groups A and D, suggesting that physical proximity and contact favor the initiation of friendships. According to a Colombian participant in group A: "... Everyday life makes us create bonds." (A7).

The four groups also mentioned the beginning of friendships through relatives. There were many environments and factors cited for the beginning of friendships, and the others that stood out were: during courses (A, B and C); through the *internet* (A, C and D); and already know the country of origin (in groups A and C). At a lower frequency and with the same number of citations, the following were mentioned: beginning of friendships in gyms (B and D); in bars or parties (A and C); and because they have cultural proximity (A and C). In the same sense, in the study by Garcia (2016), Brazilian friendships began in the workplace, in social activities and are relatives of the spouse.

VIEW OF THE NATIVES

Doing a macro analysis of the data in this subchapter, the groups were divided into two: the participants in groups A and B had a mostly positive view of the natives before weaving friendships with them: that Brazilians and other Latin Americans would be cheerful, welcoming, pleasant, etc. On the other hand, the participants in groups C and D, for the most part, had a negative view of the natives before establishing friendships with them, that Spaniards and Portuguese would be cold, closed, distant, among others.

For most participants in group A, there was no change in conception after friendships were established. For the majority of group B, there was a change, with the natives being considered distant. There was also a change for most of the participants in groups C and D, that the Spaniards and the Portuguese are not as closed and distant as imagined. This data on the Portuguese is in line with the study by Silva and Schiltz (2007), with Brazilian immigrants in Portugal, in which 87% of

Brazilian immigrants say they have a Portuguese friend and 74.7% of Brazilians have already been invited to go to the home of a Portuguese.

CONCLUSIONS

One of the analytical phases that the author Hinde (1997) proposes is the specification of the principles involved in the dynamics of friendship relationships. In this study, which aimed to analyze the history of old and new friendships of Latin American immigrants throughout their lives in the new country, it can first be concluded that most of the close friends are of the same gender and of the same nationality, and most of them live in the country of origin of the immigrant. In several passages that concerned physical distance, there was no consensus among the participants of this study: while some claimed that it does not interfere with friendship relationships, other participants said that distance hinders friendships. Literature (Bógus, 2007; Garcia, 2012a; 2012b; Garcia, Brandão, Costa & Togatlian, 2010; Garcia, Dettogni *et al*, 2010; Garcia & Rangel, 2011) suggests that physical distance makes it difficult to establish and maintain friendships. However, as previously pointed out, if most of the close friends are of the same nationality and reside in the immigrant's country of origin, it can be assumed that physical distance is not an impediment to maintaining friendship, as mentioned in the study by Garcia, Bitencourt-Neto *et al* (2010).

Corroborating this analysis, another principle was that the ties in the immigrant's country of origin are close friendships, of many years, whose main means of contact are *Facebook*, *Skype*, *WhatsApp*, telephone, *e-mail*, *internet* and in person, and the frequency of contacts varies from daily to monthly. In other words, the consequences of physical distance can be mitigated or at least minimized by the means of contact and social networks that the *internet* currently offers.

A third guiding principle of friendship relationships identified in this investigation was that it is very good to see friends from your country of origin again, with the most common shared activities being eating or going to restaurants, drinking or going to bars, and staying at home. But the vast majority of immigrants also have friendships in the new country, with friendships with natives being more frequent. Then they see friends from their country of origin, foreign friends and friends of another Latin American nationality. Therefore, it is assumed that both old (compatriots) and new friends (usually natives of the new country or other immigrants) are important in the process of migration from one culture to another. Friends of the same nationality are likely to be more intimate, offer emotional support or support, and maintain important contact with their culture of origin. Native friends or other immigrants in the new country can offer help, information about housing, transportation, safety, cultural habits, among others, and mediate access to the new culture in a more functional way.

Another important principle concerns the beginning of friendships in the new country, which happens, for the most part, in the academic environment, through other friends and through relatives. Taking advantage of this information, universities, for example, which receive many foreign students, could better plan their research and work environments, in order to bring colleagues closer together and favor the establishment and maintenance of friendly relationships.

Finally, Latin American immigrants in Brazil and Brazilians in other Latin American countries demonstrated a mostly positive view of natives before establishing friendships with them; and Brazilian immigrants in Spain and Portugal a negative view. For the majority of Latin American immigrants in Brazil, there is no change in conception after friendships have been established, continuing to perceive Brazilians as cheerful, welcoming, pleasant people, etc. For most Brazilian immigrants in other Latin American countries, Spain and Portugal, there is a change. Latin Americans were considered distant by group B, and the Spanish and Portuguese were not as closed and distant as imagined by groups C and D. In this sense, it was evident that stereotypes about cultures exist and, above all, that it is important to get in touch with the new culture and its natives in order to be able to make an analysis closer to reality. preferably devoid of prejudice.

Despite the amount of information brought by this study, it was developed with a specific population of Brazilians and other Latin Americans, in the following contexts: Brazil, Chile, Mexico, Spain and Portugal. In addition, the methodology was a field research, of a qualitative nature, with descriptive characteristics, which used as an instrument a questionnaire with open questions, answered by *e-mail*. In this sense, several other studies, with varied methodologies, can be conducted on international migration, including through partnerships between countries, which would generate greater approximation between cultures. When it comes to the cultural approximation of Latin American countries, for Garcia, Acevedo-Triana and López-López (2015), the meaning of a partnership between these cultures involves its importance, its functionality and its results. Thus, the importance is associated with the advantages of Latin American scientific cooperation. Functionality involves cultural exchanges and the formation and expansion of work networks, the sharing of information and sources, as well as the comparison of research results, the diversity of data, its validation and theories. Its significance goes beyond research, involving collaboration at the graduate level and scientific events. The results include its scientific impact in terms of knowledge dissemination and visibility, as well as national, regional and international political and social impact.

In terms of social relevance, perhaps the most important thing about this scientific cooperation was the applicability of the knowledge generated to immigrants, to their nations, continents, cultures, since "... Human mobility brings endless challenges and difficulties experienced by all migrants and, in one way or another, commonly shared characteristics." (Simai & Beaninger, 2012, p. 02).

Although this investigation did not collect sociodemographic data from the participants, it was clear that this is an economically privileged population, which is in the new country in a legal situation (for example, most went to graduate school). Access to a population of immigrants in situations of greater vulnerability, such as refugees from countries at war, for example, would be much more difficult, but it would be a population that is no less important to be investigated.

REFERENCES

1. Adams, R. G., & Bliezsner, R. (1994). An integrative conceptual framework for friendship research. *Journal of Social and Personal Relationships, 11*(2), 163-184. https://doi.org/10.1177/0265407594112001

2. Alves-Mazzotti, A. J., & Gewandsznajder, F. (1999). O planejamento de pesquisas qualitativas. In A. J. Alves-Mazzotti & F. Gewandsznajder (Eds.), *O método nas ciências naturais e sociais: Pesquisa quantitativa e qualitativa* (pp. 147-178). Pioneira.

3. Aparicio, R., & Tornos, A. (2005). *Las redes sociales de los inmigrantes extranjeros en España*. Ministerio de Trabajo y Asuntos Sociales.

4. Ávila-Molero, J. (2008). Redes personales de africanos y latinoamericanos en Cataluña, España: Análisis reticular de integración e cambio. *REDES: Revista hispana para el análisis de redes sociales, 15*(5), 61-94.

5. Bógus, L. (2007). Esperança além-mar: Portugal no "arquipélago migratório" brasileiro. In J. M. Malheiros (Org.), *Imigração brasileira em Portugal* (pp. 39-58). Paulinas Editora; Artipol. ISBN: 978-989-8000-30-9.

6. Britton, M. L. (2011). Close together but worlds apart? Residential integration and interethnic friendship in Houston. *City & Community, 10*(2), 182-204.

7. Cáceres, J. G. (2011). Las nuevas tecnologías de información y comunicación y las políticas culturales en México: Ingeniería en comunicación social del servicio de redes sociales Facebook. *Intercom – RBCC, 34*(2), 175-196.

8. CEPAL. (2013). *Contribuciones de la CEPAL en el campo de la migración internacional desde los derechos humanos y el desarrollo*. Montevideo: CEPAL.

9. Collier, M. J., & Bornman, E. (1999). Core symbols in South African intercultural friendships. *International Journal of Intercultural Relations, 23*(1), 133-156.

10. Crossman, J., & Bordia, S. (2011). Friendship and relationships in virtual and intercultural learning: Internationalizing the business curriculum. *Australian Journal of Adult Learning, 51*(2), 329-354.

11. DeBruin-Parecki, A., & Klein, H. A. (2003). Stvaranje prijatelja/making friends: Multimodal literacy activities as bridges to intercultural friendship and understanding. *Journal of Adolescent & Adult Literacy, 46*(6), 506-513.

12. Domínguez, S., & Maya-Jariego, I. (2008). Acculturation of host individuals: Immigrants and personal networks. *American Journal of Community Psychology, 42*, 309-327.

13. Flick, U. (2004). *Uma introdução à pesquisa qualitativa* (2nd ed.). Bookman.

14. Flick, U. (2009). *Uma introdução à pesquisa qualitativa* (3rd ed.). Artmed.

15. Garcia, A. (2005). Relacionamento interpessoal: Uma área de investigação. In A. Garcia (Org.), *Relacionamento interpessoal: Olhares diversos* (pp. 7-27). UFES.

16. Garcia, A. (2012a). Amizades de universitários estrangeiros no Brasil: Um estudo exploratório. *Estudos de Psicologia, 29*(4), 471-479.

17. Garcia, A. (2012b). Amizades internacionais de universitários brasileiros: Um estudo exploratório. *Estudos de Psicologia, 17*(2), 313-319.

18. Garcia, A. (Ed.). (2016). *International Friendships: The Interpersonal Basis of a Worldwide Community*. Newcastle upon Tyne, UK: Cambridge Scholars Publishing. ISBN (10): 1-4438-0136-4; ISBN (13): 978-1-4438-0136-2.

19. Garcia, A., Acevedo-Triana, C. A., & López-López, W. (2015). The meaning of and proposals for Latin-American cooperation in Psychology. *Psykhe, 24*(2), 1-12. https://doi.org/10.7764/psykhe.24.2.765

20. Garcia, A., Bitencourt-Neto, C., Moura, L. T., & Pepino, C. B. (2010). Amizades internacionais de universitários brasileiros: Uma análise dos episódios marcantes. In A. Garcia (Org.), *Relacionamento interpessoal: Uma perspectiva interdisciplinar* (pp. 196-208). Vitória: Associação Brasileira de Pesquisa do Relacionamento Interpessoal – ABPRI.

21. Garcia, A., Brandão, L. R., Costa, L. Q. M., & Togatlian, M. A. (2010). Amizades interamericanas de estudantes universitários brasileiros: Um estudo descritivo. In A. Garcia (Org.), *Relacionamento interpessoal: Uma perspectiva interdisciplinar* (pp. 169-181). Vitória: Associação Brasileira de Pesquisa do Relacionamento Interpessoal – ABPRI.

22. Garcia, A., Dettogni, F. G., Costa, L. Q. M., & Togatlian, M. A. (2010). Amizades intercontinentais de estudantes universitários brasileiros: Um estudo exploratório. In A. Garcia (Org.), *Relacionamento interpessoal: Uma perspectiva interdisciplinar* (pp. 182-195). Vitória: Associação Brasileira de Pesquisa do Relacionamento Interpessoal – ABPRI.

23. Garcia, A., & Goes, D. C. (2010). Amizades de estudantes africanos residindo no Brasil. *Psicologia: Teoria e prática, 12*(1), 138-153.

24. Garcia, A., & Miranda, R. F. (2008). A celebrated trilogy on friendship. *Interpersona, 2*(1), 127-130.

25. Garcia, A., & Miranda, R. F. (2012). Amizades interculturais, interétnicas, interraciais e internacionais. In L. K. de Souza & C. S. Hutz (Orgs.), *Amizade em contexto: Desenvolvimento e cultura* (pp. 229-260). São Paulo: Casa do Psicólogo.

26. Garcia, A., & Rangel, P. M. V. (2011). Amizades de universitários cabo-verdianos no Brasil. *Psicologia Argumento, 29*, 201-208.

27. Gois, P., Marques, J. C., Padilla, B., & Peixoto, J. (2009). Segunda ou terceira vaga? As características da imigração brasileira recente em Portugal. In B. Padilla & M. Xavier (Orgs.), *Revista Migrações – Número Temático Migrações entre Portugal e América Latina, 5* (pp. 111-133). Lisboa: ACIDI.

28. Grieve, R., Indian, M., Witteveen, K., Tolan, G. A., & Marrington, J. (2013). Face-to-face or Facebook: Can social connectedness be derived online? *Computers in Human Behavior, 29*, 604-609.

29. Hierro, M. (2013). Latin American migration to Spain: Main reasons and future perspectives. *International Migration*.

30. Hinde, R. A. (1997). *Relationships: A dialectical perspective*. Cambridge, UK: Psychology Press.

31. Kao, G., & Joyner, K. (2004). Do race and ethnicity matter among friends? Activities among interracial, interethnic, and intraethnic adolescent friends. *Sociological Quarterly, 45*(3), 557-573.

32. Kao, G., & Vaquera, E. (2006). The salience of racial and ethnic identification in friendship choices among Hispanic adolescents. *Hispanic Journal of Behavioral Sciences, 28*(1), 23-47.

33. Kouvo, A., & Lockmer, C. (2013). Imagine all the neighbours: Perceived neighbourhood ethnicity, interethnic friendship ties and perceived ethnic threat in four Nordic countries. *Urban Studies*.

34. Lirola, M. M. (2015). La representación de las mujeres inmigrantes en una muestra de la prensa española. In Á. I. Arévalo Salinas, A. Iranzo, & R. Cabral (Eds.), *Comunicación, conflictos y cambio social* (pp. 258-274). Bauru: UNESP/FAAC. ISBN: 978-85-99679-72-2.

35. Merizio, L. Q., Garcia, A., & Pontes, F. A. (2008). Brincadeira e amizade na infância: Lembranças de imigrantes libaneses vivendo no Brasil. *Gerais: Revista Interinstitucional de Psicologia, 1*, 123-135.

36. Miguel-Luken, V. de, & Tranmer, M. (2010). Personal support networks of immigrants to Spain: A multilevel analysis. *Social Networks, 32*(4), 253–262.

37. Nunan, C., & Peixoto, J. (2012). Crise econômica e retorno dos brasileiros imigrantes em Portugal. *Rev. Inter. Mob. Hum.*, 38, 233-250.

38. Padilla, B. (2007). A imigrante brasileira em Portugal: Considerando o gênero na análise. In J. M. Malheiros (Org.), *Imigração brasileira em Portugal* (pp. 113-134). Lisboa: Paulinas Editora; Artipol. ISBN: 978-989-8000-30-9.

39. Park, N., Lee, S., & Kim, J. H. (2012). Individuals' personal network characteristics and patterns of Facebook use: A social network approach. *Computers in Human Behavior, 28*, 1700-1707.

40. Peixoto, J., & Egreja, C. (2012). A força dos laços fracos: Estratégias de emprego entre os imigrantes brasileiros em Portugal. *Tempo Social – Revista de Sociologia da USP, 24*(1), 263-281.

41. Sans, A. P., Miguel-Luken, V. de, & Solana-Solana, M. (2007). *Redes sociales de apoyo. La inserción de la población extranjera*. Bilbao: Fundación BBVA. ISBN: 978-84-96515-37-6.

42. Sias, P. M., Drzewiecka, J. A., Meares, M., Bent, R., Konomi, Y., Ortega, M., & White, C. (2007). Intercultural friendship development. *Communication Reports, 20*(1-2), 1-13.

43. Silva, S., & Schiltz, A. (2007). A relação entre os imigrantes brasileiros e os portugueses – a construção de imagens recíprocas. In J. M. Malheiros (Org.), *Imigração brasileira em Portugal* (pp. 155-170). Lisboa: Paulinas Editora; Artipol. ISBN: 978-989-8000-30-9.

44. Simai, S., & Beaninger, R. (2012). Mobilidade urbana e a diversidade sociocultural. *Educação e Sociedade, 33*(121), 1281-1282. DOI: https://doi.org/10.1590/S0101-73302012000400020

45. Souza, L. K., & Hutz, C. S. (2008). Relacionamentos pessoais e sociais: Amizades em adultos. *Psicologia em Estudo, 13*(2), 257-265.

46. Souza, L. K., & Sediyama, C. Y. N. (2012). Amizades internacionais: Panorama da literatura empírica e um estudo descritivo. *Barbarói, 36*, 6-28.

47. Tajra, V. (2015). Marco civil da internet no Brasil: A legitimação de interesses de uma sociedade. In Á. I. Arévalo Salinas, A. Iranzo, & R. Cabral (Eds.), *Comunicación, conflitos y cambio social* (pp. 71-83). Bauru: UNESP/FAAC. ISBN: 978-85-99679-72-2.

A portrait of the female labor market in Tocantins between 2000 and 2021

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ABSTRACT

The expansion of women's participation in the labor market is a reality in Brazil, especially after the 80s. With the advent of labor rights aimed at women's needs, such as maternity leave and special conditions and hours for breastfeeding women, and the improvement of professional qualification and educational levels; Women were able to expand their participation in the labor market. However, this higher participation is still not enough to overcome the structural disparities between the genders in the labor market. This work has as its object of analysis the state of Tocantins and as a time frame the period between 2000 and 2021, and the results show that this insertion of women still perpetuates inequalities between genders, as it occurs even in greater proportion in sectors of greater vulnerability and lower average income – commerce and services –, and also that women are concentrated in the lower average income strata, up to 3 minimum wages.

Keywords: Tocantins, Labor market, Feminine, Productive sectors and middle income stratum.

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INTRODUCTION

The insertion of women into the labour market has been marked by continuous progress, but also by persistent challenges. Female participation has been growing gradually, especially since the 1980s, as a result of social, economic and legal transformations. Women began to enter different sectors of the economy, occupying areas traditionally associated with female work, such as education and health, to segments that were previously predominantly male, such as technology and engineering. In addition, female schooling increased substantially, allowing women to qualify better and compete more equitably in the labor market.

However, this insertion still faces several difficulties. Wage inequality is one of the main barriers, as women continue to be paid, on average, less than men, even when they hold similar positions. In addition, cultural barriers and gender stereotypes limit women's access to leadership positions and areas with greater prestige and responsibility. Another significant difficulty is the overload of the "double shift", in which many women have to reconcile professional responsibilities with the care of the home and family, which often affects the development of their careers.

In addition, women face discrimination in the workplace, especially in hiring processes, promotion, and policies related to maternity. Even with the advances, there are still obstacles that hinder full equality of opportunities in the labor market.

In view of the problem exposed, this article will discuss an analysis of the labor market in the state of Tocantins with a focus on the composition of this market between genders and at the sectoral level, this will be carried out in a time frame between 2000 and 2021. This period was thus defined to observe the post-2000s dynamics, which represents a milestone in the country's economic and political history and inaugurates a cycle of social public policies aimed at combating hunger, income transfer, and formalizing the labor market.

Therefore, the text is divided into three sections, in addition to this brief introduction, in the first a bibliographic review of the main texts and scientific contributions on the subject is made, then the data are analyzed with regard to the object of analysis and respecting the proposed time frame and finally, we present the main conclusions of the research.

THEORETICAL FOUNDATION

The participation of women in the Brazilian labor market and the historical trajectory of this phenomenon have been discussed by several scholars (RIOS-NETO and WAJNMAN, 1997; HIRATA, 1998; BRUSHINI, 2007; GARCIA and CONFORTO, 2012). Several studies indicate that the rate of female participation in the labor market increased significantly after the 1980s (WAJNMAN and PERPÉTUO, 1997; CARVALHO and VIEGO, 2023).

Among the factors that underpin this phenomenon, we can mention technological and cultural advances, the incorporation of labor rights aimed at women, such as maternity leave and adapted working hours for breastfeeding women, and economic and social changes in family patterns, especially those of workers.

The legal support provided an irreversible and constantly growing insertion of women in the Brazilian labor market, especially in the category of salaried workers (LAVINAS and BARSTED, 2016). In addition, as pointed out by Scorzafave and Menezes-Filho (2001), this entry of women into the market was driven not only by favorable legislation, but also by the improvement in professional qualification and by the change in attitude of women themselves, who began to face the challenges of the market with more assertiveness and determination.

Furthermore, as Assis (2009) points out, the growing entry of women into the labor market can be observed from the need to contribute to the family income and due to the search for financial independence. Bruschini and Lombardi (2003) point out that in addition to contributing to the family income, women have entered the labor market, the demographic, cultural and social transformations of families have opened space for this movement, the social role of women, the growing number of families headed by women and the reduction in the number of children, for example, These are factors that have contributed to this growing movement of women's participation in the labor market.

Based on data from the National Household Sample Survey (PNAD), in addition to the growth in the presence of women in the labor market, structural changes can also be observed, such as the redistribution of women among different productive sectors (LAVINAS, 1997) and the age variation of female workers (WAJNMAN and PERPÉTUO, 1997).

In the post-2000 period, the growth of female participation in the labor market was not as pronounced as in the 1980s and 1990s. Even so, there is a continuous advance in the presence of women in the market. According to data from RAIS (Annual Report of Social Information) and CAGED (General Register of Employed and Unemployed Persons), between 2003 and 2018, women's participation in formal employment increased by four percentage points, from 40% to 44% in Brazil.

Although with varying magnitudes and rhythms, the trend of increasing female participation in the labor market is observed in other Latin American countries (ILO, 2012; 2016). In Brazil, several studies point to an improvement in the disparities in participation between men and women in the labor market (DE PAULA LEITE, 2017; MATEI and DA CUNHA, 2020; CARVALHO and VIEGO, 2023). However, despite this improvement, structural segregation still persists in the productive sectors. Women, for the most part, continue to occupy jobs in sectors that require less education, have low productivity and, consequently, offer a lower average income (ASLAN SOUEN, 2012; ALVES, 2015).

According to Bruschini (2007) and Vieceli (2015), even with the entry of women into the labor market from the 1970s onwards and the increase in their participation in the occupational structure, gender disparities remain in certain productive sectors. This shows that, despite the advances, women still face significant barriers in terms of opportunities and quality of the jobs they occupy.

According to the results pointed out by Carvalho and Viego (2023) in an analysis applied to Brazil, women have entered the labor market, but still in sectors with lower average remuneration and that require less qualification. Leadership positions and those with higher salaries are still predominantly occupied by men. Cruz et al (2013), using the probit econometric method, pointed out that education levels influence women's decision to enter the labor market. According to the results pointed out by the authors, women with higher education are 30% more likely to be part of the labor market, and those with high school education 14.75%, with illiterate women as a reference.

Having this theoretical context and based on the results of the aforementioned research, this research is based on the analysis of the insertion of women in the labor market in Tocantins. The labor market in the state of Tocantins reflects both structural characteristics of the local economy and challenges common to many regions of Brazil, particularly in relation to gender disparities and macrosectoral evolution.

Gender disparities in Tocantins are evident in several indicators, such as participation rate, income, and insertion in different economic sectors. Women face significant obstacles in terms of accessing and remaining in the labour market, often focusing on lower-paid occupations and specific sectors such as services and public administration.

In addition, as pointed out by Da Silva et al (2013), the participation of women in the informal sector in the state of Tocantins is considerable, based on the results of the sample survey presented by the authors, 51.4% of women between 30 and 40 years old worked informally in 2012 in the state.

In this sense, this article will continue to analyze the structure of the labor market in Tocantins, based on the distribution of formal employment among genders at the sectoral level, according to the methodology described below.

METHODOLOGY

In this section, the methodology used to carry out the research is presented, based on a quantitative approach with the application of descriptive statistics. The study aims to analyze patterns and trends in a set of data collected in a database referring to the formal labor market in Brazil. From the information obtained, descriptive techniques will be used, such as calculation of percentage participation and frequency distribution, in order to summarize and interpret the results objectively. This methodology will allow a precise and clear analysis of the phenomena about the structure of the

labor market in Tocantins and will allow us to understand how women are inserted in the local market.

The data worked in this research were extracted from the database of the Annual Report of Social Information (RAIS), which is an instrument for collecting labor data, of government management and aims to meet the needs of control of formal labor activity in Brazil. This database also contains the number of jobs occupied at each sectoral level for different geographic areas, including the North region and the state of Tocantins, in which it is the object of analysis in this work.

With this data segregation, it will be possible to obtain sectoral jobs distributed by gender. That is, the number of workers in each sector, both male and female, in the state of Tocantins can be extracted.

Some clarifications are necessary about the source of information to be used in this study. First, RAIS presents information on jobs and income of salaried workers with a formal employment relationship. Therefore, it is noteworthy that the data do not allow conclusions about total employment, only those who are formally linked (either with a formal contract following the CLT regime or public servants). Therefore, the data used omits entrepreneurs, traders, self-employed and employers in general.

The layout of the database and the information made available allow for levels of disaggregation, whether by gender, age group, region or sector of activity (according to the National Classification of Economic Activities – CNAE).

In addition to RAIS, another relevant source of data on the labor market in Brazil is PNAD. This last source of data has the advantage of recording the entire labor market, according to the occupational category (employer, self-employed, salaried) and according to the degree of formalization (CLT, temporary, loose, etc.). However, it has some limitations that prevent its use in analyses with medium- and long-term historical series, such as the one carried out in this study. In addition, in Brazil, there were two versions of the PNAD: one, closed in 2016 (with publication referring to the 2015 information), whose data were published annually; and another, the Continuous PNAD, in force since 2012, when it underwent changes in its methodology, starting to be published quarterly.

According to the Brazilian Institute of Geography and Statistics (IBGE), the Continuous PNAD methodology provides more comprehensive territorial coverage and provides quarterly conjunctural information about the labor market at the national level. The two surveys are not fully comparable, as they are based on different samples/data collection and methodologies. Thus, the analysis based on the PNAD must necessarily end in 2015 or start in 2012, limiting the medium-term analysis, such as the one carried out in this article.

On the other hand, it is true that the data covered by RAIS reflect only a fraction of the labour market and, therefore, of employment, but even so, a part of vulnerable employment (casual workers, temporary workers or those with a fixed-term contract) is captured by this source of information. To compensate for the lack of data on informality, when there are substantial changes in the structure of female employment in a sector, we can also analyze the contract with the employer, distinguishing between indefinite contracts in the private sector, employment in the effective public sector (statutory), or temporary and casual workers, urban or rural (CLT), fixed-term or temporary contracts in the private sector.

In addition, the data presented in RAIS concentrate employment in a more stable way, allowing for long-term analyses, as is the case of the research presented in this article, and this allows for the evaluation of more permanent changes in the labor market. On the other hand, a punctual database would allow us to infer only about conjunctural changes, limiting the conclusions to a broad time horizon.

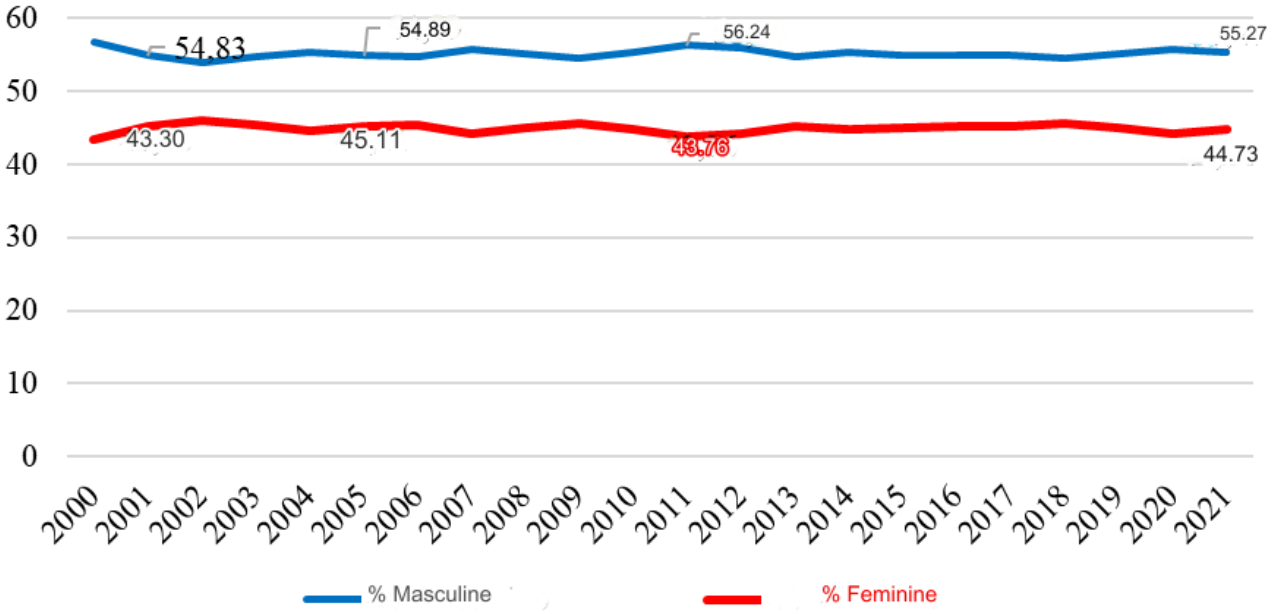
Therefore, the sectoral cut that is intended to be used in this research is that of major economic sectors according to the IBGE. Therefore, the cut is based on the five major sectors: Industry, Civil Construction, Commerce, Services and Agriculture.

The numbers of formal jobs for each of these five major economic sectors, segmented between the female and male genders, for the period between 2000 and 2021, will be extracted from RAIS, allowing inferences to be made about the structure of the labor market in the state of Tocantins.

RESULTS AND DISCUSSIONS

The female participation rate is lower than that of men, reflecting both cultural barriers and domestic responsibilities disproportionately attributed to women, as can be seen from the data in Figure 1. In addition, the unemployment rate is often higher among women, who also tend to face greater difficulties in finding formal jobs.

Figure 1 – Composition of the formal labor market between genders in the state of Tocantins between 2000 and 2021



Prepared by the authors based on data extracted from CAGED/RAIS.

The massive insertion of women in the labor market throughout the 80s and 90s seems to have been stopped, and this is observed both at the national level (CARVALHO and VIEGO, 2023) and regionally from the analysis applied to the state of Tocantins. However, even if timid, it is still observed that female participation throughout the analyzed period has been persistent and positive. But these data alone are insufficient to conclude about equality and equity in working conditions between genders. And the persistence of disparities in working conditions is portrayed in several works applied at the national level, as mentioned earlier.

In addition to this stagnation observed in the participation of women in the formal labor market in Tocantins, it is observed that the disparity in earnings between genders is something that still affects women. Women in Tocantins, as in other parts of Brazil, earn less than men, even when they perform similar functions. This difference in income is the result of wage discrimination, occupational segregation, and less access to leadership positions.

The productive structure of Tocantins is mainly composed of the agricultural, industrial and service sectors, each with distinct characteristics and dynamics.

Traditionally, the agricultural sector is one of the main sources of employment in the state. The expansion of agriculture and livestock has been significant, especially with the growth of grain and meat production. However, this sector is still marked by informal and seasonal jobs, with low access to labor rights. Women are underrepresented and often limited to support roles or unpaid family work.

The industrial sector in Tocantins is less developed compared to agriculture and services. The manufacturing industry, especially that linked to agribusiness (such as food processing), is one of the

main activities. Women's participation in industry is lower than in services, and when present, it tends to be in less qualified functions with lower salaries.

The service sector is the one that employs the most in the state, reflecting a national trend. The growth of the service sector has been driven by the increase in urbanization and the development of activities related to commerce, education, health and public administration. Women are more represented in the service sector, however, often in low-paid occupations such as domestic work and public service.

Table 1 shows the percentage participation of men and women in the formal labor market subdivided by sectors, respecting the IBGE's classification of major economic sectors (Industry, civil construction, commerce, services and agriculture). The division into sub-periods every 5 years was performed to allow an interpretation of the complete period.

Table 1 – Percentage participation of the female and male segments in the labor market in Tocantins between 2000 and 2020

IBGE/Sectors	2000		2005		2010		2015		2020		TCSF
	But	Fem	But	Fem	But	Five	But	Five	But	Five	
Industry	10,64	2,57	10,28	2,72	11,32	3,31	11,94	3,99	11,04	3,19	24%
Construction	7,88	0,47	7,13	0,38	9,84	0,70	6,34	0,63	5,69	0,56	20%
Trade	16,47	9,98	17,30	11,43	19,06	14,10	20,22	15,65	20,74	16,57	66%
Services	55,73	86,21	52,78	84,31	49,63	80,69	49,70	78,17	48,86	77,51	-10%
Agricultural	9,28	0,76	12,51	1,16	10,15	1,20	11,79	1,56	13,67	2,17	186%

Prepared by the authors based on data extracted from CAGED/RAIS.
Legend: TCSF – Growth Rate of the Women's Segment, calculated from the variation in the growth of the percentage participation of the women's segment in each sector, between 2000 and 2020.

It is observed that the sectors in which women gained the most participation were Trade and Agriculture. Reinforcing the aforementioned regional conditions and characteristics. With emphasis on the Agriculture sector, in which women increased their participation by 186%. Going from 0.76% in 2000 to 2.17% in 2020.

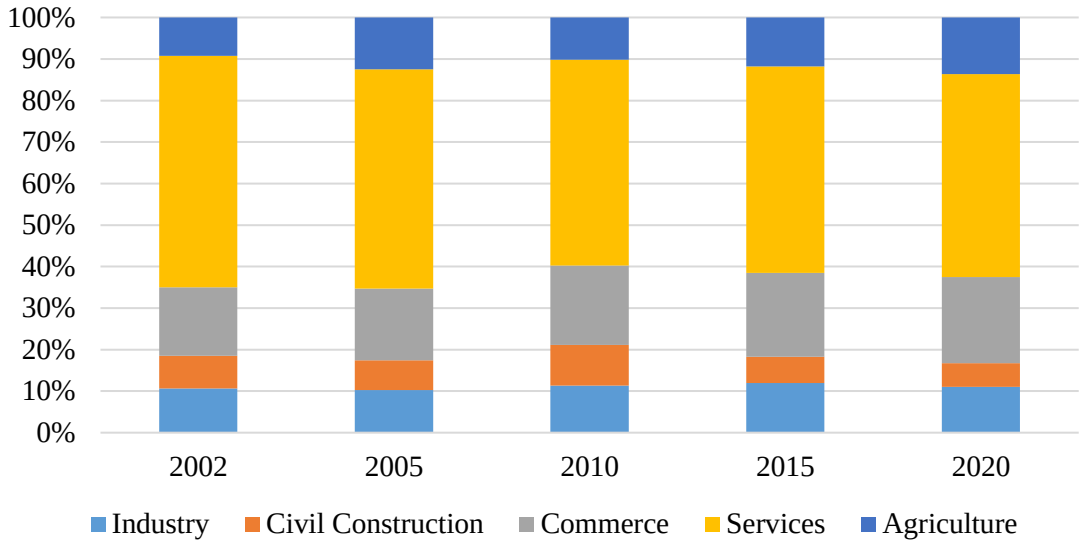
However, it should be noted that it is in the sectors and Commerce and Services that women are widely employed. In 2000, these two sectors together employed 96.2% of all formally employed women in Tocantins and in 2020 this figure was 94.08%, indicating a persistence of structural inequality in the labor market.

The concentration of women in certain sectors reflects the persistence of the sexual division of labor, in which activities traditionally associated with care, public service, and service provision are attributed to women. This segmentation limits women's opportunities in historically male sectors, such as manufacturing and technology, perpetuating wage inequalities and women's conditions of vulnerability.

The trade and services sectors tend to offer jobs with more precarious characteristics, such as high turnover, low wages, and lower labor benefits. The high female presence in these sectors contributes to the maintenance of a structural inequality in remuneration, aggravated by the social undervaluation of these occupations.

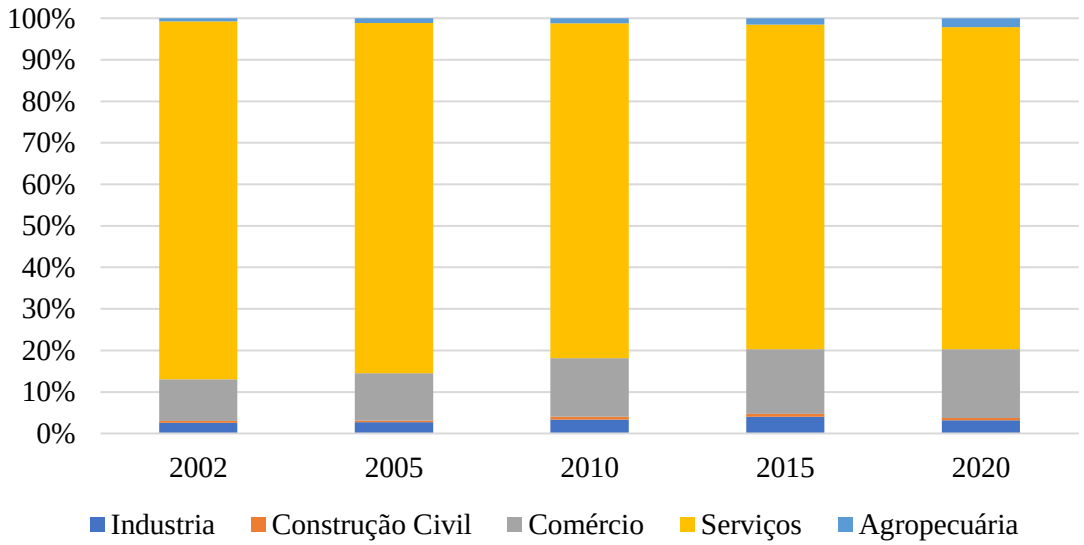
Figures 2 and 3 show the participation of employment at the sectoral level for the male and female genders. Performing an analysis of the data and a comparison between the distribution of men in the labor market in the different sectors with that of women, it is found that in Tocantins, the female concentration in the Service and Trade sectors is reinforced.

Figure 2 – Sectoral participation in male employment in Tocantins between 2002 and 2020



Prepared by the authors based on data extracted from CAGED/RAIS.

Figure 3 – Sectoral participation in female employment in Tocantins between 2002 and 2020



Prepared by the authors based on data extracted from CAGED/RAIS.

The high concentration of women in the trade and services sectors results from the horizontal segmentation of the labor market, where cultural norms and gender expectations direct women to areas associated with care and service, as highlighted above. The data presented for the state of Tocantins do not reflect a typical and specific reality of the region. As shown by the data released by the 2009 IPEA Technical Note, released from the work of the Brazilian Observatory of Gender Inequality, women in Brazil occupy the majority of jobs in the Trade and Services sectors. As Melo and Thomé (2018) point out:

> The concentration of female labor is in the sectors of education, health, social services, domestic services, housing and food, activities that concern the reproduction of life. Meanwhile, men are allocated to the agricultural, industrial and civil construction sectors, directly related to the production of material goods (MELO and THOMÉ, 2018, p. 106).

In addition, these sectors offer greater flexibility and partial working hours, making it easier to reconcile with domestic responsibilities. Gender inequality also contributes, with lower wages and lower economic valuation in these sectors, as well as barriers to advancement in male-dominated areas. The educational background of women, often directed to professions related to care, reinforces this concentration.

The income differential between men and women can be explained by the insertion of women in sectors characterized by greater informality, vulnerability and worse hiring conditions. Gender stereotypes reinforce horizontal segregation in the labor market, justifying the idea that there are "women's jobs" and "men's jobs". However, traditionally male occupations have better wage conditions, greater labor protection, and social prestige, perpetuating gender inequality, since female professions tend to be less valued and paid.

As pointed out in the results presented by Oliveira et al (2021), the strong gender wage differences are explained by horizontal segregation, in which women are concentrated in sectors with lower average incomes, such as education, health, and services, while men predominate in sectors that are more economically valued, such as industry and construction. This imbalance reflects the structural devaluation of traditionally feminized activities, resulting in significant gender pay disparities.

The data in Table 2 show the percentage participation of women according to the sector between 2002 and 2020 in the state of Tocantins.

Table 2 – Percentage participation of women according to the sector between 2002 and 2020

IBGE Gr Sectors	2002	2005	2010	2015	2020
Industry	17,09	17,84	19,15	21,90	18,65
Construction	4,82	4,24	5,41	7,59	7,26
Trade	34,07	35,20	37,46	38,85	38,80
Services	56,87	56,76	56,83	56,35	55,74
Agricultural	6,52	7,07	8,72	9,77	11,19

Prepared by the authors based on data extracted from CAGED/RAIS.

The increase in women's participation in the agricultural sector in Tocantins can be attributed to several factors, such as the growth of training programs and public policies aimed at the inclusion of women in the countryside. In addition, there is a growing appreciation of agroecology and family farming, areas in which women play a key role. The modernization of the sector has also contributed, with the emergence of technologies that facilitate agricultural work, enabling greater female inclusion in activities traditionally occupied by men.

Despite an increase in the participation of women in the industry, civil construction and agriculture sectors, women still occupy the majority of jobs in the Trade and Services sectors, reinforcing the continuity of structural disparities between genders in the labor market in Tocantins.

In addition to the structural persistence of the concentration of women in the Trade and Services sectors, another relevant point to analyze the structure of the female market is regarding the salary range. The data extracted from RAIS take into account 10 income brackets, for simplification, we propose three brackets: Up to 3 MW, from 3.01 to 7 MW and above 7 MW.

According to the data presented in Table 3, women are predominantly concentrated in the average salary range of up to 3 minimum wages. The sectors of Commerce and Agriculture were the ones that stood out the most in terms of the concentration of women in this salary range. We highlight these results in blue. In 2002, women who held positions in the Trade sector and earned up to 3 MW accounted for 94.82% of the total number of women employed in the sector and in the Agriculture and Livestock sector, this result was 95.05%. In 2020, this scenario remains, with 92.31% of women allocated to the Trade sector in the salary range of up to 3 MW and 92.27% of women working in the Agriculture sector earning up to 3 MW. This reinforces not only the sectoral concentration of women, but also their allocation to the lowest average salary brackets.

In the other sectors, although to a lesser extent, the reality is the same, most women occupy the lower income strata. In industry, for example, in 2002 88.28% of women earned up to 3 MW and in 2002 this figure fell to 85.32%, despite the drop, it is a timid movement that is not enough to verify a reversal of the structural disparities between the genders in the labor market.

The service sector, despite concentrating a large number of women, as shown in Figures 3, exhibits a greater distribution among the pay ranges due to the diversity of occupations offered in this sector. This is due to the fact that the sector covers both low-paid jobs, such as in commerce and care

activities, and better-paid positions in areas such as information technology, finance, management, and specialized services. In addition, the growing female presence in leadership positions and the increase in women's professional qualification have contributed to a greater salary variation within the sector, expanding the distribution between the different pay ranges.

In recent decades, the service sector has stood out as the main generator of jobs in Brazil, driven largely by the process of outsourcing the economy (COTRIM et al., 2020). Outsourcing allowed companies to transfer secondary activities to service providers, which expanded the demand for labor in areas such as cleaning, security, IT, administration, and specialized services. This phenomenon has also opened up more opportunities for women, who were already predominantly concentrated in this sector, increasing their participation in different pay ranges and occupations within the sector (RODRIGUES, 2023).

Table 3 – Percentage participation of women at the sectoral level, according to the salary range

IBGE Gr Sector	Remun Belt. Average (SM)	2002	2005	2010	2015	2020
Industry	Up to 3 MW	88,28	88,32	85,12	89,00	85,32
	From 3.01 to 7 MW	9,32	9,60	10,44	7,72	10,30
	Above 7 SM	2,41	2,08	4,44	3,28	4,38
Construction	Up to 3 MW	79,79	79,52	86,14	85,88	84,29
	From 3.01 to 7 MW	16,03	16,72	11,17	11,32	7,55
	Above 7 SM	4,18	3,75	2,69	2,80	8,16
Trade	Up to 3 MW	94,82	95,07	95,28	94,66	92,31
	From 3.01 to 7 MW	4,67	4,47	4,15	4,55	4,48
	Above 7 SM	0,51	0,46	0,58	0,79	3,21
Services	Up to 3 MW	67,71	67,90	68,41	64,37	64,54
	From 3.01 to 7 MW	21,97	25,37	24,95	27,34	26,15
	Above 7 SM	10,32	6,73	6,64	8,29	9,31
Agricultural	Up to 3 MW	95,05	95,02	96,95	94,29	92,27
	From 3.01 to 7 MW	3,66	4,30	2,73	3,48	4,76
	Above 7 SM	1,29	0,68	0,31	2,23	2,97

Prepared by the authors based on data extracted from CAGED/RAIS.

In summary, the data show that the distribution of female employment in different sectors and income strata reflects a combination of structural and cultural factors. Women in the state of Tocantins are strongly concentrated in sectors such as commerce and services, areas traditionally associated with care and support activities. These sectors, often characterized by lower average remuneration, are responsible for the high female presence in the lower salary brackets. However, the service sector, in particular, has a wider distribution of income, as it ranges from low-skilled occupations to more specialized and leadership positions, allowing for greater wage variation, and

has undergone a restructuring process led by the spread of outsourcing and access to leadership positions and jobs with higher average remuneration.

However, the data presented here reinforce the difficulties that women in Tocantins face in the labor market, perpetuating the disparities between genders in the labor market. These results have already been pointed out in different analysis cuts, both at the national level (AMARAL, 2012; SIQUEIRA and SAMPARO, 2017; CARVALHO and VIEGO, 2023), as well as at the regional level such as the state of Paraná (CIELO et al., 2011; TONHATI and MACEDO, 2020), Minas Gerais (DOMINGUES et al., 2012) among others. And in the state of Tocantins, based on the period analyzed, between 2000 and 2021, the results show a movement of perpetuation of the concentration of women both at the sectoral level (service and commerce) and in the income stratum below 3 minimum wages.

CONCLUSIONS

The history of exclusion and struggle of women in the labor market is still reflected today in the state of Tocantins, where gender disparities persist. While progress has been made, women continue to face significant barriers to achieving equal employment conditions. Tackling these inequalities requires a sustained effort both at the level of public policy and in the transformation of social norms.

The trajectory of women in the labor market is marked by centuries of exclusion, discrimination and the struggle for rights. Historically, women's difficulties in entering and thriving in the labor market are rooted in social, cultural, legal, and economic factors.

In Tocantins, as in other regions of Brazil, women face challenges related to entering the labor market. The lack of formal employment opportunities, especially in rural areas, limits options for many women, who end up resorting to informal work or domestic work, which is often poorly paid and without social protection. This leads to a high concentration of women in the services and trade sectors, where there is wide access to women, but with precarious working conditions, vulnerable jobs and low average remuneration.

Regarding the pay gap, the data show that women are concentrated in the lower income stratum, regardless of the sector. This wage disparity is especially pronounced in sectors such as agriculture and services, in which on average 95% of women earn up to 3 minimum wages.

The labor market in Tocantins faces the challenge of creating employment opportunities that are inclusive and sustainable, especially considering gender disparities. There is a need for public policies that promote gender equality, such as specific training programs for women, incentives for the formalization of employment in the agricultural sector, greater support for women entrepreneurs,

improvement of qualification and professional training, and support in women's family care activities, such as help with daycare centers and specialized health care for working mothers.

In addition, the development of insignificant sectors in the state, such as the industrial sector, can offer new opportunities for qualified employment, and access to technology and means of production that increase women's labor productivity can contribute to mitigating income disparities between genders in the state. The diversification of the state's economy, along with the promotion of gender equality, can contribute to a fairer and more dynamic labor market in Tocantins.

REFERENCES

1. Alves, G. (2015). La precarización salarial y el capitalismo en Brasil: Un balance de la década del neodesarrollismo. *Ecuador Debate*, 94, 99-113.

2. Aslan Souen, J. (2012). A política de valorização do salário mínimo e seus determinantes no contexto da retomada econômica, 2003-2010. In *Encontro Nacional de Estudos Populacionais, ABEP* (18). Águas de Lindóia, SP – Brasil, 19 nov.

3. Assis, R. H. de. (2009). A inserção da mulher no mercado de trabalho. In *Convibra – Congresso Virtual Brasileiro de Administração*.

4. Amaral, G. A. (2012). Os desafios da inserção da mulher no mercado de trabalho. *Itinerarius Reflectionis*, 8(2).

5. Bruschini, C., & Lombardi, M. R. (2003). Mulheres e homens no mercado de trabalho brasileiro: Um retrato dos anos 1990. In M. Maruani & H. Hirata (Orgs.), *As novas fronteiras da desigualdade: Homens e mulheres no mercado de trabalho* (pp. 59-70). São Paulo: Senac.

6. Bruschini, M. C. A. (2007). Trabalho e gênero no Brasil nos últimos dez anos. *Cadernos de Pesquisa*, 37(132), 537-572.

7. Carvalho, P. A. de, & Viego, V. (2023). Evolução do emprego feminino no mercado de trabalho brasileiro: Uma análise shift-share entre 2003 e 2018. *Economia e Sociedade*, 32, 207-224.

8. Cielo, I. D., de Lima, J. F., & Alves, L. R. (2011). Mapeamento do emprego formal feminino no estado do Paraná. *Publicatio UEPG: Ciências Humanas, Linguística, Letras e Artes - ATIVIDADES ENCERRADAS*, 19(1), 59-70.

9. Cotrim, L. R., Teixeira, M., & Proni, M. W. (2020). Desigualdade de gênero no mercado de trabalho formal no Brasil. Instituto de Economia, Unicamp.

10. Cruz, A. F., Basso, F. M. B., & Paz, D. (2013). Determinantes da participação feminina no mercado de trabalho brasileiro: Evidências utilizando modelo probit. Curitiba.

11. Da Silva, A. P., & da Silva Cerqueira, E. (2013). Nuances e interfaces da informalidade na cidade de Palmas, capital do Estado do Tocantins. *Cadernos Naui*, 2(2).

12. De Gênero, Observatório Brasil da Igualdade. (2009). A crise econômica internacional e os (possíveis) impactos sobre a vida das mulheres.

13. De Paula Leite, M. (2017). Gênero e trabalho no Brasil: Os desafios da desigualdade. *Revista Ciências do Trabalho*, 8, 55-78.

14. DIEESE. (2014). O mercado de trabalho assalariado rural brasileiro. *Estudos e Pesquisas*, 74, out.

15. Domingues, J. P. da S., et al. (2002). A inserção da mulher no mercado de trabalho no estado de Minas Gerais na década de 90.

16. Garcia, L. dos S., & Conforto, E. (2012). A inserção feminina no mercado de trabalho urbano brasileiro e renda familiar. *Saúde em Debate*, 36(95), 523-532.

17. Hirata, H. (1998). Reestruturação produtiva, trabalho e relações de gênero. *Revista Latinoamericana de Estudios del Trabajo*, 4(7).

18. ILO. (2012). *Global employment trends for women*. Geneva.

19. ILO. (2016). *Women at work*. Geneva.

20. Lavinas, L. (1997). Emprego feminino: O que há de novo e o que se repete. *Dados*, 40(1), 41-67.

21. Lavinas, L., & Barsted, L. L. (2016). Mudanças na sociedade salarial, regulamentação e emprego feminino. *Anais...*, 547-557.

22. Melo, H. P. de, & Thomé, D. (2018). *Mulheres e Poder*. São Paulo: FGV Editora.

23. Mattei, T. F., & da Cunha, M. S. (2020). A crise econômica brasileira e seus efeitos sobre o emprego formal: Uma decomposição shift-share estocástica. *Orbis Latina*, 10(1), 116-138.

24. Oliveira, M., Vieira, C., & Baeta, F. (2021). Mulheres no mercado de trabalho brasileiro: Uma análise das segregações e discriminações a partir da economia feminista. TD *Instituto de Economia*, 21.

25. Rodrigues, S. dos S. de Souza. (2023). Inserção da mulher no mercado de trabalho–no setor de serviços.

26. Rios-Neto, E., & Wajnman, S. (1994). Participação feminina na população economicamente ativa no Brasil: Alternativas para projeções de níveis e padrões. *Pesquisa e Planejamento Econômico*, 24(2), 155-180.

27. Scorzafave, L. G., & Menezes-Filho, N. A. (2001). Participação feminina no mercado de trabalho brasileiro: Evolução e determinantes. *Revista Planejamento Econômico*, 31, 441-478.

28. Siqueira, D. P., & Samparo, A. J. F. (2017). Os direitos da mulher no mercado de trabalho: Da discriminação de gênero à luta pela igualdade. *Revista Direito em Debate*, 26(48), 287-325.

29. Tonhati, T. M. P., & Macêdo, M. (2020). Imigração de mulheres no Brasil: Movimentações, registros e inserção no mercado de trabalho formal (2010-2019).

30. Vieceli, C. P. (2015). Economia e relações de gênero e raça: Uma abordagem sobre o emprego doméstico no Brasil (Dissertação de Mestrado). Faculdade de Ciências Econômicas, Universidade Federal do Rio Grande do Sul.

31. Wajnman, S. (1997). Tendências prospectivas de crescimento da população economicamente ativa no Brasil. Cedeplar/UFMG. (Texto para Discussão, n. 111).

32. Wajnman, S., & Perpétuo, I. H. O. (1997). A redução do emprego formal e a participação feminina no mercado de trabalho brasileiro. *Nova Economia*, 7(1), 123-147.

Industrial reuse of orange peel: A review of current applications

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ABSTRACT

Citrus fruits are valued globally for their high nutritional value. However, industrial processing, especially juice extraction, generates by-products that are often discarded or used in animal feed. Orange peel, a byproduct of this process, is a rich source of essential components that can be transformed into high-value bioproducts. Managing these wastes is challenging due to their high quantity, physicochemical properties, and seasonality of production. This study aims to explore the sustainable use of orange peel waste to generate new bioproducts. A literature review was conducted on the use of new technologies in orange peel waste. This encompasses several potential applications for the peel, including packaging production; use in bakery products; extraction of biologically active compounds for pharmaceutical or cosmetic use; extraction of pectin, used as an emulsifying, stabilizing, gelling and thickening agent; use in the biorefinery for the production of biodiesel, bioethanol and biogas; in the treatment of water and effluents; and in obtaining new chemical products, such as solvents. Finally, orange peel waste is a potential source for obtaining high value-added materials in various industries, contributing to a circular economy and reducing environmental liabilities.

Keywords: Citrus waste, Bioproducts, Innovation, High added value.

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INTRODUCTION

Worldwide, the citrus industry is recognized as an important commercial base between citrus exporting and importing nations. Countries such as South Africa, Brazil, China, the United States of America, and Mexico are exporters involved in large trades (Gupta *et al*., 2023).

Oranges, consumed worldwide, are extremely valued due to their pleasant taste and their nutritionally beneficial composition for health. Among its notable components are phenolic compounds, folate, heteropolysaccharides, and vitamin C (Pan *et al*., 2023).

Citrus fruits constitute about 18% of global fruit production, and oranges, as the most cultivated in the world, account for 60% of this citrus production. Brazil, China, India, and the United States stand out as major producers, also being significant consumers due to the abundance of these fruits in their territories. Of the producing countries, more than half of the global production of orange juice is controlled by Brazil, which exports 98% of this volume in its concentrated form (Allegri *et al*., 2024; Gupta *et al*., 2023; Ferreira *et al*., 2020).

The continuous agricultural activities to supply basic foods to the growing population, together with the intense growth of industrial activities, have led to an increase in the generation of solid waste, whose inadequate disposal contributes to environmental pollution. Although they are often reused as animal feed, many are still thrown away, especially by small producers, who lack adequate means for correct disposal. This disposal, most of the time, involves burning or abandoning the material in open landfills, which results in dangerous consequences, such as high energy demand, production of leachate (groundwater pollutants), greenhouse gas emissions, and negative impacts on human health (Kariim *et al*., 2024; Sanchez *et al*., 2023).

Scientists are increasingly interested in investigating agricultural and industrial leftovers, as they are rich in antioxidants and dietary fiber, as well as contributing to the reduction of pollution. In particular, the disposal of citrus peels is a major waste of resources, as studies indicate that these by-products contain the highest concentrations of bioactive components of fruits (Ritika *et al*., 2024; Wang *et al*., 2023).

Due to the fact that 50-60% of the orange juice produced succeeds in solid waste, it is essential to convert them into economical products to mitigate indiscriminate burning and use them as raw material for new industries. Thus, orange peels have received a lot of attention to evaluate their potential uses (Fehlberg *et al*., 2023; Kariim *et al*., 2024).

The orange has a varied size and a rounded-oblong shape. Its bark is composed of two parts, the flavedo, which is the colored outer layer containing oily sacs, and the albedo, the white inner part rich in pectin. The pulp is divided into segments that may contain seeds. Peels, which are rich in sugars and monoterpenes (mainly D-limonene), and seeds, composed of nitrogen-free extract, lipids, crude proteins, and fiber, are important by-products (Dongre *et al*., 2023).

In recent years, there has been a significant increase in research focused on the extraction of compounds of high biological value using various traditional and ecological technologies, in addition to their applications in different industries (Panwar *et al*., 2021). Therefore, this review article seeks to offer an overview of the various potential applications of orange peel, from its simplest uses to innovative methods for the use of this waste, including concepts of circular economy and upcycling.

METHODOLOGY

A literature review was conducted on the use of new technologies in orange peel waste waste. The search engine Science Direct was used, in which the keywords "orange juice", "waste recovery", "residue", "orange by-products", "orange peel", "value-added", "pharmacological", "limonene", "carotenoids", "phenolic compounds", "biofuel" and "wastewater treatment" were applied in different combinations with the Boolean operator "AND". The search was restricted to articles published in the last 5 years, including both review and research studies. Additional sources were incorporated through the snowballing technique, which involves the addition of references cited in the reviewed articles. In total, 41 sources were identified for detailed analysis.

DESTINATION OF WASTE

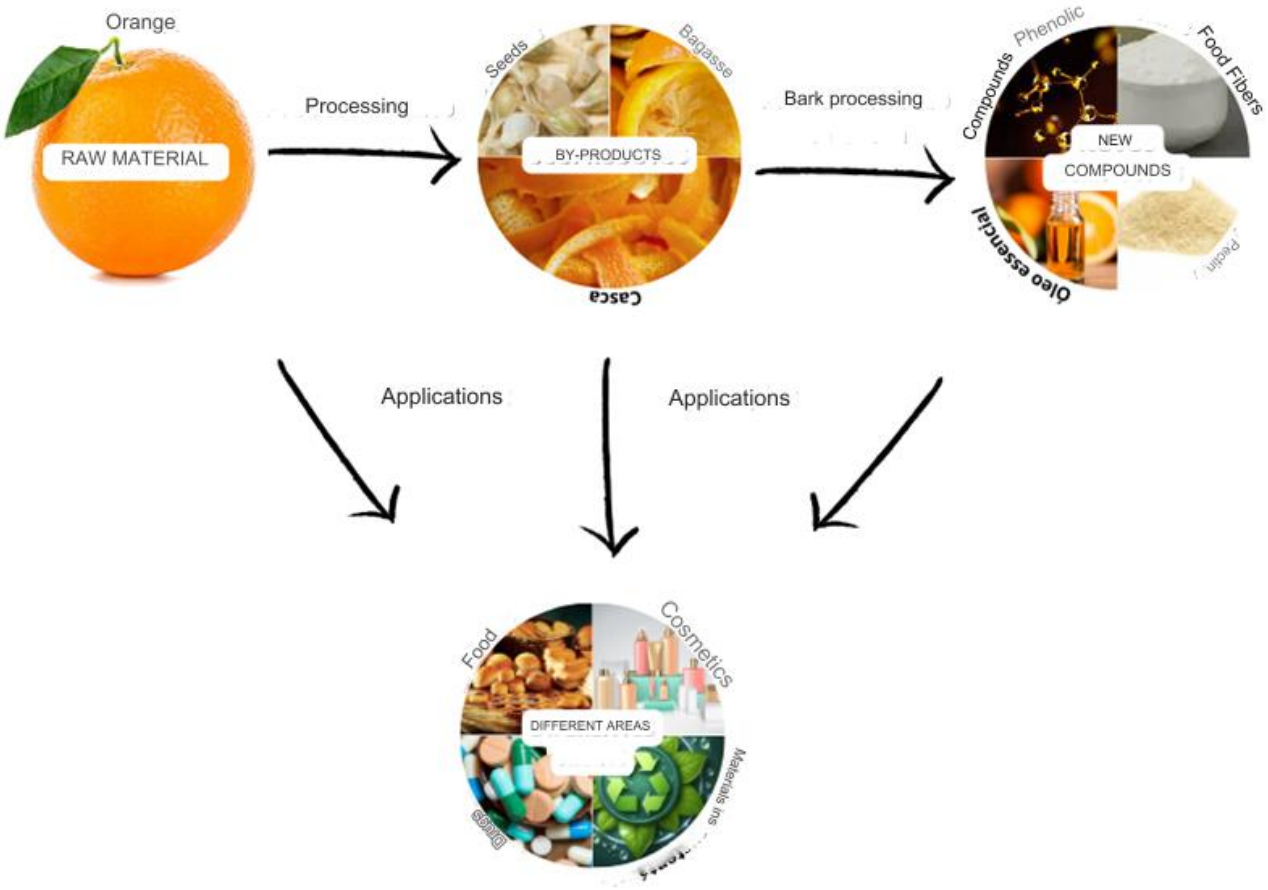
Terrestrial and water pollution resulting from the generation of agricultural waste have become a worldwide concern. The search for intelligent solutions to manage and eliminate these products has been the subject of much research. Orange peel waste has aroused considerable interest due to the extensive global production of oranges, of which a significant portion is transformed into juice, which ends up producing a large volume of waste (Fehlberg *et al.*, 2023).

One of the essential pillars for the conservation of natural resources is the Circular Economy (CE). EC promotes sustainability by focusing on eliminating waste and continuously reusing materials. This approach integrates by-products and waste back into the production chain, reducing waste production and reducing environmental impact. Upcycling, a key component of this approach, involves turning waste materials into new, higher-value products. Therefore, to reduce the environmental impact of food waste management, such as orange waste, and promote an approach based on the circular economy, treatments that aim to reuse by-products in the generation of new value-added products must be implemented (Capelleveen *et al*., 2023; Atinafu *et al*., 2024; Fraia *et al*., 2024).

The citrus fruit processing sector is generally segmented into four main stages: transportation of the harvested fruits to the processing plant; washing, sorting, and grading; extraction of the juice with subsequent heat treatment; and final packaging. After obtaining the juice, a significant amount of solid and liquid waste is generated, including peels, seeds, bagasse, and wastewater. These

residues, especially the bark, can be reused as a potential substrate to obtain various high value-added products (Figure 1) (Panwar *et al*., 2021).

Figure 1 – Applications of orange waste, especially peel, in different areas.



Source: Author (2024)

Orange peel waste has a diverse composition, including approximately 75-85% water, 6-8% mono- and disaccharides, such as sucrose, glucose, and fructose, 1.5-3% polysaccharides, such as pectin, cellulose, and hemicellulose, and 0.5-1.5% organic acids, such as citric acid and malic acid. In addition, they are rich in important antioxidants such as polyphenols and carotenoids, and contain significant amounts of trace elements such as zinc and magnesium. With a pH generally between 3 and 5, and a marked presence of essential oils, mainly limonene, these residues offer a wide range of applications after extraction by different methods (Bouaita *et al*., 2022; Pagliarini *et al*., 2024; Krivošija *et al*., 2023).

ORANGE PEEL IN THE PRODUCTION OF BIOFILMS

Orange peel waste is usually converted into citrus pulp pellets for livestock feed or disposed of in landfills. Innovative ways of using this waste have led to the exploration of its integration into plastics to add value to waste, while reducing the source of plastic and improving its properties (Fehlberg *et al.*, 2023).

McKay *et al*. (2021) and Fehlberg *et al*. (2023), reported the use of orange peel powder for the production of films for food packaging. The peels, after being collected, were freeze-dried, ground in a hammer mill, sifted and incorporated into the production of a film.

McKay *et al*. (2021) produced, from sweet orange peel powder (*Citrus sinensis* var. Valencia), a linear low-density polyethylene plastic film, insulated, and combined with the orange peel powder through the thermohydraulic press. The same type of orange and polyethylene were used by Fehlberg *et al*. (2023) for the production of plastics combined with powder in different concentrations. The process used by them was the extrusion of blown film.

McKay *et al*. (2021) evaluated the antimicrobial efficacy of plastic obtained from orange peel residues against fungi often found in food. Orange peel powder, alone, showed good results in inhibiting the growth of *Botrytis cinerea*, *Aspergillus niger* and *Penicillium* sp. However, when incorporated into the film, the antimicrobial activity was maintained only against *B. cinerea*, although with lower efficacy when compared to the isolated powder. This decrease in efficacy is attributed to the partial loss of antimicrobial compounds, such as limonene and citral, during film processing.

Additionally, Fehlberg *et al*. (2023) conducted an analysis addressing the morphology of the blown film biocomposite, along with its mechanical, barrier, optical, and thermal properties, in order to determine the maximum amount of orange peel powder that could be incorporated into the plastic. The results indicated that it is feasible to incorporate up to 11.5% orange peel powder in the composition of the plastic. Thus, the reincorporation of orange peel as a raw material in the packaging production process also offers a valuable opportunity to promote the circular economy.

ORANGE PEEL IN BAKING

In food products, residues can add significant nutritional properties. Orange peel has a high content of bioactive compounds and dietary fibers that offer several health benefits. By including orange peel powder in baked goods, manufacturers can develop more nutritious foods, improve their health-promoting properties (Talens *et al*., 2022), and at the same time decrease waste (Gasparre *et al.,* 2024).

According to Cirrincione *et al*. (2024), orange peels are used to produce flours, encapsulated essential oil, encapsulated extract, and fibers. Orange peel flours are used in the production of bread, cookies and cakes; encapsulated essential oil is used in cakes; the encapsulated extracts are applied to brownies; and the fibers are incorporated into muffins.

Gasparre *et al.* (2024) studied the use of orange peel by-products in the baking of gluten-free flatbreads. The replacement of traditional flours with orange peel powder resulted in doughs rich in fats, minerals and fiber, with an intense yellow color and good water retention. As a result, the waste

has shown great potential as a nutritional and technological improver, promoting sustainability and offering an economical alternative to gluten-free breads. However, sensory analyses were not performed to assess consumer acceptance.

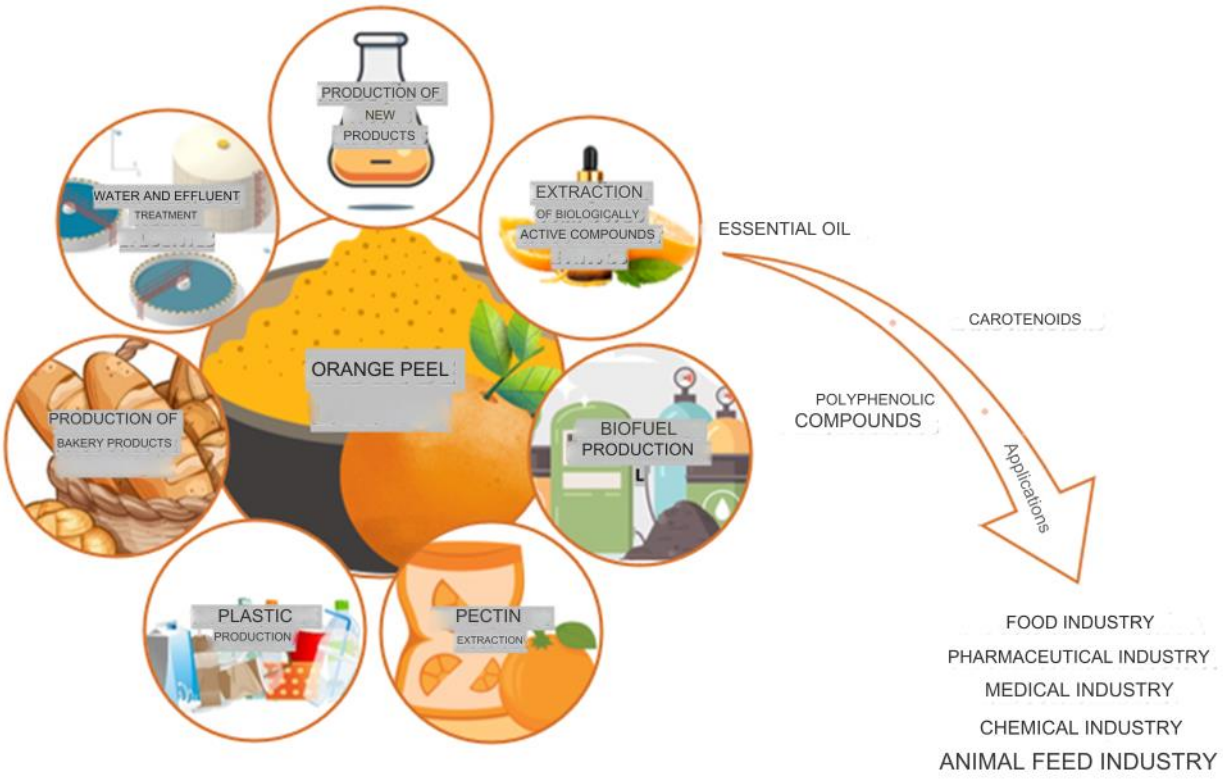
Although orange by-products improve the nutritional quality of baked goods by providing fiber, antioxidants, polyphenols, and essential oils, sensory attributes can be adversely affected. Cirrincione *et al*. (2024) point out that the addition of these by-products in larger quantities can alter the sensory characteristics of the food, resulting in less acceptance by consumers.

ORANGE PEEL IN OBTAINING BIOLOGICALLY ACTIVE COMPOUNDS

Industrially, the bioactive compounds present in orange powder extracts are widely studied and used.

Polyphenolic compounds, carotenoids, and essential oil of orange peel are the constituents that stand out for their beneficial effects on health (Figure 2). The aroma of orange peel essential oil is a result of some of its components, alcohols, aldehydes, esters, ketones and terpene hydrocarbons. Limonene, a terpenoid, is identified as the main component of the oil, however, other compounds, such as citronellal, geranial, linalool, octanal, and α-terpineol, are also present, albeit in lower concentrations (Krivošija *et al*., 2023).

Figure 2 – Possibilities of products obtained from orange peel with a focus on biologically active compounds.



Source: Author (2024)

Several terpenoids, such as limonene, are volatile at room temperature and contribute to the characteristic aroma of plants and fruits (Ritika *et al*., 2024). On the other hand, phenolic compounds are mostly responsible for the antioxidant activity of the fruit (Wang *et al*., 2023). The extraction of these compounds from the fruit peel for incorporation into pharmaceuticals must be strictly controlled to ensure the stability of the bioactive components.

Several techniques have been employed to extract phenolic compounds from citrus fruit peels. These include conventional solvent extraction, enzyme-assisted extraction, accelerated solvent extraction, microwave-assisted extraction, supercritical water extraction, supercritical fluid extraction, and ultrasound-assisted extraction (Wang *et al*., 2023). To obtain the essential oil, the methods include mechanical extraction through cold pressing, thermal methods with water or steam, such as steam distillation, microwave-assisted thermal extraction, ultrasonic extraction, extraction with supercritical CO2, and biosolvents (Teigiserova *et al*., 2021) (Table 1). However, it is crucial to note that while all of these methods enable product recovery, they can also lead to degradation of bioactive components due to heat, long extraction times, limitations in mass transfer, resistance, enzymatic denaturation, and high technical and cost requirements (Wang *et al*., 2023).

Table 1 – Main methods used to obtain biologically active compounds from orange peel.

Methods	Compounds			References
	Polyphenols	Carotenoids	Essential oil	
Ultrasound-assisted extraction	X	X	X	Wang *et al*. (2023) Teigiserova *et al*. (2021) Murador *et al*. (2019) Krivošija *et al*. (2023)
Extraction with supercritical carbon dioxide at high pressure	X	X	X	Krivošija *et al*. (2023) Teigiserova *et al*. (2021) Murador *et al*. (2019)
Enzyme-assisted extraction	X			Wang *et al*. (2023)
Conventional solvent or biosolvent extraction	X	X	X	Wang *et al*. (2023) Gómez-Mejía *et al*. (2019) Murador *et al*. (2019) Myrtsi *et al*. (2022) Teigiserova *et al*. (2021)
Microwave-assisted extraction			X	Teigiserova *et al*. (2021)
Mechanical extraction - cold pressing			X	Teigiserova *et al*. (2021)
Ionic liquid extraction		X		Murador *et al*. (2019)
Thermal extraction with water or steam		X	X	Teigiserova *et al*. (2021) Myrtsi *et al*. (2022)

Source: Author (2024)

Terpenoids are widely used in ethnomedicinal and herbal practices due to their aromatic properties. In addition, they have antibacterial activity against certain foodborne bacteria, such as *Escherichia coli*, *Staphylococcus aureus,* and *Salmonella typhimurium*, revealing great anti-biofilm

potential (Ritika *et al*., 2024). Limonene, for example, can be used in a variety of applications in the food, pharmaceutical, and medical industries, serving as a green solvent, natural insecticide, and chemopreventive agent with anticancer properties (Teigiserova *et al*., 2021).

Biologically active polyphenols, such as phenolic acids and flavonoids, demonstrate antioxidant, anti-inflammatory, antiproliferative, antiallergic, antiviral, anticarcinogenic, neuroprotective, and antimicrobial properties. Therefore, citrus peel residues generated by the juice industry can be used in dietary supplements, as raw materials in cosmetics, and as natural additives in food and pharmaceutical products (Gómez-Mejía *et al.*, 2019).

Orange peel, in turn, can also be a valuable source of carotenoids, natural pigments that give color to fruits. Carotenoid consumption is associated with improvements in the immune system and a reduced risk of developing degenerative diseases such as cancer, cardiovascular disease, Alzheimer's, and macular degeneration (Murador *et al*., 2019). These can be incorporated into the food industry as natural colorants and nutritional food fortifiers; in the cosmetics industry, in skin care products and make-up due to their antioxidant properties; in the pharmaceutical industry in medicines, supplements and nutraceuticals; and in the animal feed industry. Extraction methods, such as microwave-assisted extraction, enzyme extraction, supercritical fluid extraction, ultrasound-assisted extraction, and pulsed electric field-assisted extraction, i.e., green extraction technologies, can be utilized to achieve high carotenoid recovery rates (Myrtsi *et al*., 2022; Silva *et al*., 2024; Gebregziabher *et al*., 2023). It is observed, therefore, that orange peel is a rich source of bioactive compounds, with the potential to be used in the manufacture of various biochemical products.

ORANGE PEEL IN OBTAINING PECTIN

Pectin, a complex carbohydrate, is widely used by the food industry in a variety of applications. It performs essential functions as a gelling agent, emulsifier, stabilizer, and thickener. In the bakery industry, pectin is employed to improve the texture of products, while in confectionery, it is essential in the preparation of fillings and fruit-based products such as jams. In beverages, pectin is able to stabilize and improve the texture of fruit juices and other fruit-based beverages. In addition, pectin is also used in the manufacture of packaging, evidencing its versatility and importance in the food sector (Silva *et al*., 2024; Castro *et al*., 2024).

About 85% of commercial pectin is extracted from the residues of citrus peels, such as lemon, grapefruit, and orange. These peels contain between 1.5% and 18% pectin, depending on whether they are fresh or dried (Suri *et al*., 2022). Pectin not only has valuable technological properties, but also biological benefits. This acts as an essential dietary fiber that promotes the individual's gastrointestinal health. Such action reduces cholesterol and protects the body against different diseases, such as diabetes and cancer (Silva *et al*., 2024).

Orange peel is a particularly rich source of pectin, accounting for about 28% of its dry weight. Extraction methods such as acid extraction, enzymatic hydrolysis, microwave-assisted extraction, and ultrasound are used to obtain pectin from orange peel (Silva *et al*., 2024).

Agricultural by-products are rich in bioactive compounds, but these compounds are unstable under environmental and industrial conditions. Microencapsulation is a technology that can protect these compounds, forming capsules of micrometric to millimeter size. Different encapsulating materials, such as polysaccharides, lipids, and proteins, have been used (Comunian *et al*., 2021). Kaderides *et al*. (2019) used orange residue powder to encapsulate pomegranate peel extract, obtaining high efficiency (99.77%) and a yield of 12.99%, lower than when compared to traditional materials.

Pectin, extracted from orange peel, can also be used as a gelling agent, meeting the demand for natural ingredients in the food industry. Li *et al*. (2024) showed that orange peel suspensions, ground for more than 60 minutes in a stirred mill, form hydrogels. This suggests that milling may improve the utilization of orange peel as a functional ingredient due to the high-methoxyl pectin.

Another application of pectin extraction is described in the work of Manthei *et al*. (2024), in which, from orange peel and apple pomace, they extracted by high-pressure homogenization and enzymatic hydrolysis, large quantities of oligosaccharides with potential uses as a prebiotic.

ORANGE PEEL IN OBTAINING BIOFUELS

Fossil fuels, such as coal, oil, and methane, are the world's main sources of energy, but their non-renewable nature leads to scarcity and contributes to global warming. The increasing demand for energy due to industrialization and population growth, highlights the urgent need for renewable and sustainable sources. The production of biofuels from biomass is a promising solution, as it offers an efficient and ecological alternative that can reduce dependence on fossil fuels and consequently protect the environment (Kariim *et al*., 2024; Viswanathan *et al*., 2022).

Orange peel is high in carbon and contains large amounts of complex sugars such as cellulose, lignin, and hemicellulose. These components can be converted into soluble sugars through the use of enzymes or hydrolysis techniques with dilute acid. Thus, a viable option to value this waste is to produce biofuels, such as biodiesel, bioethanol and biogas (Kariim *et al.*, 2024).

According to Mawlid *et al*. (2024), orange peel powder was used to produce hydrochar (carbonaceous material) through hydrothermal carbonization. This activated hydrocarbon was then functionalized with potassium carbonate (K2CO3) to generate a heterogeneous catalyst. The catalyst was used in the transesterification reaction of a residual frying oil, which resulted in the production of biodiesel. The process demonstrated the effectiveness of functionalized orange peel hydrochar as a

catalyst in the conversion of waste oils into biofuel, highlighting a sustainable and innovative approach to the use of plant waste.

On the other hand, Viswanathan *et al*. (2022) used orange peels as a raw material for the manufacture of biofuel. Bitter orange oil, obtained through steam distillation, was the main source used in the production of biodiesel. The results of the study demonstrated that this biofuel can be a renewable low-viscosity option, suitable for engines, providing low emissions and contributing to a more sustainable and cleaner environment.

In addition, fruit and vegetable residues, as well as other raw materials rich in natural sugars and cellulosic biomass, are also used for the production of bioethanol. The process of producing bioethanol from agro-waste involves steps such as pre-treatment, enzymatic hydrolysis, fermentation and distillation. Mishra *et al*. (2022) demonstrated that orange, banana and pineapple peel residues can be fermented with immobilized microorganisms under various conditions, which leads to efficient bioethanol production.

Orange peel waste can also be used in the production of biogas (Sanchez *et al*., 2023). Although the D-limonene present in the essential oil of the peels acts as an inhibitor in anaerobic digestion, Bouaita *et al*. (2022) demonstrated that, under controlled conditions, the anaerobic digestion of orange peel waste is efficient in generating biogas. Even with the high content of limonene, an antimicrobial agent, the researchers found that by maintaining a low concentration of this substance in the anaerobic digester, inhibition of the process can be avoided. To achieve this goal, they performed anaerobic co-digestion of the orange peels with the organic fraction of municipal solid waste, which helped dilute the D-limonene in the organic mixture (Bouaita *et al*., 2022). Therefore, orange peel is a promising waste for the generation of renewable energy sources.

ORANGE PEEL IN WATER AND WASTEWATER TREATMENT

Adsorption is widely used to remove drugs, dyes, and heavy metals from wastewater. This process is fast, economical, simple and highly effective. Currently, researchers are focused on the development of bioadsorbents made from waste for the treatment of water and effluents. The choice for bioadsorbents is justified by their low production cost, availability, ease of handling, possibility of regeneration, and respect for the environment (Khalfaoui *et al*., 2024).

Gao *et al*. (2024) developed an adsorbent aerogel from orange peel waste combined with amino MXene, a two-dimensional inorganic compound, with the aim of removing heavy metals from effluents. The results indicated that this material had excellent adsorption properties for pentavalent vanadium in water, reaching a maximum adsorption capacity of 748.42 mg/g at a pH of 4.

Khalfaoui *et al.* (2024) synthesized two bioadsorbents from artichoke leaves and orange peel residues treated with zinc chloride (ZnCl2). These materials were evaluated under different operating

conditions for the adsorption of ketoprofen, a non-steroidal anti-inflammatory drug, in water. The results showed that the adsorption capacity of the orange peel and artichoke leaf bioadsorbents reached 96% and 90%, respectively, with adsorption capacities of 1,937 mg/g and 1,803 mg/g. Thus, these bioadsorbents have been shown to be effective for the treatment and removal of medications, such as ketoprofen, from wastewater.

Roy et al. (2024) described another efficient application of waste. They developed an interfacial solar steam generator using charred orange peel to desalinate ocean water and produce fresh water. The resulting three-dimensional photothermal material demonstrated an evaporation rate of 1.86 kg m−2 h−1 and an energy efficiency of 87.90% under a solar irradiation of 1 kW/m². In addition, the system achieved a salt rejection rate of 99.99% during desalination and a complete removal of dyes during water purification. This solar evaporator has proven to be an efficient and low-cost solution for interfacial solar vapor generation, highlighting the potential of biological waste as effective photothermal materials.

ORANGE PEEL IN THE MANUFACTURE OF NEW CHEMICALS

Orange peel waste, important by-products of biomass resulting from juice manufacturing, can be harnessed as a valuable resource for the production of a variety of chemicals (Allegri *et al*., 2024).

Allegri *et al*. (2024) presented a catalytic process that involved the dehydrogenation of limonene to p-cymene and subsequent hydrogenation by catalytic transfer of methyl levulinate to γ-valerolactone. This solvent, which is non-toxic and bio-based, has gained attention as an important precursor in industrial chemistry.

In addition, Qamar *et al*. (2023) reviewed the use of cost-effective materials, such as industrial and household waste, in the production of biosurfactants, highlighting their ability to replace expensive synthetic materials. Food waste and agro-industrial by-products, such as sugarcane bagasse, cassava wastewater, rice straw, banana stalks, corn cobs, and fruit peels, were investigated as efficient substrates. Orange peel, used as a substrate for *Bacillus licheniformis*, has shown potential in the production of lipopeptides applicable in the biodegradation of hydrocarbons.

Another application of the residue was described by Ousaadi *et al*. (2021), in which they demonstrated that orange peel can be used in the production of α-amylase by *Streptomyces* sp. Microbial enzymes, which are widely used in various industries such as textiles, bakery, alcohol manufacturing, and detergents, are expensive when produced with synthetic media. In the study, the researchers demonstrated that orange peel, an economical and available agricultural waste, can replace these expensive means. The research optimized the cultivation conditions of *Streptomyces* sp., using orange peel as the only source of carbon in low-cost media, confirming the viability of agricultural residues as growth substrates.

CONCLUSION

This updated review explores the growing interest in the use of orange peel by-products, mainly from the juice industry, and highlights the variety of value-added products that can be derived from these wastes. The industrial application of orange peel is promising in several areas due to its abundance and the richness of valuable components, such as fermentable sugars and bioactive compounds.

Orange peel has been extensively studied and used in the production of a wide range of bioproducts in the food and biotechnology industries. Through different methodologies, it is possible to transform this waste into valuable products, including essential oils, pectin, biofuels, chemicals, adsorbent materials, biologically active compounds, bakery products, and plastics.

These products not only represent a sustainable and cost-effective approach to waste management, but also offer environmental and economic benefits to the establishments that adopt them. In addition, the use of orange peel waste helps to mitigate the negative environmental impacts associated with improper waste disposal, promoting sustainability and the circular economy.

REFERENCES

1. Allegri, A., Paone, E., Bosticco, C., Pedullà, A., Musolino, M. G., Cavani, F., Tabanelli, T., & Albonetti, S. (2024). Tandem reductive catalytic upgrading of orange peel waste derived methyl levulinate and limonene into γ-valerolactone and p-cymene promoted by Pd/ZrO2 and ZrO2 catalysts. *Molecular Catalysis*, 555. https://doi.org/10.1016/j.mcat.2024.113840

2. Atinafu, D. G., Choi, J. Y., Kang, Y., Nam, J., & Kim, S. (2024). Thermochemical transformation of biowaste for encapsulation technology and enabling a circular economy. *Trends in Food Science & Technology*, 147. https://doi.org/10.1016/j.tifs.2024.104468

3. Bouaita, R., Derbal, K., Panico, A., Iasimone, F., Pontoni, L., Fabbricino, M., & Pirozzi, F. (2022). Methane production from anaerobic co-digestion of orange peel waste and organic fraction of municipal solid waste in batch and semi-continuous reactors. *Biomass and Bioenergy*, 160. https://doi.org/10.1016/j.biombioe.2022.106421

4. Capelleveen, G. V., Vegter, D., Olthaar, M., & Hillegersberg, J. V. (2023). The anatomy of a passport for the circular economy: A conceptual definition, vision and structured literature review. *Resources, Conservation & Recycling Advances*, 17. https://doi.org/10.1016/j.rcradv.2023.200131

5. Castro, S. C. de, Barbosa, J. C. J., Teixeira, B. S., Fill, T. P., & Tasic, L. (2024). Investigation of pectin deficiency in modulating the bioflavonoid profile of orange processing waste: A sustainable valorization of industrial waste. *Food Chemistry: X*, 22. https://doi.org/10.1016/j.fochx.2024.101326

6. Cirrincione, F., Ferranti, P., Ferrara, A., & Romano, A. (2024). A critical evaluation on the valorization strategies to reduce and reuse orange waste in the bakery industry. *Food Research International*, 187. https://doi.org/10.1016/j.foodres.2024.114422

7. Comunian, T. A., Silva, M. P., & Souza, C. J. F. (2021). The use of food by-products as a novel for functional foods: Their use as ingredients and for the encapsulation process. *Trends in Food Science & Technology*, 108, 269-280. https://doi.org/10.1016/j.tifs.2021.01.003

8. Dongre, P., Doifode, C., Choudhary, S., & Sharma, N. (2023). Botanical description, chemical composition, traditional uses and pharmacology of Citrus sinensis: An updated review. *Pharmacological Research - Modern Chinese Medicine*, 8. https://doi.org/10.1016/j.prmcm.2023.100272

9. Fehlberg, J., McKay, S., Matuana, L. M., & Almenar, E. (2023). Use of orange juice processing waste to produce films using blown film extrusion for food packaging. *Journal of Food Engineering*, 341. https://doi.org/10.1016/j.jfoodeng.2022.111337

10. Ferreira, T. V., Mizuta, A. G., Menezes, J. L. de, Dutra, T. V., Bonin, E., Castro, J. C., Szczerepa, M. M. dos A., Pilau, E. J., Nakamura, C. V., Mikcha, J. M. G., & Filho, B. A. de A. (2020). Effect of ultraviolet treatment (UV–C) combined with nisin on industrialized orange juice in Alicyclobacillus acidoterrestris spores. *LWT*, 133. https://doi.org/10.1016/j.lwt.2020.109911

11. Fraia, S. D., Sharmila, V. G., Banu, J. R., & Massarotti, N. (2024). A comprehensive review on upcycling of food waste into value-added products towards a circular economy: Holistic approaches and life cycle assessments. *Trends in Food Science & Technology*, 143. https://doi.org/10.1016/j.tifs.2023.104288

12. Gao, F., Qiu, Z., Hou, Y., You, Y., Lv, X., & Dang, J. (2024). Novel aerogel of aminated MXene composite orange peel biomass for ultra-high capacity of V(V) adsorption. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 697. https://doi.org/10.1016/j.colsurfa.2024.134472

13. Gasparre, N., Garzon, R., Marín, K., & Rosell, C. M. (2024). Exploring the integration of orange peel for sustainable gluten-free flatbread making. *LWT*, 198. https://doi.org/10.1016/j.lwt.2024.115969

14. Gebregziabher, B. S., Gebremeskel, H., Debesa, B., Ayalneh, D., Mitiku, T., Wendwessen, T., Habtemariam, E., Nur, S., & Getachew, T. (2023). Carotenoids: Dietary sources, health functions, biofortification, marketing trend and affecting factors – A review. *Journal of Agriculture and Food Research*, 14. https://doi.org/10.1016/j.jafr.2023.100834

15. Gómez-Mejía, E., Rosales-Conrado, N., León-González, M. E., & Madrid, Y. (2019). Citrus peels waste as a source of value-added compounds: Extraction and quantification of bioactive polyphenols. *Food Chemistry*, 295, 289-299. https://doi.org/10.1016/j.foodchem.2019.05.136

16. Gupta, A. K., Dhua, S., Pratiksha, Kumar, V., Naik, B., Magwaza, L. S., Ncama, K., Opara, U. L., McClements, D. J., & Mishra, P. (2023). Current and emerging applications in detection and removal of bitter compounds in citrus fruit juice: A critical review. *Food Bioscience*, 55. https://doi.org/10.1016/j.fbio.2023.102995

17. Kaderides, K., & Goula, A. M. (2019). Encapsulation of pomegranate peel extract with a new carrier material from orange juice by-products. *Journal of Food Engineering*, 253, 1-13. https://doi.org/10.1016/j.jfoodeng.2019.02.019

18. Kariim, I., Park, J. Y., Kazmi, W. W., Swai, H., Lee, I. G., & Kivevele, T. (2024). Solvothermal liquefaction of orange peels into biocrude: An experimental investigation of biocrude yield and energy compositional dependency on process variables. *Bioresource Technology*, 391. https://doi.org/10.1016/j.biortech.2023.129928

19. Khalfaoui, A., Benalia, A., Laggoun, Z., Bouchareb, R., Zaamta, I., Melloul, R., Menasria, A., Merouani, S., Pizzi, A., & Derbal, K. (2024). Effective synthesis and application of artichoke and orange peels-based bio-sorbents for Ketoprofen removal from wastewater: Process optimization using factorial methodology. *Desalination and Water Treatment*, 317. https://doi.org/10.1016/j.dwt.2024.100197

20. Krivošija, S., Jerković, I., Nastić, N., Zloh, M., Jokić, S., Banožić, M., Aladić, K., & Vidović, S. (2023). Green pathway for utilisation of orange peel dust and in silico evaluation of pharmacological potential. *Microchemical Journal*, 193. https://doi.org/10.1016/j.microc.2023.109132

21. Li, C., McClements, D. J., Taotao Dai, T., Jiang, D., Deng, L., Liu, C., & Chen, J. (2024). Improving food sustainability by converting orange peel waste products into hydrogels using stirred media milling. *Journal of Food Engineering*, 366. https://doi.org/10.1016/j.jfoodeng.2023.111813

22. Manthei, A., Elez-Martínez, P., Soliva-Fortuny, R., & Murciano-Martínez, P. (2024). Prebiotic potential of pectin and cello-oligosaccharides from apple bagasse and orange peel produced by high-pressure homogenization and enzymatic hydrolysis. *Food Chemistry*, 435. https://doi.org/10.1016/j.foodchem.2023.137583

23. Mawlid, O. A., Abdelhady, H. H., El-Moghny, M. G. A., Hamada, A., Abdelnaby, F., Kased, M., Al-Bajouri, S., Elbohy, R. A., & El-Deab, M. S. (2024). Clean approach for catalytic biodiesel production from waste frying oil utilizing K2CO3/orange peel derived hydrochar via RSM optimization. *Journal of Cleaner Production*, 442. https://doi.org/10.1016/j.jclepro.2024.140947

24. McKay, S., Sawant, P., Fehlberg, J., & Almenar, E. (2021). Antimicrobial activity of orange juice processing waste in powder form and its suitability to produce antimicrobial packaging. *Waste Management*, 120, 230-239. https://doi.org/10.1016/j.wasman.2020.11.048

25. Mishra, K., Rathore, M., Tickoo, J., & Singh, A. K. (2022). Production of bioethanol from fruit waste. *Materials Today: Proceedings*, 68, 1167-1171. https://doi.org/10.1016/j.matpr.2022.09.324

26. Murador, D. C., Salafia, F., Zoccali, M., Martins, P. L. G., Ferreira, A. G., Dugo, P., Mondello, L., De Rosso, V. V., & Giuffrida, D. (2019). Abordagens de extração verde para carotenóides e ésteres: caracterização da composição nativa da casca de laranja. *Antioxidantes*, 8. https://doi.org/10.3390/antiox8120613

27. Myrtsi, E. D., Koulouceri, S. D., Evergetis, E., & Haroutounian, S. A. (2022). Agro-industrial co-products upcycling: Recovery of carotenoids and fine chemicals from Citrus sp. juice industry co-products. *Industrial Crops and Products*, 186. https://doi.org/10.1016/j.indcrop.2022.115190

28. Ousaadi, M. I., Merouane, F., Berkani, M., Almomani, F., Vasseghian, Y., & Kitouni, M. (2021). Valorization and optimization of agro-industrial orange waste for the production of enzyme by halophilic Streptomyces sp. *Environmental Research*, 201. https://doi.org/10.1016/j.envres.2021.111494

29. Pagliarini, E., Minichiello, C., Sisti, L., Totaro, G., Baffoni, L., Gioia, D. D., & Saccani, A. (2024). From food waste to eco-friendly functionalized polymer composites: Investigation of orange peels as active filler. *New Biotechnology*, 80, 37-45. https://doi.org/10.1016/j.nbt.2024.01.001

30. Pan, X., Bi, S., Lao, F., & Wu, J. (2023). Factors affecting aroma compounds in orange juice and their sensory perception: A review. *Food Research International*, 169. https://doi.org/10.1016/j.foodres.2023.112835

31. Panwar, D., Saini, A., Panesar, P. S., & Chopra, H. K. (2021). Unraveling the scientific perspectives of citrus by-products utilization: Progress towards circular economy. *Trends in Food Science & Technology*, 111, 549-562. https://doi.org/10.1016/j.tifs.2021.03.018

32. Qamar, S. A., & Pacifico, S. (2023). Cleaner production of biosurfactants via bio-waste valorization: A comprehensive review of characteristics, challenges, and opportunities in bio-sector applications. *Journal of Environmental Chemical Engineering*, 11. https://doi.org/10.1016/j.jece.2023.111555

33. Ritika, Rizwana, Shukla, S., Sondhi, A., Tripathi, A. D., Lee, J. K., Patel, S. K. S., & Agarwal, A. (2024). Valorisation of fruit waste for harnessing the bioactive compounds and its therapeutic application. *Trends in Food Science & Technology*, 144. https://doi.org/10.1016/j.tifs.2023.104302

34. Roy, A., Tariq, M. Z., La, M., Choi, D., & Park, S. J. (2024). 3D carbonized orange peel: A self-floating solar absorber for efficient water evaporation. *Desalination*, 573. https://doi.org/10.1016/j.desal.2023.117191

35. Sanchez, M. O., Omarini, A. B., Aguirre, J. A. G., Baglioni, M., Zygadlo, J. A., Breccia, J., D'Souza, R., Lemesoff, L., Bodeain, M., Alzate, C. A. C., Pejchinovski, I., & Lahore, M. H. F. (2023). Valorization routes of citrus waste in the orange value chain through the biorefinery concept: The Argentina case study. *Chemical Engineering and Processing - Process Intensification*, 189. https://doi.org/10.1016/j.cep.2023.109407

36. Silva, C. N. da, Almeida, L. M. P. de, Lemes, A. C., & Ribeiro, B. D. (2024). Citrus by-products valorization using deep eutectic solvents – A review. *Food Bioscience*, 60. https://doi.org/10.1016/j.fbio.2024.104446

37. Suri, S., Singh, A., & Nema, P. K. (2022). Current applications of citrus fruit processing waste: A scientific outlook. *Applied Food Research*, 2. https://doi.org/10.1016/j.afres.2022.100050

38. Talens, C., Rios, Y., Alvarez-Sabatel, S., Ibargüen, M., & Rodríguez, R. (2022). Designing nutritious and sustainable biscuits using upcycled fibre-rich ingredients obtained by hot air - microwave drying of orange by-products. *Plant Foods for Human Nutrition*, 77, 271–278. https://doi.org/10.1007/s11130-022-00972-5

39. Teigiserova, D. A., Tiruta-Barna, L., Ahmadi, A., Hamelin, L., & Thomsen, M. (2021). A step closer to circular bioeconomy for citrus peel waste: A review of yields and technologies for sustainable management of essential oils. *Journal of Environmental Management*, 280. https://doi.org/10.1016/j.jenvman.2020.111832

40. Viswanathan, K., Taipabu, M. I., & Wu, W. (2022). Novel Petit grain bitter orange waste peel oil biofuel investigation in diesel engine with modified fuel injection pressure and bowl geometry. *Fuel*, 319. https://doi.org/10.1016/j.fuel.2022.123660

41. Wang, Z., Mei, X., Chen, X., Rao, S., Ju, T., Li, J., & Yang, Z. (2023). Extraction and recovery of bioactive soluble phenolic compounds from brocade orange (Citrus sinensis) peels: Effect of different extraction methods thereon. *LWT*, 173. https://doi.org/10.1016/j.lwt.2022.114337

Seeing, hearing, feeling and acting: Brazil and the SUS from the perspective of medical students

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ABSTRACT

Despite the progress in primary care coverage, the Unified Health System faces the challenges of guaranteeing health care in a country of continental dimensions marked by significant social inequality. Based on the above, medical students carried out a qualitative study that aimed to broaden the view of primary care and the practice of semiology in a different scenario from that experienced in Brazilian medical schools, expanding the horizons of medical education to other social realities. Three families from the municipality of São Benedito do Sul, recognized for having a low human development index and being an endemic area for neglected diseases, were randomly selected. Sociodemographic and clinical data were obtained through anamnesis, physical examination, capillary glucose collection and electrocardiogram, the latter for screening for Chagas disease. Future doctors were able to see, hear and feel the reality of a portion of the population that is on the margins of public policies. The need to reformulate the medical curriculum to deal with this reality was evidenced, based on the teaching of the values of clinical examination and alternative medicine based on the use of natural resources to modify this situation.

Keywords: Health Systems, Collective Health, Primary Care, Complementary Medicine, Socioeconomic Factors.

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INTRODUCTION

In the face of the devastating socioeconomic situation of the 1980s, several movements highlighted the need to look at the human being in its entirety. In this scenario, the Health Reform emerged in Brazil, through comprehensive action to health and not only to care care, which became ensured by the Federal Constitution of 1988, through Law 8.080, of 19901. The welfare model, previously intended for a small portion of Social Security contributors, was replaced by one of the largest and most complex public health systems in the world: the Unified Health System (SUS). Meanwhile, the world scenario also turned to the indivisibility of the being as a member of a community, which can be evidenced in the International Conference on Primary Health Care in Alma Ata, in 1978 and, decades later, ratified in the sustainable development proposed by the World Health Organization through the 2030 Agenda2, 3.

However, public initiatives aimed at health coverage are still permeated by stigmas. As a result of this, it was found that, in 2019, among SUS users, 64.7% had a per capita household income of less than 1 minimum wage and 32.4% were in the range of 1 to 3 minimum wages at the time4. This population, exposed to the most diverse forms of vulnerability, needs social assistance focused on objective and subjective issues, which are not always guaranteed, although guaranteed by law5, 6. The Family Health Strategies (FHS) gradually achieved greater coverage of Primary Health Care, which represented an increase from 50.9% in 2008 to 53.4% in 20137. However, in a continental and heterogeneous country, care occurs differently, depending on the regions, so that there is a greater deficit in territories in more unfavorable situations and isolated from urban centers8.

The relationship between socioeconomic conditions and access to health care in poor Brazilian areas remains a dilemma to be explored, especially with regard to food security, quality of life, and family planning, a fact that requires a greater analysis of the reality experienced by this population. In order to better clarify this scenario, which is very little scientifically addressed, and to exercise the power of clinical examination and intervention focused on the local reality, medical students from the University of Pernambuco sought to broaden their view of primary care in a municipality in the state, São Benedito do Sul, considered to have a low human development index (HDI) and being recognized as an endemic area of neglected diseases.

METHODS

The idealization of the study began with an extension project of the Faculty of Medical Sciences of the University of Pernambuco, which aimed to carry out medical consultations with some families in a municipality considered to be in need in the state of Pernambuco. The municipality of São Benedito do Sul was chosen because it has a low human development index, because it is recognized by the state of Pernambuco as a vulnerable municipality, which is home to

part of the rural endemic diseases, and because it is a place previously visited by the project's advisor in the active search for patients with Chagas disease9. The vulnerability of the municipality, composed of 16,069 inhabitants10, of which 48.66% live in rural areas, can be seen in data from the SNIS (National Sanitation Information System), according to which of the total population of the municipality, 55.68% do not have water supply. That is, 44.32% of the total population of São Benedito do Sul has access to water supply services, while the average for the state of Pernambuco is 81.68% and for Brazil it is 83.96%.

A community health agent in the municipality was instructed to select ten families that she considered most vulnerable. Of the ten families, three were randomly selected to be visited, in one day, by a group of twelve medical students, distributed between the fourth and ninth semesters of the undergraduate course, and a professor of Semiology at the institution, a cardiologist (Figure 1). The number of families selected to receive the visit was limited due to the difficulty of access to the residences, located in a mountain range and far from the local district. Each student received a kit to be used during the visits: official project shirt; files of interest for the clinical examination on site, as well as information on the local endemics and a booklet to record the data obtained (Figure 2).

Figure 1 – Group responsible for carrying out the visits.

Source: Own collection.

Figure 2 – Kit distributed to the participants of the experiment.

Source: Own collection.

The experience involved the sequential performance of the clinical examination with a well-directed look at the local reality, exercising the power of detailed listening (figure 3). For each family, the number of inhabitants of the household, housing conditions, family income, as well as the content of daily food, schooling, weight, height, physical examination of the systems, capillary glucose and electrocardiogram (ECG) of each member were recorded on a form. The ECG was included as a screening for Chagas heart disease, as previously planned in the mentor's project for this experience.

Figure 3 – One of the selected residences receiving the team.

Source: Own collection.

Thus, we sought to qualitatively analyze socioeconomic conditions, evaluate objective and subjective data associated with health, economy and socialization, including themes such as food security, quality of access to medical services and family planning. Next, an analysis of the literature

was carried out regarding relevant themes found in the field, and the association of these data with the reality found by the students, who were witnesses of the situation of vulnerability of the population studied.

RESULTS

The group was an eyewitness to a reality marked by socioeconomic inequality, especially with regard to health care, access to education, food security, family planning, and housing infrastructure (figure 4). In addition, a discrepancy in the focus of medical education focused on the hospital-centered model in contrast to the basic, economically viable and necessary issues to guarantee the minimum health to a completely unprotected population was evidenced.

Figure 4 – Representation of the absence of local housing infrastructure.

Source: Own collection.

The visits showed a scenario of lack of democratization of access to health, and it is important to consider certain variables when evaluating this context. The families lived in a rural environment, very far from the local district, where there were no health units to carry out periodic monitoring of their clinical condition. On the other hand, although there was no close access to Primary Care units, there was the presence of ambulances to transport them to more specialized centers, which reinforces the presence of a hospital-centered model. Thus, the care provided by a Community Health Agent (CHA) was, in an almost absolute percentage of the cases, the greatest reference for care received. Public referral hospitals were also far from the city and, in order to access more complex services, it was necessary to travel for hours or even go to the capital to receive more specific treatments, which became an obstacle to the entry of this population into these services.

From this, it is possible to notice a disparity between precepts formalized by the SUS and what is put into practice by the responsible bodies, which should ensure comprehensive, universal and equitable health care. This fact is confirmed by observing data from the 1998 National Household Sample Survey, according to which 15% of the population did not have real access to the SUS due to the scarcity of services in their neighborhood, of resources to pay for transportation, the slowness of waiting lines for care, or even the insufficient number of medical professionals11.

The analysis of the data obtained in the visits provided information on infrastructure, highlighting the fact that none of the three households visited had a bathroom, only one toilet outside the residence. The average number of rooms per household was four, all with two bedrooms, a kitchen and a living room. None of the residences had a water supply through a general distribution network. In addition, among the families visited, the use of wood stoves predominated and all households had access to electricity.

This context of poverty can be objectively analyzed by considering factors such as monthly income and dietary pattern. The daily food consumption in all the families visited was of processed foods, such as mortadella and sausage, combined with couscous, in the three food meals, commonly called "Quarenta". It is observed that this food combination and the lack of variety in its content is in disagreement with the daily recommendations for an individual according to the Food Guide for the Brazilian Population12. Despite the availability of bananas in some households, their consumption was restricted to the absence of the usual foods mentioned above. The reports also include the consumption of powdered juice and soft drinks, as well as rice, beans and chicken for lunch sporadically, when there was work that increased the family income.

The reasons for such a dietary practice involve its low cost and the lack of knowledge about nutrients and benefits linked to different types of food. The guidelines given to the families, therefore, involved restricting the consumption of ultra-processed foods and the use of products obtained from planting available on their lands.

The concept of food security was born in the 70s. Its evolution, up to the current definition, included different economic and sociocultural variables. According to the Food and Agriculture Organization of the United Nations (FAO), in a definition established at the World Food Conference (WCC) in Rome in 1996, food security occurs when all people have permanent physical, social and economic access to safe, nutritious food in sufficient quantity to satisfy their nutritional needs and food preferences, thus having an active and healthy life. According to the 2013 National Household Sample Survey (PNAD), in Brazil, 22.6% of the population lives in a situation of Food and Nutrition Insecurity (FNI). There is, therefore, difficulty in accessing adequate food, mainly due to low income. The Northeastern panorama is even more aggravating, since, according to the same survey,

the Northeast is the leader in population in the state of FNI, with a share of 38.1% of the population13.

Regarding the fertility rate, a high number of children and, consequently, family members were observed. The number of children ranged from 4 to 714. As a result, a large number of people were divided into houses with a low number of rooms and insufficient structure. Such facts are essential for a greater understanding of the integral state of communities, since it becomes difficult to raise children in precarious situations.

In a more detailed analysis of the Brazilian fertility rate, it is notorious that there are some variables, such as the urban or rural context of the population, given the difference in the average number of children per woman and in the number of members per family between these realities. In 2017/18, the average size of the urban family in Brazil was three individuals, while in the rural family, the number increased to 3,214.

From the experience obtained during the project, the medical students were able to see, hear and feel up close what the reality of many Brazilians who live in distance from health centers is like. Such individuals verge on oblivion and suffer consequences in various areas, from the sanitary to the food aspect. Thus, the students concluded that it is their role, as future doctors, to accommodate these families at the center of care, redistributing care totally directed to large hospital centers and turning care to basic, efficient and effective health care. The reflection of this segregational pattern is already seen in the data presented in the literature, such as those mentioned above, with no lack of arguments to ensure the need to expand medical care beyond large urban centers.

Some testimonies of the students who lived this experience faithfully reveal its relevance. "Having had the opportunity to see the reality of Brazil up close and see the importance of the SUS for the Brazilian people brings a new perspective to my medical practice."; "Expanding my social vision, going beyond the hospital-centric perspective that often limits the thinking of medical students, through the experience in the practice of neglected communities was, without a doubt, a very important gain to my professional and, above all, human training."; "From this experience, I was able to get to know a different reality in our country and understand the importance of fighting for a medicine that has capillarity with our population and that is not limited to a hospital-centric approach to health."**;** **"**The experience was, to say the least, unique, shocking and realistic. We know the conditions of many Brazilian "interiors" through statistical data, but seeing up close the conditions of such a vulnerable and needy population, still in graduation, is rare within the courses of large cities, such as the one where our teaching hospital is located. Many patients come from far away, but our assistance hardly reaches them. This reality is reflected in a dichotomy, in what the people we visit need to do to be healthy and what they are really able to do. This experience broadened our vision of the concept of Health Care, and made us reflect on the Medicine we must

exercise: more universal, integral and decentralized."; " From this experience, I was able to observe a completely different reality, a Brazil often forgotten by us. It was incredible to be able to experience this cut in the daily life of a vulnerable population and I am sure it enriched my training as a person and health professional in the future."; " Getting in touch with the reality of the interior of the Brazilian Northeast was enriching in my journey in medicine. Being able to help, even if in a simple way, through conversations, clarifications, advice and assistance, was unique. There is, however, more to be done."

DISCUSSION

It is worthy, therefore, to propose a reformulation of medical education and the creation of practice fields for medical students that are capable of showing the reality of the Brazilian population and, thus, reviewing the role of the SUS. The teaching model is still aimed at treating diseases and high-cost prescriptions. Even if based on the greatest evidence, it is evident that the available resources must be resized so as not to get sick and the preventive model the one with the greatest scope. Healthy food alternatives should be a major priority intervention in this continental country full of social diversity. Various alternative dietary practices should be introduced and taught on an ongoing basis to populations without access to safe food. Among them, we can mention the production of biomass, which has bananas as its main composition, a food that is very present in the daily lives of these families and that is often wasted. In addition, stimulating the consumption of Non-Conventional Food Plants (PANCS) is also presented as an alternative to be implemented.

The biomass is obtained from the pulp of unripe bananas, forming a flavorless paste that can be used in a wide variety of dishes. In addition to generating an increase in the volume of food to be consumed, ensuring greater satiety, it also incorporates fiber, minerals and vitamins to meals. Biomass has no restrictions on its use and its obtaining is simple and fast, requiring only washing the fruit, cooking, crushing and extrusion, being totally feasible. When not used immediately, it can still be chilled in the refrigerator for eight days or frozen for up to four months without losing its beneficial effects15. Among its benefits, we can highlight the starch that resists the digestion of green bananas, making them a functional food, a concept defined by the National Health Surveillance Agency (ANVISA) as a food or ingredient that, in addition to containing basic nutritional functions, triggers beneficial effects on health and is safe for consumption without medical supervision. The large amount of short-chain fatty acid produced in the large intestine from the fermentation of starch serves as nutrients for the colon microbiota, inhibiting the growth of cancer cells by reducing local PH. In addition, starch also acts by increasing the fecal bolus, preventing diverticulitis, hemorrhoids and diluting toxic compounds. Another advantage of using biomass involves the consumption of dietary fiber and starch, which are important contributors to the reduction of the glycemic index of

foods and, consequently, to the reduction of the insulin response, helping with type 2 diabetes. This benefit is essential in the context of the overuse of foods with a high glycemic load in the context of neglected regions, reducing the risk of cardiovascular diseases and contributing to the reduction of body mass index (BMI) and obesity16, 17.

Another feasible feeding practice is the insertion of Non-Conventional Food Plants (PANCS) in meals. The term PANC was created in Brazil by professor and biologist Valdely Ferreira Kinupp, in 2008, being internationally known as Neglected and Underutilized *Species* (NUS). In this sense, they refer to numerous plant species that are known, have several nutritional benefits, but are not part of the daily diet, arising with the purpose of increasing the variety of vegetables consumed by individuals. Regarding cultivation in the Northeast, we can highlight the yam, already popularized, the red passion fruit, the papaya foot cactus and the northern mint. Thus, the promotion of PANCS, in addition to presenting a possibility to improve food security, can also stimulate cultivation by local producers, increasing income and boosting local development in regions farther from the centers18.

FINAL CONSIDERATIONS

It is worth mentioning that the present experience has some limitations, such as the restricted number of families visited, but the common report among the families about food and assistance in the governmental sphere were essential for a reflection on how unequal Brazil is, marked by relegated health and precarious access. The families were unanimous about the difficulty of medical care, the lack of access to prescribed medications, and the lack of information on an alternative diet, demonstrating that the role of the SUS has not been played by those who compose it.

Thus, it becomes clear that there is a need to establish the composition of a family and community medicine team with well-established and contextualized care goals and strategies for each region, seeking immediate alternatives to improve food and sanitary conditions.

REFERENCES

1. Brasil. (1990). **Lei nº 8.080 de 19 de setembro de 1990.** Dispõe sobre as condições para a promoção, proteção e recuperação da saúde, a organização e o funcionamento dos serviços correspondentes e dá outras providências. *Diário Oficial da União*, 19 set.

2. Conferência Internacional sobre cuidados primários de saúde. (1978). **Declaração de Alma-Ata.** In Ministério da Saúde (BR). Secretaria de Políticas de Saúde. *Projeto Promoção da Saúde* (p. 15). Brasília (DF): Ministério da Saúde.

3. United Nations. (2015). **Transforming our world: The 2030 agenda for sustainable development.** New York: UN. Disponível em: <https://sdgs.un.org/sites/default/files/publications/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf>. Acesso em 28 de março de 2023.

4. IBGE - Instituto Brasileiro de Geografia e Estatística. (2020). **Pesquisa Nacional de Saúde de 2019: Atenção primária à saúde e informações antropométricas.** Rio de Janeiro: IBGE. Disponível em: <https://abeso.org.br/wp-content/uploads/2021/07/Pesquisa-Nacional-de-Saude-2019.pdf>. Acesso em 28 de março de 2023.

5. Brasil. Secretaria do Estado de Assistência Social, Trabalho e Habitação. (2018). **Informativo GEPSB n° 72: Relação entre o conceito de vulnerabilidade ao SCFV.** Santa Catarina: Governo do Estado de Santa Catarina, Secretaria de Estado do Desenvolvimento Social. Disponível em: <https://www.sds.sc.gov.br/index.php/assistencia-social2/protecao-social-basica/scfv/2943-informativo-gepsb-n-72-relacao-entre-o-conceito-de-vulnerabilidade-ao-scfv/file#:~:text=Na%20linguagem%20corrente%2C%20vulnerabilidade%20%C3%A9,implica%20risco%2C%20fragilidade%20ou%20dano>. Acesso em 29 de março de 2023.

6. Do Carmo, M. E., & Guizardi, F. L. (2018). **O conceito de vulnerabilidade e seus sentidos para as políticas públicas de saúde e assistência social.** *Cadernos de Saúde Pública*, 34(3), 1-14. Disponível em: <https://scielosp.org/article/csp/2018.v34n3/e00101417/pt/#:~:text=A%20concep%C3%A7%C3%A3o%20de%20vulnerabilidade%20denota,bens%20e%20servi%C3%A7os%20p%C3%BAblicos%209>. Acesso em 29 de março de 2023.

7. IBGE - Instituto Brasileiro de Geografia e Estatística. (2015). **Pesquisa Nacional de Saúde de 2013: Acesso e utilização dos serviços de saúde, acidentes e violências.** Rio de Janeiro: IBGE. Disponível em: <https://www.icict.fiocruz.br/sites/www.icict.fiocruz.br/files/PNS%20Vol%202.pdf>. Acesso em 29 de março de 2023.

8. Filho, A. M. S., Vasconcelos, C. H., Dias, A. C., De Souza, A. C. C., Merchan-Hamann, E., & Da Silva, M. R. F. (2022). **Atenção Primária à Saúde no Norte e Nordeste do Brasil: Mapeando disparidades na distribuição de equipes.** *Cienc. Saude Coletiva*, 27(1), 377-386. Disponível em: <https://www.scielo.br/j/csc/a/QkRq5Kt3MHW96dC6p4qmthh/>. Acesso em 29 de março de 2023.

9. Barros, M. N. D. S., Duarte Neto, A. N., Melo, M. G. A., Gazin, P., Albuquerque, A. L. T., Miranda, Y. G., & Oliveira, W. (1999). **A doença de Chagas na zona da mata pernambucana. Clínica e epidemiologia da doença de Chagas.** *Revista da Sociedade Brasileira de Medicina Tropical*, 32(Supl II), 112. Disponível em: <https://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers20-05/010025688.pdf>. Acesso em 30 de março de 2023.

10. IBGE - Instituto Brasileiro de Geografia e Estatística. (2020). **Censo Brasileiro de 2020.** Rio de Janeiro: IBGE.

11. IBGE - Instituto Brasileiro de Geografia e Estatística. (2019). **Programa Nacional por Amostra de Domicílios.** Rio de Janeiro: IBGE.

12. Brasil. Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. (2014). **Guia alimentar para a população brasileira** (2. ed., 1. reimpr.). Brasília: Ministério da Saúde.

13. Bezerra, M. S., Jacob, M. C. M., Ferreira, M. A. F., Vale, D., Mirabal, I. R. B., & Lyra, C. D. O. (2020). **Food and nutritional insecurity in Brazil and its correlation with vulnerability markers.** *Ciência & Saúde Coletiva*, 25, 3833-3846. Disponível em: <https://www.scielo.br/j/csc/a/vpGZNFNcKySWVrVy4KR3Gtc/?lang=en&format=pdf>. Acesso em 30 de março de 2023.

14. Brasil. Ministério da Mulher, da Família e dos Direitos Humanos, Secretaria Nacional da Família. **Família e filhos no Brasil: Fatos e Números.** Disponível em: <https://www.gov.br/mdh/pt-br/navegue-por-temas/observatorio-nacional-da-familia/fatos-e-numeros/familias-e-filhos-no-brasil.pdf>. Acesso em 30 de março de 2023.

15. Marx, V. Z. (2019). **Benefícios da biomassa de banana verde na alimentação humana.** Disponível em: <http://bibliodigital.unijui.edu.br:8080/xmlui/handle/123456789/5973>. Acesso em 30 de março de 2023.

16. Pereira, K. D. (2007). **Amido resistente, a última geração no controle de energia e digestão saudável.** *Revista Ciência Tecnologia e Alimento*, 27, 88-92.

17. Bianchi, M. (2011). **Banana verde – propriedades e benefícios.** Disponível em: <http://www.valemaisalimentos.com.br/material/bananaverdepropriedades_e_beneficios.pdf>. Acesso em 30 de março de 2023.

18. Kinupp, V. F., & Lorenzi, H. (2014). **Plantas alimentícias não convencionais (PANC) no Brasil: Guia de identificação, aspectos nutricionais e receitas ilustradas.** Disponível em: <http://www.nossacasa.net/biblioteca/PANC_identifica%C3%A7%C3%A3o.pdf>. Acesso em 30 de março de 2023.

Case report – Kidney-Lung Syndrome (*Goodpasture Syndrome*) when to think

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ABSTRACT

Lung-kidney syndrome is an anti-glomerular basement membrane (anti-GBM) disease, which is often characterized by pulmonary hemorrhage and renal dysfunction. To date, no specific trigger for the development of anti-GBM antibodies has been identified, and exposure of the alveolar capillaries to these antibodies requires an initial attack on the pulmonary vasculature, resulting in a typical picture of glomerulonephritis. As it is a disease of low prevalence, clinical reasoning associated with an effective investigation for early detection is essential for a satisfactory evolution. Good results are seen when treatment is started immediately. Thus, the present case report aims to discuss, through a literature review in databases such as Scielo and PubMed, the efficacy of an early intervention in a patient with initially unexplained respiratory failure and renal dysfunction, associated with alterations in laboratory and imaging tests. In addition, it aims to demonstrate the importance of quick clinical reasoning to avoid sequelae and increase the chances of a good prognosis.

Keywords: Kidney-Lung Syndrome, Goodpasture Syndrome, Pulmonary Hemorrhage, Glomerulonephritis, Glomerular Basement Membrane.

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INTRODUCTION

Goodpasture syndrome refers to an anti-glomerular basement membrane (anti-GBM) disease that involves the lungs and kidneys, often presenting as pulmonary hemorrhage and glomerulonephritis. (HELLMARK; SEGELMARK, 2014) It seems to be the result of environmental insults in a person with a genetic predisposition, so far, no triggering stimulus for the development of anti-glomerular basement membrane antibodies has been identified. (PHELPS; REES, 1999)

Exposure of the alveolar capillaries to these autoantibodies requires an initial insult to the pulmonary vasculature. These environmental factors include: Drugs, such as alemtuzumab, which cause lymphocyte depletion; Cocaine inhalation; Infections, such as influenza A2; Smoke; Exposure to metal dust; organic solvents or hydrocarbons; Extracorporeal shock wave lithotripsy. (CRANFIELD; MATHAVAKKANNAN, 2014)

Autoantibodies activate the complement system in the basement membrane, causing tissue injury. This autoantibody binding can be seen as a linear deposition of immunoglobulins along the basement membrane and the inflammatory response in this area results in the typical picture of glomerulonephritis. Although Goodpasture syndrome is considered an autoantibody-mediated disease, a vital role is played by T cells in the initiation and progression of the disease, T cells cause B cells to increase antibody production and play a direct role in kidney and lung injury. (CUI et al., 2011)

Up to 80-90% of patients have features of rapidly progressive glomerulonephritis, characterised by active urine sediment analysis, subnephrotic proteinuria, and reduced urine output. 40-60% of patients will have pulmonary hemorrhage concomitant with hemoptysis and varying degrees of dyspnea. A small minority of patients may have isolated lung disease. In a few cases, patients present with severe acute kidney injury that requires dialysis treatment. (REGGIANI et al,. 2023).

In a retrospective study conducted in the United States, about 93 million hospitalizations found in the national database between 2003 and 2014 were analyzed, among these 964 patients were hospitalized with the diagnosis of Goodpasture's syndrome. Thus, the prevalence was approximately 10 hospitalizations per 1,000,000. (KAEWPUT et al., 2020) Other studies show that among European and Asian populations, there is a frequency of 0.5 to 1.8 cases per million inhabitants per year. A recent paper from Ireland reported a national incidence of Goodpasture Syndrome of 1.64 per million population per year. (GULATI; MCADOO, 2018).

Good renal outcomes can be achieved with immediate initiation of treatment. However, when patients have severe renal impairment requiring dialysis or with a high proportion of glomerular crescents on biopsy, renal outcomes are poor. Relapses are rare, and when renal involvement is

present, concomitant diseases such as ANCA-associated vasculitis and membranous nephropathy should be suspected. (REGGIANI et al,. 2023).

In the study by Reggiani (2023), patients treated with the combination of plasma exchange, cyclophosphamide, and corticosteroids have a 1-year survival of 80-90% and the efficacy of treating pulmonary hemorrhage is greater than 90%. The degree of renal involvement directly affects renal survival. In patients with creatinine values equal to or less than 5.65 mg/dL, renal survival varies between 94-95% in up to 5 years. Creatinine values higher than 5.65 mg/dL and that do not require immediate dialysis have renal survival of 82% and 50% at 1 and 5 years, respectively. However, when immediate dialysis is required, it has renal recovery in only 8% in 1 year. Along with renal function, the proportion of glomeruli affected by crescents was also correlated with renal survival. (REGGIANI et al,. 2023).

CASE REPORT

S.R.H., 58 years old, hypertensive. The patient was admitted to the emergency department with a drop in general condition, hemoptysis, cough and chills that began 5 days ago and worsened in the last 24 hours, arrives in respiratory failure associated with a lower level of consciousness, and orotracheal intubation is performed and antibiotics (ampicillin + sulbactam) are started due to the initial suspicion of community-dwelling bacterial pneumonia.

Initial tests were performed and severe renal dysfunction was identified with dialysis urgency with creatinine 18 (CKD-EPI 3 ml/min/1.73m2), urea 332 , K 7.6 and metabolic acidosis (arterial blood gas analysis PH 6.38, PCO2 57 PO2 157, HCO3 9.9 BE -23 and SatO2 96%, on mechanical ventilation with FiO2 100%). At this time, the patient had no evidence of shock or poor tissue perfusion with lactate 0.6, with BP 168x90 mmhg, HR 80 bpm, and no other organ dysfunctions, except renal and pulmonary. Other tests were not compatible with infection or septic shock, including: hemoglobin 10.3, hematocrit 28.6, leukocytes 17450, rods 2%, platelets 215,000, creatinine 22.10, urea 431, potassium 7.2, sodium 123, CRP 3.10. At 07h: haemoglobin 9.3, haematocrit 26.8, leukocytes 15180,

platelets 210,000, INR 1.16, creatinine 21.80, urea 430, potassium 8.1, sodium 136, ionic calcium 0.69, magnesium 2.5, glutamic-oxaloacetic transaminase (GOT) 25, pyruvic transaminase (TGP) 33, total bilirubins 0.70, CRP 2.90, non-reactive VDRL and urine test with no signs of infection but bleeding with dysmorphic red blood cells (protein+++, hemoglobin++++, negative nitrite, leukocytes 300,000, hyaline casts +, bacteria).

After 48 hours in the hospital, the patient was transferred from the emergency room to the intensive care unit (ICU) undergoing a chest tomography (Fig. 1) during transport, which showed alveolar hemorrhage and thought of kidney-lung syndrome.

Figure 1. Chest CT scan

Chest CT scan, where areas compatible with alveolar hemorrhage (hemoptoic report, hemoglobin drop, bilateral alveolar consolidations with central predominance).

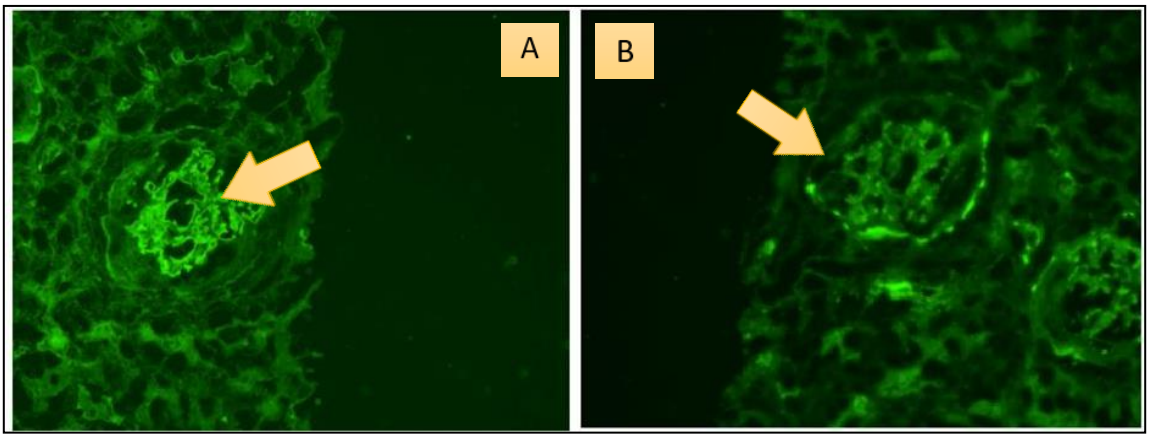
Upon arrival at the ICU, antibiotics were withdrawn, albendazole and ivermectin were given a dose to treat worms, and pulse therapy was discussed with the pulmonology and nephrology team in groups.

After 5 days of hospitalization, we received additional tests performed to investigate Goodpasture's Syndrome, including: serology for hepatitis B and C, ANA, ANCA, ASCA, complement, ESR, cryoglobulin and NEGATIVE immunoglobulins, glomerular basement membrane antibodies: 156.00 U/mL (compatible with Goodpasture's Syndrome) (Fig. 2). Pulse therapy was then started with methylprednisolone 01 gram/day for 3 days and intravenous cyclophosphamide 01 gram single dose, with a schedule to administer a new dose after 4 weeks.

After completion of methylprednisolone, performed for 3 days, the first plasmapheresis was performed, with subsequent extubation within 48 hours, after improvement of the pulmonary condition, still requiring dialysis, without recovery of diuresis or renal function.

For better investigation, a renal biopsy was performed, with results received about 7 days after discharge from the ICU and in an inpatient unit already in the hospital discharge plan.

Figure 2. Renal biopsy



A. IgG: POSITIVE in glomerular loops, linear pattern (4+/4+); B. C3: POSITIVE in glomerular loops (2+/4+).

DISCUSSION

The patient studied arrived at the hospital with hemoptysis, bronchospasm and asthenia, which was clinically unstable. However, without a definitive diagnosis, due to the complexity of the condition and severity, some suspicions were raised, since he was being treated for pneumonia.

Laboratory and imaging tests were performed to better elucidate the case and raise some diagnostic hypotheses, because with the results it was possible to find some worsening factors even with the optimized treatment. An electrocardiogram was performed, in which an apiculated T wave was revealed, and laboratory tests showed drastically reduced renal function, proteinuria, and hematuria.

In patients with renal and pulmonary involvement, leptospirosis, Goodpasture's syndrome, heart failure, and rapidly progressive glomerulonephritis may be suspected. According to Devrieze and Hurley (2022), some physical examination findings related to Goodpasture's syndrome are: Increased respiratory rate; Basilar inspiratory crackles; Cyanosis; Hepatosplenomegaly; Hypertension; Oedema.

Some differential diagnoses can also be thought of in patients with these renal and pulmonary symptoms, they are: granulomatosis with polyangiitis (Wegener's granulomatosis); systemic lupus erythematosus; microscopic polyangiitis; Henoch-Schonlein purple; IgA nephropathy; Acute glomerulonephritis; community-acquired pneumonia; granulomatosis with polyangiitis; pneumonia caused by Pneumocystis jiroveci; Churg-Strauss syndrome.

Careful physical examination should be performed of patients presenting with findings suspicious of anti-glomerular basement membrane disease. Patients with Goodpasture syndrome initially present similarly to other forms of rapidly progressive glomerulonephritis with acute renal failure. Pulmonary symptoms are typically present at or shortly after the initial encounter. Haemoptysis of various grades is typical of pulmonary involvement, ranging from severe, life-threatening bleeding to mild diffuse haemorrhage.

It is more common for younger patients affected by the disease to have concurrent renal and pulmonary symptoms and to be critically ill at presentation and patients over 50 years of age tend to have only glomerulonephritis and follow a less severe course. And in this patient, even at 57 years old, he was affected by the severe form of the disease.

Some tests help guide treatment decisions, such as: urine test that is characteristic and usually demonstrates low-grade proteinuria, macroscopic or microscopic hematuria, and red cell casts; a complete blood count may reveal anaemia secondary to intrapulmonary haemorrhages, and leukocytosis is usually present; in renal function tests they can be altered secondary to renal dysfunction; Chest X-ray shows irregular parenchymal opacifications, which are usually bilateral and bibasal. Costophrenic apices and angles are usually spared; pulmonary function tests show high carbon monoxide diffusing capacity (DLCO) secondary to carbon monoxide binding to intra-alveolar hemoglobin.

Subsequently, a computed tomography scan was performed in this patient, which revealed bilateral alveolar consolidations with central predominance, and after discussing the case with a nephrologist to request renal biopsy, pulse therapy was initiated with methylprednisolone 500mg/day for 3 days, ivermectin for 2 days, and albendazole for 5 days.

Patients who present with Goodpasture's syndrome (both glomerulonephritis and pulmonary hemorrhage) may be critically ill at presentation. Urgent hemodialysis is often necessary, and intubation for respiratory failure as well. When the clinician suspects the diagnosis, a renal biopsy should be done as soon as the clinical situation permits. After diagnosis, patients should be started on prednisone, cyclophosphamide, and daily plasmapheresis to improve overall mortality in general and renal survival in particular. (JOHNSON et al., 1985)

Renal biopsy is the gold standard for diagnosis, but it is not required to initiate treatment or continue therapy if biopsy is not feasible. When performed, biopsy provides important information about the activity and chronicity of renal involvement that can guide therapy. Renal biopsy is preferable to lung biopsy as it provides a much higher yield, but lung biopsy can be performed when renal biopsy is contraindicated for any reason.

Light microscopy will show increasing glomerulonephritis. Over time, the crescents become fibrotic, and frank glomerulosclerosis with interstitial fibrosis and tubular atrophy may be seen. Immunofluorescence will show linear deposition of IgG and complement (C3) along the basement membrane. Predominantly, the IgG-1 subclass is present. (ZHAO et al., 2009)

Typically, daily plasmapheresis is performed until anti-glomerular basement membrane antibodies are undetectable, with steroids and cyclophosphamide continuing thereafter for 3 to 6 months until complete remission is achieved. This can be assessed by checking for repeated titers after plasmapheresis, as well as any time new symptoms develop that may be a harbinger of relapse.

Overall, relapse remains rare. The initial dose of cyclophosphamide is 2 mg/kg orally, adjusted to maintain a white blood cell count of approximately 5,000. (SYEDA et al., 2013)

Even with proper treatment, kidney function can be impaired to the point of failure. Although renal failure is a relatively common complication for patients with Goodpasture syndrome, less than 30% of surviving patients require long-term dialysis. In severe cases, a kidney transplant may be necessary.

The prognosis of Goodpasture syndrome with the development of aggressive therapies such as plasmapheresis, corticosteroids, and immunosuppressive agents has improved significantly. With these therapies, the 5-year survival rate has exceeded 80% and less than 30% of patients require long-term dialysis. However, delayed administration of cyclophosphamide has been found to be associated with a fatal prognosis. (WEBER et al., 1992)

CONCLUSION

Lung-Kidney Syndrome is a disease that is difficult to diagnose and needs to be remembered in cases of alveolar hemorrhage and renal dysfunction. Many patients have unexplained pulmonary and kidney symptoms, so whenever possible, the syndrome should be diagnosed and treated early in order to avoid sequelae, disease progression, and increase the chances of a good prognosis. The patient will also require an intensive care setting for better outcome and outcome. Kidney biopsy is essential to confirm the diagnosis, but it should not delay the start of treatment, and can be done at a later time, when the patient is stable.

REFERENCES

1. Apaydin, S. (2018). The treatment of ANCA-associated rapidly-progressive glomerulonephritis and Goodpasture syndrome with therapeutic apheresis. *Transfusion and Apheresis Science*, 57(1), 8-12. https://doi.org/10.1016/j.transci.2018.02.007

2. Cranfield, A., & Mathavakkannan, S. (2014). Goodpasture's disease following extracorporeal shock wave lithotripsy: A case report & literature review. *Clinical Case Reports*, 3(3), 160-164. https://doi.org/10.1002/ccr3.190

3. Cui, Z., Zhang, L., Chen, X., & Wu, Y. (2011). Clinical features and outcomes of anti–glomerular basement membrane disease in older patients. *American Journal of Kidney Diseases*, 57(4), 575-582. https://doi.org/10.1053/j.ajkd.2010.09.022

4. Devrieze, B. W., & Hurley, J. A. (2022). Goodpasture syndrome. Retrieved August 15, 2023, from https://www.ncbi.nlm.nih.gov/books/NBK459291/?report=reader#_NBK459291_pubdet_

5. Gulati, K., & McAdoo, S. P. (2018). Anti–glomerular basement membrane disease. *Rheumatic Disease Clinics of North America*, 44(4), 651-673. https://doi.org/10.1016/j.rdc.2018.06.011

6. Hellmark, T., & Segelmark, M. (2014). Diagnosis and classification of Goodpasture's disease (anti-GBM). *Journal of Autoimmunity*, 48-49, 108-112. https://doi.org/10.1016/j.jaut.2014.01.024

7. Johnson, J. P., Ecker, R., & Miskulin, D. (1985). Therapy of anti-glomerular basement membrane antibody disease. *Medicine*, 64(4), 219-227. https://doi.org/10.1097/00005792-198507000-00003

8. Kaewput, W., Vannaprasit, K., & Kanya, W. (2020). Inpatient burden and mortality of Goodpasture's syndrome in the United States: Nationwide inpatient sample 2003–2014. *Journal of Clinical Medicine*, 9(2), 455. https://doi.org/10.3390/jcm9020455

9. Levy, J. B., & et al. (2001). Long-term outcome of anti–glomerular basement membrane antibody disease treated with plasma exchange and immunosuppression. *Annals of Internal Medicine*, 134(11), 1033. https://doi.org/10.7326/0003-4819-134-11-200106050-00009

10. Nunes, A. J. F., & et al. (2003). Relato de caso: Síndrome de Goodpasture. *Brazilian Journal of Nephrology*, 25(2), 104-107. https://bjnephrology.org/wp-content/uploads/2019/11/jbn_v25n2a06.pdf

11. Phelps, R. G., & Rees, A. J. (1999). The HLA complex in Goodpasture's disease: A model for analyzing susceptibility to autoimmunity. *Kidney International*, 56(5), 1638-1653. https://doi.org/10.1046/j.1523-1755.1999.00720.x

12. Reggiani, F., & et al. (2023). Goodpasture syndrome and anti-glomerular basement membrane disease. *Clinical and Experimental Rheumatology*, 41, 964-974. https://doi.org/10.55563/clinexprheumatol/tep3k5

13. Syeda, U. A., & et al. (2013). Anti-glomerular basement membrane antibody disease treated with rituximab: A case-based review. *Seminars in Arthritis and Rheumatism*, 42(6), 567-572. https://doi.org/10.1016/j.semarthrit.2012.10.007

14. Zhao, J., & et al. (2009). The immunoglobulin G subclass distribution of anti-GBM autoantibodies against rHα3(IV)NC1 is associated with disease severity. *Human Immunology*, 70(6), 425-429. https://doi.org/10.1016/j.humimm.2009.04.004

15. Weber, M. F., & et al. (1992). Antineutrophilcytoplasmic antibodies and antiglomerular basement membrane antibodies in Goodpasture's syndrome and in Wegener's granulomatosis. *Journal of the American Society of Nephrology*, 2(7), 1227-1234. https://doi.org/10.1681/asn.v271227

Contribution to the chemical study of *Chrysobalanus icaco* leaves

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ABSTRACT

Chrysobalanus icaco (Chrysobalanaceae), is a shrub in Brazil, occurs throughout the coast and in the Amazon biome, known as abajurú, abajerú, bajerú, guajurú, among other popular names. In folk medicine, it is mainly used to control blood glucose in diabetics, dysentery and leukorrhea. There are studies in the scientific literature that confirm its antidiabetic effects. From a chemical point of view, the species is characterized as a bioproducer of terpene and phenolic compounds. The objective of this work is to contribute to the chemical studies of the species *C. icaco*, considering its relevant pharmacological activities. In this work we present the isolation and characterization of two triterpenes and three flavonoids, in addition to the product obtained by acetylation reaction of an ethyl acetate fraction identified as 2α, 3β-diacetoxy-6β-hydroxy-olean-12-en-28-oate of [β-D-triacetoxy-glycopyranosyl (2→1) – β - triacetoxy-xylopyranosyl]. The structural determination of the substances was made through the analysis of 1D and 2D nuclear magnetic resonance spectra and HR-ESI-MS mass spectrometry and comparison with values recorded in the literature.

Keywords: *Chrysobalanus icaco*, Chrysobalanaceae, Triterpenos, Flavonoides.

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INTRODUCTION

The family Chrysobalanaceae comprises l7 genera and about 525 species represented by trees and shrubs widely distributed in tropical and subtropical areas [1]. Chrysobalanus is a small genus of this family, composed of the species *Chrysobalanus icaco*, *Chrysobalanus cuspidatus,* and *Chrysobalanus venezuelanus*, widely distributed in tropical America and tropical Africa [2]. The species *C. icaco*, in Brazil, occurs throughout the coast and in the Amazon biome it is known as abajurú, abajerú, bajerú, guajurú, among other popular names. It has edible fruits and various parts of the plant are used in folk medicine. Roots, bark and leaves are astringent and employed against dysentery, leukorrhea, kidney stones [3]. Aqueous extracts of its leaves are commonly used for blood glucose control in diabetics [4]. There are also studies in the scientific literature that, in addition to confirming its antidiabetic effects, report inhibitory effects on the HIV-1 virus, anti-inflammatory and antinociceptive activities, leishmanicidal, antioxidant, genotoxic, antimicrobial, antiangiogenic, anti-cancer and anti-cancer resistant to multi-drugs, prevention against obesity, decreases doxorubicin-induced DNA damage [5-10]. From a chemical point of view, the species that present reports in the literature are *C. icaco,* followed by *C. venezuelanus*, giving the genus Crhysobalanus a rich source of terpenes and phenolic compounds [2,5,7]. Among the terpenes, kaurane-type diterpenes have been recorded [10]. and triterpenes mainly with oleanan and ursan skeletons [2.5.6]. Of the phenolic compounds, the flavonoids myricetin, quercetin and their O-glycosylated derivatives stand out, as well as catecholic tannins [2,4,5] and anthocyanins [7]. Flavonoids, particularly myricetin and its glycosides, have been used as chemotaxonomic markers in the family Crhysobalanaceae [2,4]. In this work we present the isolation and characterization of two elean skeleton triterpenes, the flavonoids quercetin, kaempferol and 3-O-β-D-glycopyranosyl myricetin, as well as a product obtained by acetylation reaction of a fraction of the ethyl acetate partition of the methanol extract of *C. icaco* leaves identified as 2α, 3β-diacetoxy-6β-hydroxy-olean-[β-D-triacetoxy-glycopyranosyl(2→1)β--D-triacetoxy-pyranosyl] 12-en-28-oate. The structural determination of the substances was made through the analysis of 1D and 2D nuclear magnetic resonance spectra and HR-ESI-MS mass spectrometry and comparison with values recorded in the literature. The presence of these flavonoids may be responsible for its anti-oxidant and anti-inflammatory activity, and may attribute the hypoglycemic activity to myricetin [4].

EXPERIMENTAL PART

INSTRUMENTATION

The NMR1H and NMR13C spectra (1D and 2D) were obtained in Bruker Avance II 400 and Bruker Avance III 500 spectrometer operating at the hydrogen frequencies 400MHz and 500 MHz and at the carbon-13 frequencies at 100 MHz and 125 MHz from the analytical center of the Institute

of Chemistry of the Federal Rural University of Rio de Janeiro. The solvents used in the dissolution of the samples were deuterated chloroform, methanol and pyridine. The high-resolution mass spectra were obtained in a MICROTOF-Bruker Daltonics spectrometer equipped with an electrospray ionization source from the Analytical Instrumentation Center of the University of São Paulo (Laboratory of Mass Spectrometry).

MATERIAL VEGETAL

Leaves of *C. icaco* were collected in the municipality of Rio de Janeiro, Brazil and identified by Dr. Rosa Fuks from Jardim Botânico/RJ. An exsicata of the species was deposited in the Herbarium of the National Museum (R195941) of UFRJ. SIsGen Registration: AEADE65.

EXTRACTION AND ISOLATION OF CHEMICAL CONSTITUENTS

Dried and ground leaves (2,500g) were subjected to the maceration process at room temperature using methanol as solvent (5L). Part of the 3-liter methanolic extract was subjected to solvent removal through a rotary evaporator under reduced pressure, generating (220g) of the dry extract. From this, a 90g aliquot was solubilized in methanol/H2O solution (8:2) and subjected to liquid/liquid partitioning with the solvents hexane, ethyl acetate and butanol in increasing order of polarity to provide four fractions. The ethyl acetate fraction, after removal of the solvent by distillation under reduced pressure, provided 50.0 g of residue, of which 5.0 g was subjected to a silica gel chromatographic column (70-230 *mesh*) eluted with mixtures of Hex:AcOEt:MeOH solvents in a gradient of increasing polarities, originating 20 fractions of 200 mL. These fractions were analyzed by thin layer chromatography and regrouped according to their chromatographic profile. The group of fractions 9-12 (170.0 mg) was rechromatographed in a silica gel column using the CHCl3/MeOH mixture (9:1) as eluent, producing triterpenes **2** (20.0mg) **and 3** (32.0mg). Sub-fractions 14-16 (220mg) were pooled and submitted to a Sephadex-LH 20 column eluted with 100% methanol generating 10 fractions. The CCDA analyses revealed with Liebermann-Burchard, showed a violet coloration, indicating the presence of triterpenes and that fractions 3 to 7 were similar despite being impure, so they were gathered (40.0mg) and then subjected to an acetylation reaction using acetic anhydride and pyridine (1:1) and left at room temperature with agitation for 24 hours. The product of this reaction, after purification in a small silica gel filter column and analysis of NMR spectra, allowed to be identified as substance **1** (19.0 mg). 20 g of the butanolic fraction was submitted to a chromatographic process in an eluted silica gel column with a binary mixture of the solvents ethyl acetate and methanol, in a gradient of increasing polarities. 27 fractions of 300 ml were obtained. Fractions 1-6 after development with sulfuric vanillin were presented as a mixture of phenolic compounds. These were gathered and submitted to a new chromatographic process in a

Sephadex LH-20 column and 8 new subfractions were obtained; Of these, subfraction 2 was purified by filtration in silica to provide flavonoids **4** (15.0 mg) and **5** (11.0 mg). Fractions 5-6 of the latter column were gathered and rechromatographed in Sephadex LH-20, leading to the isolation of flavonoid **6** (8.0 mg).

RESULTS AND DISCUSSION

The phytochemical study of the methanol extract of *C. icaco leaves* led to the isolation and identification of two triterpene acids (**2** and **3**), flavonoids **4**, **5** and **6,** in addition to the substance obtained from the acetylation reaction of an ethyl acetate fraction**,** substance **1.** From the ethyl acetate fraction from the liquid/liquid partition of the methanol extract of leaves, the following were isolated: triterpenic acids, 2α-3β-6β-trihydroxy-olean 12-en-28-oic (**2**) and 2α-3β-6β-23-tetrahydroxy-olean 12-en-28-oic (**3**) and obtained the substance of the acetylation reaction, 2α, 3β-diacetoxy-6β-hydroxy-olean-[β-D-triacetoxy-glycopyranosyl 12-en-28-oate (2→1)-β-triacetoxy-xylopyranosyl] (**1**); From the butanolic fraction from the liquid/liquid partition of the methanol extract of the leaves, the flavonoids quercetin (**4),** kaempferol (**5)** and 3-O-β-glycopyranosyl-myricetin (**6)** were isolated. The structures of the isolated compounds were determined through the analysis of the 1H and 13C NMR spectra, DEPET, HMBC, HSQC, COSY and by comparison with data described in the literature. Substance **1** was obtained as a white solid. The high-resolution mass spectrum of substance **1** showed the peak at *m/z* 1141.5338 ([M+Na+], C57H82NaO22, calculated: 1141.4965) compatible with the molecular formula C57H82O22. In the 1H NMR spectrum, seven singlets δH 0.93, 0.94, 0.98, 1.01, 1.13, 1.34, 1.49 corresponding to seven methyl groups, a broad simplete at δH 5.36 characteristic of olefin hydrogen, was observed. In the NMR spectrum, 13C in the olefins region shows signals in δC 122.56 (CH) and δC 142.46 (C). These 1H and 13C NMR data allow us to propose the presence of a triterpene structure with an Olean-12-en skeleton [11]. The presence in the 1H NMR of the broad double at δH 2.86 (J= 11Hz) compatible with H -18 [11] also corroborates the Olean skeleton [11]. The δH 5.20 (H -2 dt, J=10; 10; 4.0Hz) and δH 4.71 (H-3 d, J=10 Hz) present in the 1H NMR spectrum and correlations observed with acyl groups (δC 170.6 and 171.0 respectively) through HMBC contour map (Table 1) made it possible to recognize the presence of a 2α, 3β di-O-acyl system [12]. The presence of glycosidic units was also detected through the analysis of the HMBC contour map, where 3JCH correlations were observed between the δH 5.45 anomeric methinic hydrogen (H-1', d,J= *8Hz) and δH* 4.71 anomeric methinic hydrogen (H-1", d,J=*8.0 Hz) with the carbons δC* 91.5 (C-1') and δC 100.7 (C-1"), respectively, allowing the presence of two sugar units to be proposed and according to the coupling constants of their Anomeric hydrogens are in β configuration. In the 13C/NMR spectrum (DEPET) eight signals of quaternary carbons between δC 169.70 – 171.00 attributed to acyl groups incorporated into the molecule were

observed, which had their locations established through analysis of the HMBC contour map. Still analyzing the 13C/ NMR spectrum (DEPET), the presence of carbinolic methinic carbons compatible with the presence of one glucose unit and one xylose unit characterized mainly by δC 62.5 (CH2, C-5") are observed. The determination of the sequence of hydrogens relative to each unit of monosaccharides was performed through homonuclear correlations in the COSY spectrum: Glucose [δH5.46(H-1')↔3.94(H-2')↔5.28 (H-3')↔5.0 (H-4')↔3.78 (H-5')↔4.30 (H-6a')↔4.06 (H-6b')]; Xylose [δH4.60 (J=8.0 Hz, H-1")↔4.85 (H-2")↔5.15(H-3") ↔4.93 (H-4")↔4.12 (H-5a")↔3.31 (H-5"b)]. The union between the monosaccharide units was determined by the long-distance correlation ^{3JCH} between δH 3.94 (H-2') of glucose and δc 100.7 (C-1") of xylose. And the heteroside position was determined by correlating δH 5.45 (H-1') of glucose and δC 175.6 (C-28) of aglycone observed in the HMBC contour map. The presence of carbinolic methinic carbon at δC 67.75 (C-6), not correlated to the acyl group and presenting ^{1JCH} with a broad simplet, δH 4.55, is compatible with the presence of a hydroxyl group at the 6β position (axial), presenting a 1.3 diaxial interaction with methyl group 10β δC 17.78 (CH3-25), making it aglycone similar to 6β hydroxymaslinic acid [13-15]. The data obtained allowed the characterization of substance **1** as being 2α,3β-diacetoxy-6β-hydroxy-olean-12-en-28-oate of [β-D-triacetoxy-glycopyranosyl (2→1) – β - triacetoxy-xylopyranosyl]. The structures of the known compounds **2-6** were defined by interpreting the NMR spectra 1H and 13C and comparing them with the literture for 2α-3β-6β-trihydroxy-olean 12-en-28-oico2 [13], 2α-3β-6β-23-tetrahydroxy-olean 12-en-28-oico3 **[**16], quercetin **4** [17], Kaempferol **5** [18], 3-O-β-glycopyranosyl-myricetin **6 [**19].

Figure 1. Structures of substances isolated from the methanol extract of C. Icaco leaves.

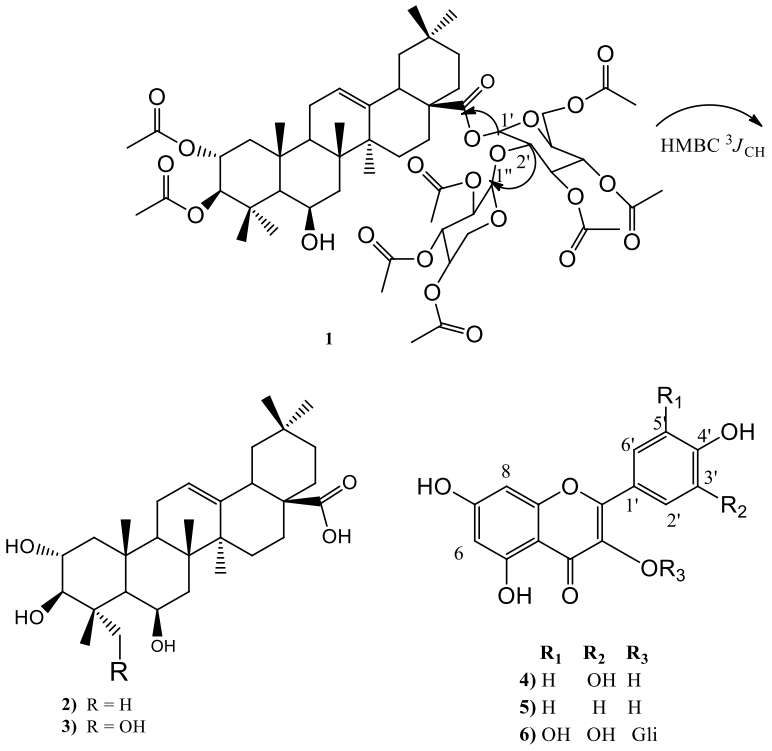

Table 1: 1H (400 MHz) and 13 C (100 MHz) NMR data, CDCl3, of substance 1.

	HSQC		HMBC		1Hx1H-COSY
C	CDs	dH(mult, *J* em Hz)	Day 2	Day 3	
1	46,65	1,99 sl	C-2; C-10	C-5	
2	70,22	5,20 (dt,10,0; 10,0; 4,0)		AcO(170,63)	H-3
3	80,90	4.71 (d, 10)	C-2; C-4	C-24; C-23; AcO(171,0)	
4	40,67				
5	55,37	0,9 s			
6	67,75	4,55 sl			H-5
7	39,99				
8	38,58				
9	47,89				
10	37,77				
11	22,13				
12	122,56	5,36 sl		C-9; C-14	
13	142,69				
14	42,16				
15	28,74				
16	23,40				
17	45,53				
18	41,19	2,86 (d, 11,0)		C-12	
19	45,89				
20	30,64				
21	33,73				
22	31,42				
23	28,20	0,98 s		C-24 ; C- 4; C-5; C-3	
24	19,16	1,34 s		C-23 ; C-4 ; C-5; C-3	
25	17,78	1,49 s	C-10	C-1; C-5	
26	17,93	1,01 s	C-8	C-7 ; C-14 ; C-9	
27	25,95	1,13 s	C-14	C-15; C-8	
28	175,63	COOH			
29	33,10	0,93 s		C-30 / C-21	
30	23,58	0,94 s		C-23 / C-21	
1'	91,58	5,45 (d, 8,0)		**C-28**	H-2'
2'	74,47	3,94 t	C-3'; C-1'	**C-1"**	H-3'
3'	74,94	5,26 t	C-4', C-2'	AcO	H-4'
4'	68,01	5,0 t	C-5’	AcO	H-5'
5'	72,54	3,8dl	C-4’		H-6'a
6'	61,48	4,30 (dd, 4,3; 12,4 e 4,06 (m)		AcO	H-6b'
1"	100,75	4,71 (d, 8,0)		C-3”	H-2"
2"	71,52	4,88 t	C-1" , C-3"	AcO	H-3"
3"	72,57	5,13 t	C-2"	AcO	H-4"
4"	68,09	4,93m		AcO	H-5"
5"	62,54	4,12 (dd, 12,0 e 5,6) / 3,31(dd, 12,0 e 4,0		C-1”	H-5"a/H-5"b

2α, 3β-diacetoxy-6β-hydroxy-olean-12-en-28-oate of [β-D-triacetoxi-glucopyranosyl (2→1) – β - triacetoxi-xylopiranosyl] (**1**). White solid, NMR $^{13C\ (100\ MHz,\ CDCl3}$ δ (ppm) as given in Stem 1.

2α-3β-6β-trihydroxy-olean-12-en-28-oic acid (2). White solid, NMR RMN 13C (100 MHz,C5D5N) δ(ppm) 46,5 (C-1), 68,6(C-2), 83,8(C-3), 41,0(C-4), 56,3(C-5), 67,3(C-6), 42,6(C-7), 39,0(C-8), 48,5(C-9), 38,1(C-10), 23,6(C-11), 122,2(C12), 144,4(C13), 42,0(C-14), 28,1(C-15), 23,6(C-16), 46,7(C-17), 42,5(C-18), 49,8(C-19), 30,8(C-20), 34,2(C-21), 33,2(C- 22), 28,9(C-23),

19,0(C-24), 18,5(C-25), 18,2(C-26), 26,4(C-27), 181,0(C-28), 33,2(C-29), 23,6(C-30).The chemical displacements of the carbon atoms of 2 were attributed by the analysis of the 2D spectra of heteronuclear correlation HSQC, HMBC and comparison with data described in the literature [13].

2α-3β-6β-23-tetrahydroxy-olean-12-en-28-oic acid (3). White Solid RMN ^{13}C (125 MHz C_5H_5N δ (ppm) 49,7 (C-1), 68,8(C-2), 77,9(C-3), 44,3(C-4), 48,5(C-5), 67,3(C-6),40,7(C-7), 39,0(C-8), 48,5(C-9), 37,9(C-10), 23,5(C-11), 122,3(C12), 144,7(C13), 42,5(C-14), 28,4(C-15), 23,8(C-16), 46,5(C-17), 41,9(C-18), 46,3(C-19), 30,7(C-20), 34,0(C-21), 33,0(C- 22), 65,7(C-23), 15,7(C-24), 18,7(C-25), 18,4(C-26), 25,9(C-27), 180,0(C-28), 33,0(C-29), 23,5(C-30). The chemical displacements of carbon atoms of 3 were attributed by the analysis of the heteronuclear correlation 2D spectra HSQC, HMBC and comparison with data described in the literature [16].

Quercetin (4). White/yellowish solid NMR 13C (125 MHz CD3OD δ (ppm): 147,3 (C-2); 135,8 (C-3); 175,9 (C-4); 161,1 (C-5); 97,8 (C-6); 164,1 (C-7); 92,9 (C-8); 156,8 (C-9); 103,0 (C-10); 122,7 (C-1'); 114,5 (C-2'); 144,8 (C-3'); 146,5 (C-4'); 114,7 (C-5'); 120,4 (C-6').The chemical displacements of carbon atoms of 4 were attributed by the analysis of the 2D heteronuclear correlation spectra HSQC and HMBC and comparison with data described in the literature [17].

Kaempferol-(5) yellowish solid: RMN ^{1}H (500 MHz CD_3OD δ (ppm): 8.1 2H (*J*= 8,8 Hz; H-2' e H-6'); 6,92 (*J*=8,8 Hz H-3' e H-5'); 6,42 (H-6); 6,20 (H-8). RMN ^{13}C (125 MHz CD_3OD δ (ppm): 146 (C-2); 97,8 (C-6); 93,0 (C-7): 103 (C-9); 121, (C-1'); 129,2 (C-2'/6'); 114,8(3'/5'); 159 (C-4').. The chemical displacements of the carbon atoms of 5 were attributed by the analysis of the 2D heteronuclear correlation spectra HSQC and HMBC and comparison with data described in the literature[18].

Myricetin-3-O-β-D-glycopyranosyl (6) RMN ^{13}C (125 MHz CD_3OD δ (ppm): 157,0 (C-2); 134,2 (C-3); 178,2 (C-4); 162,0 (C-5); 98,4 (C-6); 164,0 (C-7); 93,2 (C-8); 156,0 (C-9); 104,0 (C-10); 120,0 (C-1'); 108,4 (C-2'); 146,0 (C-3'); 134,2 (C-4'); 146,0 (C-5'); 108,4 (C-6'); 103,1 (C-1''); 73,8 (C-2'');76,1 (C-3''); 69,6 (C-4''); 76,1(C-5''); 65,8(C-6''). The chemical displacements of the carbon atoms of 6 were attributed by the analysis of the 2D spectra of heteronuclear correlation HSQC and HMBC and comparison with data described in the literature [19].

FINAL CONSIDERATIONS

The chemical study of *Chrysobalanus icaco* led to the isolation of trithepenic acids: 2α-3β-6β-trihydroxy-olean-12-en-28-oico 2; 2α-3β-6β-23-tetrahydroxy-olean-12-en-28-oico 3; flavonoids: quercetin 4; kaempferol 5 , myricetin 3-O-β-glycopyranosyl 6, in addition to obtaining and characterizing 2α,3β-diacetoxy-6β-hydroxy-olean12-en-28-oate of [β-D-triaocetoxy-glycopyranosyl(2→1)-β-trioacetoxy-xylopyranosyl] substance 1, prepared by acetylation reaction of an ethyl acetate fraction. The proposed structure for substance 1 is compatible with an acetylated

triterpene saponin. The obtaining of this substance, more nonpolar, by means of a simple acetylation process (acetic anhydride/pyridine stirring for 24 hours) suggests the presence of triterpene saponins among the chemical constituents of the species. The complexity of the structure and the high degree of polarity of this class of metabolites make it difficult to isolate it in natura by traditional chromatographic methods. Saponins can often undergo hydrolysis reactions in the plant extract or in the column, thus allowing the isolation of only aglycones, such as triterpenic acids 2 and 3. The work contributes to the chemical study of the species *Chrysobalanus icaco*, presenting new constituents of its metabolites, confirming that myricetin derivatives are chemical markers of the Chrysobalanaceae family and that it is a bioproducer of terpenoidic and flavonoid compounds.

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REFERENCES

1. Feitosa, E. A., Xavier, H. S., & Randau, K. P. (2012). Chrysobalanaceae: Traditional uses, phytochemistry and pharmacology. *Brazilian Journal of Pharmacognosy*, *22*(6), 1181-1186. https://www.scielo.br/j/rbfar/a/ywSbCxQxPJbsyQKj4ydsSdG/?format=pdf&lang=en

2. Estrada, O., Conde, D., Mendez, J., & Cardozo, A. (2012). Chemical constituents from *Chrysobalanus venezuelanus*. *Biochemical Systematics and Ecology*, *45*, 66-68. https://www.cabidigitallibrary.org/doi/full/10.5555/20123412252

3. Silva, I. M., & Peixoto, A. L. (2009). O abajuru (*Chrysobalanus icaco* L. e *Eugenia rotundifolia* Casar.) comercializado na cidade do Rio de Janeiro, Brasil. *Brazilian Journal of Pharmacognosy*, *19*(2), 325-332. https://www.scielo.br/j/rbfar/a/vCBMtcXVg47h7RVxwCm4zyN/?format=pdf&lang=pt

4. Barbosa, W. L. R., Peres, A., Gallori, S., & Vincieri, F. F. (2006). Determination of myricetin derivatives in *Chrysobalanus icaco* L. (Chrysobalanaceae). *Brazilian Journal of Pharmacognosy*, *16*(3), 333-337. https://www.scielo.br/j/rbfar/a/w8ZCnmbvBjdJSHzNhZqh74w/?lang=en

5. Andrade, J. K. S., Barros, R. G. C., Rezende, Y. R. R. S., Nogueira, J. P., de Oliveira, C. S., Gualberto, N. C. C., & Narain, N. (2021). Evaluation of bioactive compounds, phytochemicals profile and antioxidant potential of the aqueous and ethanolic extracts of some traditional fruit tree leaves used in Brazilian folk medicine. *Food Research International*, *143*, 110282. https://www.sciencedirect.com/science/article/pii/S0963996921001812?via%3Dihub

6. Paracampo, N. E. P., Prance, G. T., Poppi, R. J., & da Silva, J. A. F. (2017). Chemotaxonomic study of *Chrysobalanus icaco* Linnaeus (Chrysobalanaceae) using ultra-high performance liquid chromatography coupled with diode array detection fingerprint in combination with multivariate analysis. *Journal of Separation Science*, *40*(11), 2161-2169. https://analyticalsciencejournals.onlinelibrary.wiley.com/doi/full/10.1002/jssc.201601444

7. Mendonça, D. A., Oliveira, P. A., Kaplan, M. A. C., Carvalho, M. G., Suzart, L. R., & Marinho, B. G. (2017). The 2α-3β-6β-23-tetrahydro-olean-12-en-28-oic acid from the leaves of *Chrysobalanus icaco* L. attenuates the inflammatory hypernociception in mice. *International Journal of Pharmacy and Pharmaceutical Sciences*, *9*(5), 94-100. file:///C:/Users/Home/Downloads/admin,+Journal+manager,+16848-77967-1-CE.pdf

8. Venancio, V. P., Cipriano, P. A., Kim, H., Antunes, L. M. G., Talcott, S. T., & Talcott-Mertens, S. U. (2017). Cocoplum (*Chrysobalanus icaco* L.) anthocyanins exert anti-inflammatory activity in human colon cancer and non-malignant colon cells. *Food & Function*, *8*(1), 307-314. https://pubs.rsc.org/en/content/articlelanding/2017/fo/c6fo01498d

9. Venancio, V. P., & Almeida, M. R. (2018). Cocoplum (*Chrysobalanus icaco* L.) decreases doxorubicin-induced DNA damage and downregulates Gadd45α, Il-1β, and Tnf-α *in vivo*. *Food Research International*, *105*, 996-1002. https://www.sciencedirect.com/science/article/pii/S0963996917308633

10. Gustafson, K. R., Munro, M. H. G., Blunt, J. W., Cardellina, J. H., McMalon, J. B., Gulakowshi, R. J., Cragg, G. M., Cox, P. A., Brinen, L. S., Clardy, J., & Boyd, M. (1991). HIV inhibitory natural products: Diterpenes from *Homalanthus acuminatus* and *Chrysobalanus icaco*. *Tetrahedron*, *47*(26), 4547-4554. https://www.sciencedirect.com/journal/tetrahedron/vol/47/issue/26

11. Olea, R. S. G., & Roque, N. F. (1990). Análises de misturas de triterpenos por RMN 13C. *Química Nova*, *13*(4), 278-281. http://submission.quimicanova.sbq.org.br/qn/qnol/1990/vol13n4/v13_n4_%20(13).pdf

12. Monte, F. J. Q., de Oliveira, E. F., & Braz-Filho, R. (2001). Triterpenóides pentacíclclicos de *Mentha villosa*: Identificação estrutural e atribuição dos deslocamentos químicos dos átomos de hidrogênio e carbono. *Química Nova*, *24*(4), 491-500. https://www.scielo.br/j/qn/a/c5xscdWYQTkqdk9xSzhSYrN/?format=pdf&lang=pt

13. Zucaro, Y. L. Z., Compagnone, R. S., Hess, S. C., & Monache, F. D. (2000). 6β-Hydroxymaslinic acid, a triterpene from *Vochysia ferrugínea*. *Journal of the Brazilian Chemical Society*, *11*(3), 241-244. https://www.scielo.br/j/jbchs/a/R69yttG9kRgmRhhnFNqdZKC/?lang=en&format=pdf

14. Collins, D. J., Pilotti, C. A., & Wallis, A. F. A. (1992). Triterpene acids from some Papua New Guinea *Terminalia* species. *Phytochemistry*, *31*(3), 881-884. https://www.sciencedirect.com/science/article/pii/0031942292800319

15. Mahato, S. B., & Kundu, A. P. (1994). 13C NMR spectra of pentacyclic triterpenoids – A compilation and salient features. *Phytochemistry*, *37*(6), 1517-1575. https://www.sciencedirect.com/science/article/pii/S0031942200895692

16. Li, X. C., Joshi, A. S., Elsohly, H. N., Khan, S. I., Jacob, M. R., Zhang, Z., Khan, I. A., Ferreira, D., Walker, L. A., Broedel, S. E. Jr., Raulli, R. E., & Cihlar, R. L. (2002). Fatty acid synthase inhibitors from plants: Isolation, structure elucidation and SAR studies. *Journal of Natural Products*, *65*(12), 1909-1914. https://pubs.acs.org/doi/full/10.1021/np020289t

17. Miyazawa, M., & Hisama, M. (2003). Antimutagenic activity of flavonoids from *Chrysanthemum morifolium*. *Bioscience, Biotechnology, and Biochemistry*, *67*(10), 2091-2099. https://academic.oup.com/bbb/article/67/10/2091/5944630

18. Agrawal, P. K. (1989). Carbon-13 NMR of flavonoids. In *Studies in Organic Chemistry* (Vol. 39). Elsevier.

19. Markham, K. R., Ternai, B., Stanley, R., Geiger, H., & Mabry, T. J. (1978). Carbon-13 NMR studies of flavonoids III: Naturally occurring flavonoid glycosides and their acylated derivatives. *Tetrahedron*, *34*(10), 1389-1397. https://www.sciencedirect.com/science/article/pii/0040402078883367

The time of ecological rights

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ABSTRACT

The article analyzes the metamorphosis of law to the end of the promotion of ecological rights. It takes as a hypothesis whether the promises of the social contract have been fulfilled in relation to the collective good of the environment in the face of the transformations of law, society and the State in modernity. To this end, first, by linking the memories of the past, the axes of individual (or private) law and the successive solutions adopted until the contemplation of collective rights in the 1988 Constitution, with the solution of global, local and radiated collective conflicts, will be rescued; second, by turning off the past to connect the future, the standardization of ecological rights in a constitutional text will give us the opportunity to list environmental principles and outline the distribution of administrative and legislative competences in environmental matters; and, thirdly, by zooming in on the main general environmental laws, confirm that the law is transformed and that it can offer means for the recovery of the environmental deficit, according to the rural environmental registry (CAR), the environmental recovery program (PRA), the protected territorial spaces, the administrative licenses, etc., with the possibility of three-dimensional responsibility of the polluter. In conclusion, we want to confirm the hypothesis of the problem of the metamorphosis of the law and its virtuous image in front of the social mirror with the commitment to preserve and protect the environment. Finally, guided by the hypothetical-deductive method, the article makes an evaluative approach to the formal sources of the environment, based on books, scientific articles, public hearings, jurisprudence and legislation.

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Keywords: Time of the law, Constitutional promise, Ecological Principles, Responsibilities of the public power, Three-dimensional responsibility.

INTRODUCTION

The article analyzes the time of law in the field of ecological rights, with the intention of linking and disconnecting the past and the future.

In methodology, it is intended to confirm or refute the metamorphosis of law, as well as its instrumentalization to recover and protect the environment.

In development, the work was structured in four phases. The first phase is the inquiry phase. The second phase is the panoramic phase. The third phase is the zoom phase. The fourth phase is the reflective phase or the final considerations.

The inquiry phase brings the motivations of the research, treading the paths to follow. To this end, the question is asked: is it possible to verify the transformations of law, society and the State in relation to the protection and recovery of the environment as a promise of the contemporary social contract?

In the second panoramic phase, to answer the previous question, the theoretical development will be carried out. As a premise, by linking the past, an attempt will be made to rescue the axes of the ideology of individual (or private) right, of the "status libertatis", basically founded on freedom and property, in order to, subsequently, by turning off the past, linking the future with the promise of collective rights in the 1988 Constitution and its new typology in the solution of collective conflicts.

Connected to the future, by regulating the chapter on the environment in the 1988 Constitution, it is intended to identify the legal provisions related to the theme and, then, to evaluate the content. From this logical and rational exercise, ecological principles will appear - prevention, precaution, polluter-pays responsibility and democratic participation - as general structuring clauses of the system, serving as inspiration, guidance and integration of the rules.

Still in the panoramic phase, in view of the responsibilities attributed to the public power, it is appropriate to present the distribution of administrative competence and concurrent legislative competence in environmental matters between the Union, States, Federal District and municipalities, in order to understand the extent of the constitutional promise and the complexity of the legal tasks assigned to each of the public entities of the three spheres in the construction of the legal system.

In the third zoom phase, by expanding the focus on environmental legislation, at the federal level, the main environmental ones will be analyzed, with the respective solutions adopted over time, to prove the existence of legal instruments for electronic registration of the rural environmental registry (CAR), the environmental recovery program (PRA), protected territorial spaces, environmental zoning, prior environmental impact study and administrative licenses for the preservation of the environment.

Still in the zoom phase, in view of the definition of constituent elements of the environment, the legislator's concern with holding the polluter, individual or legal entity, accountable in three

dimensions, will be verified, with the details of the possible legal consequences in the administrative, civil and criminal spheres, so that a better understanding of the legal duties and the regulation of the constitutional project is obtained.

The fourth phase of the final considerations will bring objective reflections on the research. With our eyes turned to the formal reality, we want to confirm the hypothesis raised about the transformations of the law and its instrumentalization for the protection of the environment as a good for common use.

DIALECTICS OF DIVERSE: INDIVIDUAL AND COLLECTIVE

By the social contract, the entire legal order is thought of as a promise, in the sense of a norm, reciprocally establishing the obligations for the people and for the government.

The people entrust to the government the task of establishing general and permanent laws, for the public good, under the commitment of the rulers to respect individual rights and their respective inviolability according to the social contract (constitution).

The law results from the close relationship between the two elements, the people and the government, and must sanction the rights of the people based on the ideals of personal property (freedom of psychic and moral action) and real property (freedom to dispose of things). Freedom is the *"first property of man"* (SEABRA, 1850, p. 16, 31-32),

In the mirror of nineteenth-century society, constitutions, codes and laws develop on the axes of property and freedom, approaching the vision of John Locke. By the spectrum of *status libertatis,* individualism is positioned at the center of the dimensions of conflicts. These are individual disputes arising from private, subjective, divisible and available law.

Over time, however, new fundamental rights began to be conceived and other social rights emerged, detaching freedom from property to bring freedom closer to the conception of equality, according to the conception of Jean-Jacques Rousseau (ANTERO, 1979, p. 83-84).

In the twentieth century, the *"successive solutions of law"* (OST, 2005, p. 61) are perceptible, in order to, without breaking the thread that connects them, transform the liberal State into a Social State and from a Social State to a Democratic State of Law, opening the way for the solution of collective conflicts and individual conflicts.

It is the time of the *status civitatis*, a period in which the State reassumes its political promise and regulates individual and collective rights, in a *"new dialectic of diverse, not opposites"* (FIGUEIREDO, 1989, p. 20-22). Public issues are of interest to everyone and, therefore, access to information and democratic participation in decision-making in the interest of the community are guaranteed.

The right to property and its respective inviolability continue to be enshrined in the 1988 Constitution (Article 5, XXII), preserving the line of individual or private rights, but now combined by the collective promise of the social function of property (Article 5, XXIII), to limit individual freedom in the face of the socio-environmental responsibility expected in society.

Issues involving the environment, consumer relations, goods and rights of artistic, historical, touristic and landscape values and economic issues are of interest to the community. In addition, procedural instruments (public civil action, collective writ of mandamus, popular action, writ of injunction, habeas data) are made available for the effective protection of collective rights.

Collective rights transcend the individual and, therefore, are called transindividual rights. In kind, there are collective rights in the strict sense and diffuse rights. The latter bring subjects linked by circumstance of fact, the former bring certain categories, groups or classes of subjects linked by a legal relationship. Both are conceptualized in legislation along with homogeneous individual rights and all can be the object of protection in collective proceedings through adequate representation.

Although historically relevant, the concepts of diffuse, collective and homogeneous individual rights do not allow us to affirm what transindividual rights are and whose rights are. Thus, based on concrete cases, there are those who propose the reconstruction of the concepts related to the collective process by categories of global, local and irradiated collective disputes, according to the *"typology of litigation, a new starting point for collective protection"* (VITORELLI, 2020, p. 93-118),

It is not the objective to discuss the structural collective process, however, with the intention of showing the reality, in the first category, there are global collective litigations, with injuries that do not affect people directly, but affect the goods of interest to the collective (for example, global warming); then, in the second category, there are local collective disputes with injuries that specifically and seriously affect certain groups of people (for example, illicit mineral extraction in indigenous territory); and, in the third category, there are radiated collective litigations, equated to mega-conflicts, with injuries that affect people and property to different degrees and extents (for example, the disaster in Mariana-MG, with the rupture of the dam, the avalanche of mineral tailings caused work accidents, fatalities, bodily injuries, destroyed property, memories and families, etc.).

Finally, whether due to contractual liability, or non-contractual liability, or liability for an unlawful act, the fact is that injuries to the environment have practical implications in the lives of people in society and, in this context, as diffuse collective rights, they deserved a specific chapter in the 1988 Constitution, inaugurating ecological rights. Thus, it is opportune to empirically verify the articles related to the environment in the constitutional text and, based on the evaluation of the content, to list the ecological principles (prevention, precaution, responsibility of the payer-polluter and participation) and to present the distribution of concurrent administrative and legislative

competences in environmental matters in the three spheres of the federation (Union, States, Federal District and municipalities), so that a broad understanding is obtained. At the same time, it needs the constitutional promises and the plan of tasks for the recovery of environmental liabilities.

ECOLOGICAL RIGHTS IN THE CONSTITUTION

The environment was regulated in article 225, and paragraphs, of Chapter VI, *"On the Environment",* Title VIII, *"On Social Order*", of the 1988 Constitution.

The increase in pollution and the harmful consequences to the environment associated with technological advances and the finiteness of natural resources, non-renewable or difficult to renew, are the material sources that resulted in the creation of formal sources on constitutional ecological norms and principles.

Alongside negative rights (individual freedoms), positive rights (political, social, environmental, cultural, and economic) emerge. In doctrinal classification, political freedoms and rights are first-generation rights; social, economic and cultural rights, of the second generation; and ecological rights, composing collective rights, of the third generation. It is *"the right to live in an unpolluted environment"* (BOBBIO, trans. COUTINHO, 2004, p. 9).

Replacing individualism with collective well-being, a continuous planning project is required for the use of natural resources, for the fulfillment of the requirements of the social function of property and for the definition of the parameters for the responsible use of the right to property, in search of a balance between economic development, quality of life and the preservation of the environment. translating a balance to sustainable development (article 225, "caput").

Prevention was elevated to a condition of principle, in the sense of requiring the performance and publication of prior studies on environmental impacts before granting the environmental license for the installation of a work or activity potentially causing environmental degradation, *"in accordance with the law"* (article 225, paragraph 1, IV). As a principle, prevention is transformed into a general clause, which will serve as the basis of validity for the structuring of other infra-constitutional laws.

The same occurred with the elevation of precaution to the condition of principle. In the precautionary principle, there is no scientific certainty about the impacts caused by activities or works that are potentially harmful to the environment. Thus, in the absence of scientific certainty about the adverse reactions of the activities (for example, oil exploration in an environmental preservation area), as a precaution (article 5, paragraph 3, c/c article 225), the granting or revocation of the environmental license must be denied, in addition to the possibility of liability.

The polluter-pays principle and the principle of responsibility were jointly regulated in the text of the Constitution (article 225, paragraph 3), with the possibility of three-dimensional liability

of the person who caused damage to the environment, whether an individual or a legal entity. The polluter must bear the preventive costs, to avoid environmental impacts, but if there is environmental damage, it must bear the costs for the restoration of the affected environmental area. Thus, based on the general clause, it will be perceived that there is a commitment in infra-constitutional legislation to define the legal elements that make up the environment and the responsibility of the subjects causing pollution in the administrative, criminal and civil fields.

Alongside prevention, precaution and the responsibility of the polluter pays, democratic participation was also elevated to a constitutional principle. Thus, in view of the standardization of the rational use of natural resources, the imposition of requirements for the social function of property and the creation of parameters for the responsible use of the right to property, the environment was recognized as a good for common use and, in this condition, an unavailable patrimony whose duty to act in its defense and protection is imposed on all individuals, companies, civil society actors and bodies in the *"three spheres"* (SIRKIS, 1999, 719). In other words, the *"quality of the environment is transformed into a good, a heritage, a value itself, whose preservation, recovery and revitalization have become an imperative of the Public Power"* (SILVA, 2013, p. 818).

When referring to the participation of the Public Power in the three spheres, it is meant that the administrative competence is common between the Union, the States, the Federal District and the Municipalities, that is, all of them must join efforts to protect the environment and to combat pollution (Article 23, VI).

When it comes to legislative competence in environmental matters, however, it is up to the Union, the States and the Federal District to legislate the general rules on forests, hunting, fishing, fauna, soil conservation, use of natural resources, protection of the environment and pollution control (Article 24, VI), although, in practice, "the states, in general, behave much more as licensing bodies for effectively or potentially polluting activities than as managers of environmental policies in macro sense." (MARQUES, 2000, p. 28).

The municipalities, as long as they respect the general rules of the federal and state plans, have exclusive competence to legislate on *"matters of local interest"* (Article 30, I). Thus, it is up to them to institute the licensing system for polluting or potentially polluting activities (V); prepare the municipal zoning plan, the subdivision of urban land, with environmental protection (VIII); the realization of previous environmental impact studies and awareness through education (VI); the organization, control and inspection of public cleaning services for the collection and transportation of solid waste; landfills, waste trade, incineration plants, etc. (DELGADO, 2000, p. 48).

In this sense, as long as the distribution of competence is respected, the legal duties of the Union, the States, the Federal District and the municipalities are established (article 225, paragraph 1), especially to preserve and restore ecological processes, provide for the ecological management of

species and ecosystems (I), preserve the integrity of the genetic heritage, supervise entities destined to research and manipulation of genetic material (II), define the protected territorial spaces (III), require a prior environmental impact study (IV), control the production and commercialization of substances, as well as the controlled disposal of their respective packaging, as they are harmful to the environment, the quality of the environment and life (V), promote environmental education to raise awareness for the preservation of the environment (VI), protect fauna and flora (VII) and also maintain a favorable tax regime for biofuels and low-carbon hydrogen (VIII).

There are other passages on the environment in the 1988 Constitution (MEIRA, 2008, p. 21). In addition to the possibility of protecting the environment by means of popular action (Article 5, LXXIII) and by means of public civil action (Article 129, III), the protection of the environment is elevated to a general principle of economic activity (Article 170, VI); the rational use of natural resources and environmental preservation become assumptions of the social function of rural property (art. 186, II); the environment becomes an object of interest of the unified health system (art. 200, VIII); Finally, the importance of indigenous peoples for the preservation of the environment and the importance of preserving the environment for survival was recognized (art. 231, §1).

Finally, in view of the ecological promises in the 1988 Constitution, it is now essential, as a next step, to evolve towards the empirical verification of the general environmental laws, at the federal level, which serve to regulate environmental principles and to sanction the tasks, especially with the intention of proving the transformations of the right over time and confirming whether there are advances in the definition of potregulated areas and the implementation of the rural environmental registry and the environmental recovery program, in addition to bringing elements for three-dimensional responsibility.

THE MOSAIC OF LEGISLATION

It is the infra-constitutional laws that will define the constituent elements of the environment necessary to sanction the constitutional duties.

In the legal system, infra-constitutional laws are hierarchically located below the Constitution that gives them the basis of validity (KELSEN trans. MACHADO, 2011, p. 221).

At the federal level, environmental laws are general norms, applicable throughout the national territory and that serve as beacons for state laws and the organic laws of the municipalities, hence the intention to, at least briefly, analyze them to verify the metamorphosis of the right to sustainable development.

There are records that the first environmental rules emerged in colonial Brazil, with the Manueline Ordinances, until the beginning of the seventeenth century, and the Philippine

Ordinances, mandatory in the kingdom and in the colonies, *"to combat the smuggling of brazilwood and contain attacks on the Amazon"* (FREITAS, 2006, p. 23).

Although it is not the objective to make a detailed analysis, however, there are several environmental laws, codes and decrees on the environment (forests, mines, fauna, pesticides, environmental crimes, etc.), whose separate analysis will allow us to organize ideas and, more than that, to empirically verify the transformation of ecological rights.

FOREST CODE

The first forest code was instituted by Decree 23.793/1.934, during the Republic, and authorized the felling of up to three-quarters of the forests on rural properties.

Subsequently, Law No. 4,771/1,965 revoked Decree No. 23,793/1,934 and brought with it the first legal restrictions on property rights, such as the prohibition of the use of fire in forests and the definition of permanent preservation areas (APP), which was revoked by Law No. 12,651/2,012.

By instituting the new Forest Code, Law No. 12,651/2,012 is the main environmental legislation for the preservation of forests and native vegetation, with the merits of disciplining the use of land and the conservation of natural resources, defining the various protected territorial spaces and implementing the rural environmental registry (CAR) and the environmental regularization program (PRA).

The rural environmental registry is a mandatory electronic registry that allows environmental agencies to know the exact location of each of the rural properties existing in the national territory and their respective situation in relation to the adequacy of the legal reserve percentages, in order to allow the verification of environmental liabilities and, from there, demand the recovery of the environment.

According to data from the "Permanent Joint Commission on Climate Change", when the new Forest Code came into force in 2012, there were just over 100 thousand rural properties with the CAR and, currently, there are seven million properties with the CAR.

There is still a deficit of native vegetation, which should be protected as a legal reserve or permanent preservation area, however, in any case, the owner, possessor or holder of the area has the duty to conserve the vegetation cover, even transmitting the responsibility to the successor.

Legal reserve areas are the areas of native vegetation that every property must maintain according to the percentage defined by law according to its location (article 12). Thus, if the property is in the forest of the Legal Amazon, the percentage of native vegetation is 80%; if it is in the Cerrado region, 35%; if it is in Campos Gerais, 20%; and if it is in the other regions, 20%. The percentages in question can be increased or reduced, provided that there is scientific data and that they respect the legal criteria.

The Forest Code also protects permanent preservation areas (articles 4 to 6), that is, the marginal strips of natural watercourses; the areas around springs and perennial water holes, the slopes, the sandbanks, the mangroves, the edges of tablelands or plateaus, the tops of hills, mountains and mountains, the areas at an altitude of more than one thousand and eight hundred meters and the paths. Only in the case of public utility, social interest or activities with low environmental impact will it be possible to authorize the suppression of vegetation.

That said, the registration of the rural property in the CAR will allow the identification of environmental liabilities and adherence to the environmental recovery program (PRA), in order to, from the signing of the term of commitment, grant a deadline for environmental recovery. However, the greatest difficulty or challenge of the Forest Code appears with the implementation of the PRA (articles 59 and 60), because, although the Union has edited the general rules, the States do not comply with the detailed duties, considering their territorial, climatic, historical, cultural, economic and social peculiarities, in addition to enormous obstacles due to insufficient equipment of the environmental inspection agencies.

LAW OF ENVIRONMENTAL CRIMES AND EXTRAVAGANT TYPES

In 1940, the Law of Introduction of the Penal Code typified conducts harmful to the environment as types of criminal misdemeanors in its article 3.

Law No. 5,197/1,967, when providing for wild fauna, defined that animals living outside captivity constitute wild fauna, including nests, shelters and natural breeding sites, and that all are owned by the State (Article 1), prohibiting the collection, persecution, use, hunting (Article 2) and trade of wild animals (Article 3).

A few years later, with the enactment of Law No. 7,653/1,988, however, the conducts previously typified as misdemeanors were elevated to the category of environmental crimes (article 27). In addition, the law authorizes the seizure of game products and instruments used in the offense (article 33) and, finally, environmental crimes were considered non-bailable (article 34).

Law No. 9,605/1,998, called the "Law of Crimes Against the Environment", typifying crimes against fauna (articles 29 to 37), crimes against flora (articles 38 to 53), pollution crimes (articles 54 to 61), crimes against urban planning and cultural heritage (articles 62 to 65) and crimes against environmental administration (articles 66 to 69-A), in addition to administrative infractions, of which it is sufficient for the authorities to become aware of them to initiate criminal prosecution. In these conflicts, the report finding that the damage has been repaired is a mandatory condition.

There are still other criminal types in specific environmental laws. For example, Law no. **Law 14.785/2.023, called the "Pesticides Law". By way of clarification, pesticides are products and agents (physical, chemical or biological) intended for use in agricultural sectors, pastures**

or planted forests, with the purpose of altering the composition of flora or fauna, under the pretext of preserving the harmful action of harmful living beings. According to recent legislation, **it is considered a crime to produce, store, transport, destine, use or sell pesticides, environmental control products or the like "not authorized by law" (article 56), or even "in disagreement with the law" (article 57).**

Criminal offenses can be committed by individuals (offender, director, administrator, board member or technical body) and by legal entities, with the possibility of piercing the corporate veil and holding the partners liable. With regard to criminal sanctions, the individual offender is subject to the penalties of loss of liberty, restrictions of law and fine. In the case of legal entities, however, there is no custodial sentence, and penalties of fines, restrictions of rights (suspension of activities, temporary prohibition of establishment, work or activity and prohibition of contracting with the public authorities) and provision of services to the community (funding of environmental programs and projects, execution of works to recover degraded areas, maintenance of public spaces and contributions to public environmental or cultural entities), in addition to the loss of assets in favor of the National Penitentiary Fund after the final and unappealable sentence.

NATIONAL ENVIRONMENTAL POLICY LAW

Without precedent in legislation, Law No. 6,938/1,981 instituted the National Environmental Policy, to preserve, improve and recover environmental quality.

It is understood that only the State is capable of curbing environmental aggressions with environmental education and the management of legal instruments (SANTOS, 1999, p.185).

Environmental zoning, prior environmental impact studies and environmental licensing – of North American origin (BENJAMIM, 2001, p. 12-14) – are instruments used by the State before authorizing the execution of works or activities that are harmful to the environment.

Based on scientific data, the State establishes the measures and limits of the *"legal standards of environmental quality and tolerated conducts"* (ZAPATER, 2020, p.7), in order to enable administrative decision-making on requests for the granting of environmental licenses; authorization of products, trade, and harmful activities; mandatory information on origin, labeling, storage, transportation and disposal of packaging etc.

It is in this context that the National Environmental Policy Law creates the National Environmental System (SISNAMA), to gather scientific data, and sets the objectives of the national policy of making economic and social development compatible with the preservation of the environment; the definition of priority areas for ecological balance, the establishment of environmental quality criteria in relation to the rational use of natural resources; the dissemination of

environmental management technologies and environmental data; environmental restoration and preservation, in addition to the responsibility of the polluter (Article 4).

OTHER ENVIRONMENTAL LAWS

There are other environmental standards. This is the case of Law No. 9,985/2,000, which regulated article 235 § 1, items I, II, III and VII, of the Constitution, and instituted the full protection unit and the sustainable use unit, establishing which are the territorial spaces of public domain and expropriable private domains, imposing prohibitions and restrictions on access, as well as authorizing the research and exceptional permanence of indigenous peoples, extractivists, quilombolas and traditional peoples, etc.

Decree-Law No. 227/1,967, known as the "Mining Code", regulates the rights over mineral or fossil substances found on the surface or inside the earth, forming what is understood as the country's mineral resources; By defining the competence, the law established that it is the responsibility of the Federal Government to inspect mining, distribution, trade and consumption, with priority to research and license registration, provided that the requirements of environmental codes and laws are met, including to repair environmental damage and to indemnify third parties, in the case of damage caused by mining activities. with the closure of the mine and the dismantling of facilities, dams and tailings, in addition to the application of administrative and criminal sanctions (articles 1, 2, 3, 11 and 43-A).

Recently, **Law 14,785, of December 27, 2023, called the "Pesticides Law", revoked the old Law 7,802/1,989, and began to regulate the new rules on pesticides, bringing not only the legal definition of these harmful agents and products, but also providing for production, labels, trade, use, import, export, final disposal of waste, disposal, etc. (article 1). In addition,** the registration of products with a federal agency is required and registration will only be granted when the toxic action on human beings and the environment is equal to or less than the products and agents already registered for the same purpose and provided that there is the possibility of effective treatment (article 2, VIII and XXVI). Hence it is stated that pesticides transcend the diffuse rights of the environment to reach the diffuse rights of health and consumers.

THREE-DIMENSIONAL RESPONSIBILITY

It can be seen that general environmental laws define the constituent elements of the environment necessary for the polluter to be held accountable.

Thus, whenever the normal qualities and conditions of water, air, soil, fauna, flora or human health are affected, there will be " *ecological damage" or "environmental damage"* (FRANÇA, 1996, p. 105).

Environmental damage is, in general, difficult or impossible to repair, and can affect health, safety, well-being, socioeconomic activities, the biosphere and environmental conditions. Thus, the repair of environmental destruction, when and as long as possible, is slow and costly.

Based on environmental legislation, it was possible to delineate what they call three-dimensional liability, since conducts, works and activities that are effectively harmful to the quality of the environment will subject the person of the polluter to sanctions in the administrative sphere, sanctions in the criminal sphere and sanctions in the sphere of civil liability.

Administrative power is peculiar to the Union, the States, the Federal District and the Municipalities. Thus, respecting the jurisdiction, administrative sanctions are those that result from administrative procedures and that result in the application of a warning, fine, seizure, temporary or definitive interdiction of activity, destruction of product, embargo, demolition of work, suspension of benefit, seizure, cancellation of registration, destruction, etc., as established in article 3 of Decree No. 6,514/2,008.

Civil liability is the one that imposes on the offender the obligation to compensate for the damage caused by his polluting activity or work. Civil liability can arise from a contract, it can be extra-contractual and it can be for an unlawful act (unlawful conduct) or a lawful act (risky activity). In any case, when it comes to the environment, the rule is strict civil liability, that is, there is no room for the discussion of fault or exclusion of liability.

Still on civil liability, it is worth remembering the typology of global collective litigation, local collective litigation and radiated collective litigation, respectively, with the occurrence of damages that exclusively affect the environment, damages that specifically affect certain groups of people and damages that will affect the environment and people, simultaneously, to different degrees and extents, but that, in all situations, will require the perpetrator to fully repair the damage caused.

In fact, the Federal Supreme Court, on Topic 999, admitted Extraordinary Appeal No. 654833, in light of articles 1, III, 5, V and X, 37, paragraph 5, and 225, paragraph 3, of the Constitution, to distinguish the object protected in terms of prescription. Thus, if the legal interest protected is eminently private, the normal deadlines for indemnification actions prescribed in civil legislation are followed; However, if it is found that the protected legal interest is unavailable, fundamental, preceding all other rights, since there is no life without it, the right to reparation for environmental damage is considered imprescriptible.

Finally, criminal liability occurs for the commission of a crime or misdemeanor, typified in the laws of environmental crimes and other extravagant crimes, as exposed above. These are criminal offenses against the environment that offend the interests of the community (LECEY, 2000, p. 52-53). Thus, due to the relevance of the good in the scale of social values, criminal protection

becomes necessary as a social response, as an instrument of pressure for the solution of the conflict, as an instrument of effectiveness of general norms and as an instrument of prevention.

RESULTS

The results confirm the metamorphic state of law, as if law reflected the transformations of society and the State over time.

It was confirmed that, in view of the transformations from the liberal State to the Social State and, later, from the Social State to the Democratic State of Law, collective rights began to be contemplated in the Constitution.

It can also be empirically confirmed that ecological rights have been elevated to a category of constitutional norms and principles, serving as a basis and parameter for the creation, application and interpretation of infra-constitutional laws on the environment, in addition to a plan of tasks to the public power, with the distribution of crystalline competence of the Union, of the States, the Federal District and the municipalities.

By focusing on the infra-constitutional legislation, at the federal level, in an empirical way, the existence of several laws, decrees and codes on the environment was confirmed, highlighting the transformations of environmental law, with the revocation of one diploma by another, or, if not, new diplomas emerged, in search of the creation of legal instruments and programs aimed at the recovery of environmental liabilities, for the preservation of the environment and for democratic participation.

DISCUSSION

It takes as a hypothesis whether the promises of the social contract have been fulfilled in relation to the collective good of the environment in the face of the transformations of law, society and the State in modernity. Thus, in theoretical contextualization, based on the analysis of the work "The Time of Law", by Francois Ost, we chose to adapt the structural ideas of the classic – that is, "Memory. Linking the past", "Forgiveness. Turning off the past", "Promise. Connecting the future" and "Questioning. Turning off the future" – to confirm the metamorphosis of law, but now focusing on the field of ecological rights in Brazil.

CONCLUSION

In reflection, the existence of the metamorphic mode of law was confirmed, that is, that law is transformed according to the reality reflected in the social mirror.

Sometimes reflecting the dominant ideology, sometimes reflecting the static moralizing character, sometimes reflecting a more virtuous function of the right to the recognition of rights and

participatory distribution, the substitution of one form for another in successive solutions of the law has been empirically proven.

Although the first environmental laws had appeared in Colonial Brazil, criminalizing the trafficking of brazilwood, it was during the transformations of the liberal State to the Social State and from the Social State to the Democratic State of Law of the 1988 Constitution, in the Republic, that the detachment from the past to connect the future to the promise of ecological rights can be perceived.

By analyzing the 1988 Constitution, the paradigm change was confirmed, by recognizing collective and individual rights, as diverse and complementary to each other, and by disciplining the environment in its own chapter, by recognizing it as a heritage of common use, with norms of a principled nature to structure the system, to inspire the legislator in the creation of new rules, to guide the executive in the application of the rules and to integrate the rules that are lacunae by the judiciary in the solution of global, local and radiated collective conflicts.

Within a plan of legal tasks, it can be seen that each of the entities of the Federation (Union, States, Federal District and municipalities) have a very well-defined role, in terms of the distribution of concurrent administrative and legislative competences in environmental matters, for the construction and implementation of ecological promises in relation to the use of natural resources, the requirements of the social function of property and the parameters for the responsible use of property.

By looking at the general rules, at the federal level, it is possible to confirm not only the successive solutions adopted by the law, with the revocation of one legal diploma by another, but also to confirm that the environmental codes and laws sanctioned the constitutional promises to define protected spaces, to plan the rational use of natural resources, to monitor the quality of the environment, to control activities or works that are potentially harmful to the environment, to control the pesticide chain from manufacture to disposal of packaging, dissemination of scientific data and research, and three-dimensional accountability of the person who caused the damage

By focusing on points considered important, it was seen that the forest code, as the main legislation for the protection of native vegetation, defined the areas of legal reserve and permanent protection, instrumentalized the rural environmental registry (CAR) and the environmental recovery program, although it was also confirmed that the greatest difficulty is in the implementation of the environmental recovery program in view of the insufficient cross-referencing of data to define the environmental liability. Competence attributed to the States, but which have considerable obstacles.

The law of the national environmental policy, in turn, empowered the State with the functional attributions of environmental zoning, prior study of the environmental impact and

concession, suspension or revocation of environmental licenses for activities, works or products harmful to the environment.

On the other hand, after verifying the evolution from misdemeanor to crimes, the law of environmental crimes began to typify crimes against fauna, against flora, pollution crimes, crimes against urban planning and cultural heritage and crimes against environmental administration, in addition to other legal diplomas providing for extravagant crimes (for example, pesticide law), prescribing fines, restrictive of rights and deprivation of liberty.

In a condensed way, it was seen that the law that instituted the units of full protection and sustainable use, defining the areas of public domain, with access restrictions. It was also confirmed that the mining code deals with mineral resources, of interest to the Union, and that it brings the rationalization of mineral exploration in the soil and subsoil. Finally, we updated the text with the recent pesticide law, pointing out not only the concept of pesticides, but also the need for control from registration to disposal.

In the final part, by analyzing the set of environmental laws and codes, it is possible to confirm the regulation of the principle of the polluter-pays' responsibility for ecological damage, with the possibility of applying administrative sanctions (warning, fine, suspension or reregulation of license, embargo of work, prohibition of activity, product, etc.); the possibility of strict civil liability, with the obligation to repair the damage caused to the environment (global collective disputes), to people (local collective disputes) and to the environment and to people simultaneously (radiated collective conflicts), recorded by the imprescriptibility of the environmental damage under review for life; and, finally, with the possibility of criminal liability

About the "Questioning. Detach the future", it only remains for us to say that Brazilian environmental legislation is quite advanced and that, at present, more than the edition of new rules, it is necessary to enforce the legal instruments and programs for the recovery of environmental liabilities that already exist, in order to finally fulfill the constitutional promise.

REFERENCES

1. Antero, P. H. C. (1979). O pensamento político de Rousseau. *Teoria Política – Cadernos da UnB*.

2. Audiência Pública. (2024, 20 de junho). Debate mostra implementação do Código Florestal e do CAR ainda é desafio. *Agência Senado*. Disponível em: https://www12.senado.leg.br/noticias/materias/2024/06/20/debate-mostra-implementacao-do-codigo-florestal-e-do-car-ainda-e-desafio (Acessado em 2 de setembro de 2024).

3. Benjamin, A. H. (2001, 21 de agosto). Direito ambiental no Brasil e nos Estados Unidos. Palestra proferida no curso Introdução ao Direito Norte-americano. Degravado por Fernanda Nunes Barbosa e revisado por Marcelo Leal. *STJ*. Disponível em: https://www.stj.jus.br/direito_ambiental_brasil_benjamin.pdf (Acessado em 17 de janeiro de 2024).

4. Bobbio, N. (2004). *A era dos direitos* (C. N. Coutinho, Trad., 7a ed.). Rio de Janeiro: Elsevier. Disponível em: https://www.usp.br/era.dos.direitos_gout.p65 (Acessado em 4 de fevereiro de 2024).

5. Brasil. (1988). Constituição da República Federativa do Brasil. Disponível em: https://www.planalto.gov.br/Constituicao (Acessado em 14 de janeiro de 2024).

6. Brasil. (1967). Lei n. 5.197, 3 de janeiro de 1967. Dispõe sobre a proteção da fauna e dá outras providências. Disponível em: https://www.planalto.gov.br/L5197compilado (Acessado em 5 de setembro de 2024).

7. Brasil. (1967). Decreto-lei n. 227, de 28 de fevereiro de 1967. Dá nova redação ao Decreto-lei n. 1.985, de 29 de janeiro de 1940 (Código de Minas). Disponível em: https://www.planalto.gov.br/Del0227compilado (Acessado em 23 de janeiro de 2024).

8. Brasil. (1981). Lei n. 6.938, de 31 de agosto de 1981. Dispõe sobre a Política Nacional do Meio Ambiente, seus fins e mecanismos de formulação e aplicação, e dá outras providências. Disponível em: https://www.planalto.gov.br/L6938 (Acessado em 19 de janeiro de 2024).

9. Brasil. (1988). Lei n. 7.653, de 12 de fevereiro de 1988. Altera a redação dos arts. 18, 27, 33 e 34 da Lei n. 5.197, de 3 de janeiro de 1967, que dispõe sobre a proteção à fauna, e dá outras providências. Disponível em: https://www.planalto.gov.br/L7653 (Acessado em 21 de agosto de 2024).

10. Brasil. (1998). Lei n. 9.605, de 12 de fevereiro de 1998. Dispõe sobre as sanções penais e administrativas derivadas de condutas e atividades lesivas ao meio ambiente, e dá outras providências. Disponível em: https://www.planalto.gov.br/L9605 (Acessado em 6 de setembro de 2024).

11. Brasil. (2000). Lei n. 9.985, de 18 de julho de 2000. Regulamenta o art. 225, § 1o, incisos I, II, III e VII da Constituição Federal, institui o Sistema Nacional de Unidades de Conservação da Natureza e dá outras providências. Disponível em: https://www.planalto.gov.br/L9985 (Acessado em 8 de setembro de 2024).

12. Brasil. (2001). Lei n. 10.257, de 10 de julho de 2001. Regulamenta os arts. 182 e 183 da Constituição Federal, estabelece diretrizes gerais da política urbana e dá outras providências. Disponível em: https://www.planalto.gov.br/L10257 (Acessado em 14 de janeiro de 2024).

13. Brasil. (2008). Decreto n. 6.514, de 22 de julho de 2008. Dispõe sobre as infrações e sanções administrativas ao meio ambiente, estabelece o processo administrativo federal para apuração destas infrações, e dá outras providências. Disponível em: https://www.planalto.gov.br/Decreto6514 (Acessado em 11 de março de 2024).

14. Brasil. (2012). Lei n. 12.651, de 25 de maio de 2012. Dispõe sobre a proteção da vegetação nativa; e dá outras providências. Disponível em: https://www.planalto.gov.br/L12651compilado (Acessado em 20 de janeiro de 2024).

15. Brasil. (2023). Lei n. 14.785, de 27 de dezembro de 2023. Dispõe sobre a pesquisa, a experimentação, a produção, a embalagem, a rotulagem, o transporte, o armazenamento, a comercialização, a utilização, a importação, a exportação, o destino final dos resíduos e das embalagens, o registro, a classificação, o controle, a inspeção e a fiscalização de agrotóxicos, de produtos de controle ambiental, de seus produtos técnicos e afins. Disponível em: https://www.planalto.gov.br/L14785 (Acessado em 21 de janeiro de 2024).

16. Cordeiro, F. A. S. (2001). Constitucionalismo contemporâneo e globalização. *Cidadania e Justiça - Revista da Associação dos Magistrados Brasileiros*, 5(11), 75-76.

17. Delgado, J. A. (2000). Reflexões sobre Direito Ambiental e competência municipal. *Cidadania e Justiça - Revista da Associação dos Magistrados Brasileiros*, 4(9), 37-48.

18. Documentário. (2023). Cortina de Fumaça. *Brasil Paralelo*. Disponível em: https://www.youtube.com/watch?v=hPTlsV2lmBw (Acessado em novembro de 2023).

19. Embrapa. (2024). Entenda a Lei 12.651 de 25 de maio de 2012. Disponível em: https://www.embrapa.br/sobre-a-lei-12651-2012 (Acessado em 20 de janeiro de 2024).

20. Figueiredo, L. V. (1989). *Direitos Difusos e Coletivos*. São Paulo: Editora Revista dos Tribunais.

21. França, M. A. C. (1996). Da Reparação do Dano Ecológico. *Revista da Escola Paulista da Magistratura*, 1(1), 105.

22. Freitas, V. P., & Freitas, G. P. (2006). *Crimes contra a natureza* (8. ed.). São Paulo: Revista dos Tribunais.

23. Kelsen, H. (2011). *Teoria pura do direito* (J. B. Machado, Trad., 8. ed.). São Paulo: Martins Fontes.

24. Lecey, E. (2000). A proteção do meio ambiente e os Juizados Especiais Criminais. *Cidadania e Justiça - Revista da Associação dos Magistrados Brasileiros*, 4(9), 52-53.

25. Lovejoy, T. E., & Nobre, C. (2018). Amazon Tipping Point. *Science Advances*, 4(2), eaat2340. Disponível em: http://advances.sciencemag.org/content/4/2/eaat2340 (Acessado em 9 de setembro de 2023).

26. Marques, J. R. N. (2000). A Constituição Federal e o meio ambiente. *Cidadania e Justiça - Revista da Associação dos Magistrados Brasileiros*, 4(9), 28.

27. Marques, L. (2018). Ponto crítico na Amazônia. *Jornal da Unicamp*. Disponível em: https://www.unicamp.br/unicamp/noticias/2018/03/05/ponto-critico-na-amazonia (Acessado em 27 de janeiro de 2024).

28. Marques, M. (s.d.). Um olhar sobre a construção do “sujeito de direito”. *Boletim da Faculdade de Direito. STVDIA IVRIDICA*, 96, 104. Coimbra Editora.

29. Meira, J. C. (2008). Direito ambiental. *Informativo Jurídico da Biblioteca Ministro Oscar Saraiva*, 19(1), 11.

30. Odeveza, J. (2019). Senado ouve especialistas que negam a ação do homem para mudanças climáticas. *Rádio Senado*. Disponível em: https://www12.senado.leg.br/radio (Acessado em 8 de março de 2024).

31. Ost, F. (2005). *O tempo do direito* (É. Fernandes, Trad.). EDUSC.

32. Rattis, L. (2023). Climatic limit for agriculture in Brazil. *Nature Climate Change*. Disponível em: https://www.nature.com/articles/s41558-023-01521-w (Acessado em 13 de setembro de 2023).

33. Resende, M. A. B., & Frazão, Q. (2017). A tutela do patrimônio cultural na legislação brasileira: Instrumentos de proteção do patrimônio material e imaterial. *Revista Jurídica UNIARAXÁ*, 21(20), 197-219. Disponível em: http://www.mpsp.mp.br (Acessado em 14 de janeiro de 2024).

34. Santini, M., Salles, D. G., & Barros, C. E. B. (2022). Panorama da infodemia socioambiental: uma análise multiplataforma do ecossistema brasileiro de mídia digital (2021-2022). *Netlab UFRJ*. Disponível em: https://www.netlab.ufrj.br/post/panorama-da-infodemia-socioambiental (Acessado em 8 de março de 2024).

35. Santos, L. N. (1999). A ação civil pública como instrumento de proteção ambiental. *Cidadania e Justiça - Revista da Associação dos Magistrados Brasileiros*, 3(6), 185.

36. Seabra, A. L. (1850). *A propriedade: Philosophia do direito* (16ª ed., pp. 16, 31-32). Coimbra. Disponível em: https://www.stf.jus.br (Acessado em 2 de janeiro de 2024).

37. Sirkis, A. (1999). Legislação ambiental e gestão local. *Cidadania e Justiça - Revista da Associação dos Magistrados Brasileiros*, 3(7), 719.

38. Silva, J. A. (2013). *Curso de direito constitucional positivo* (17ª ed.). São Paulo: Malheiros.

39. Souza, A. C., & Lagiodice, R. A. C. (2024). Roteiro de atuação de agrotóxicos. *Ministério Público do Estado de São Paulo*. Disponível em: http://www.mpsp.mp.br/portal/page/portal/Cartilhas/RoteiroAtuacao-Agrotoxico.pdf (Acessado em 24 de janeiro de 2024).

40. STF. (2020). RE 654833/AC - Acre – Repercussão Geral - Tema 999. Relator: Ministro Alexandre de Moraes. Data de Trânsito em Julgado: 19 de agosto de 2020. Disponível em: https://www.stf.jus.br (Acessado em 13 de setembro de 2024).

41. Vitorelli, E. (2024). O devido processo legal coletivo: Quatro princípios pragmáticos de implementação. *Revista do Ministério Público do Estado de Goiás*, 94-97. Disponível em: https://www.mpgo.mp.br (Acessado em 17 de abril de 2024).

42. Vitorelli, E. (2020). Tipologia dos litígios: um novo ponto de partida para a tutela coletiva. *Revista do Ministério Público do Estado do Rio de Janeiro*, 77, 93-118. Disponível em: https://www.mprj.mp.br (Acessado em 22 de agosto de 2024).

43. Zapater, T. C. V. (2020). Princípio da prevenção e princípio da precaução. *Tomo Direitos Difusos e Coletivos*, 1, julho. Disponível em: https://www.pucsp.br (Acessado em 18 de janeiro de 2024).

Effect of transcutaneous irradiation under the radial artery on hemodynamic variables in hypertensive patients: Double-blind clinical study

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ABSTRACT

Systemic Arterial Hypertension (SAH) is a multifactorial clinical condition, with a high rate of morbidity and mortality and low control rates. Although photobiomodulation (FBM) is capable of inducing a photobiological interaction inside cells and modifying the micro and macrovascular response *in situ*, there is a lack of studies that evidence its systemic effect, especially clinical and placebo controlled. Thus, this study aimed to evaluate the modulatory effects on blood pressure control in hypertensive patients after transcutaneous photobiomodulation of the radial artery. To this end, 44 participants were randomly divided into 4 groups, one group irradiated for 60 minutes a day, for 5 days, being repeated after 20 days with a total of 3 cycles (Group A), and their respective placebo (Group B); the third group was irradiated for 30 minutes a day, for 10 days, and repeated after 20 days, also totaling 3 cycles (Group C), and their respective placebo (Group D). All participants remained with previously instituted conventional drug treatment. Before the interventions, after each cycle and at the end of the interventions, blood pressure and heart rate were measured. Before and at the end of the interventions, blood samples were collected to measure interleukins 6 and 1beta. Statistical analysis was performed to compare the groups in each phase of treatment, with $\alpha = 0.05$. Modulatory effects were evidenced in the control of blood pressure in hypertensive patients after photobiomodulation. Group A showed a better response to the reduction of hemodynamic variables than group C. Multidisciplinary care may have increased the adherence to treatment of all participants, including the placebo groups, which also showed a decrease in the values of hemodynamic variables.

Keywords: Photobiomodulation, Systemic arterial hypertension, Hemodynamic variables, Low-level laser.

INTRODUCTION

Systemic Arterial Hypertension (SAH) is currently a risk factor for the development of cardiovascular diseases (CVD) and associated with the aging process, because as we age the risk of developing SAH increases alarmingly. SAH is a chronic non-communicable disease (NCD) of multifactorial origin, with high prevalence and low control rates, characterized by high and sustained levels of systolic and/or diastolic blood pressure (BP), ≥ 140 mmHg and/or 90 mmHg, respectively, and by metabolic alterations leading to the risk of cardiovascular complications, which may be aggravated if accompanied by other risk factors for cardiovascular disease, such as diabetes and hypercholesterolemia. Hypertension is characterized by high and sustained levels of systolic and/or diastolic blood pressure (BP), ≥ 140 mmHg and/or 90 mmHg, respectively, and by metabolic alterations leading to the risk of cardiovascular complications, which is aggravated by the association of other risk factors (RF) for cardiovascular disease (Nobre, 2013 *et al*, 2013); (Bernardi *et al*, 2023); (Amaral Moreira-Mota, 2023).

According to studies by the Global Burden of Diseases (GBD) there is a forecast of about 10.8 million annual deaths and 235 million years of disability-adjusted lives lost related to high blood pressure, unfortunately a silent disease. (DALYs – *Disability Adjusted Life Years* (Liu *et al*, 2023); (Buso *et al*, 2024).

Considered a global public health problem, this disease affects more than 1.2 billion people worldwide, 70 million people in the United States, causing 9.4 million deaths each year worldwide (Lim *et al*, 20122). According to the VII Brazilian Guidelines on Hypertension (2016), it is a chronic non-communicable disease, representing high levels of mortality in the world and can account for up to 75% of deaths in countries in the Americas and the Caribbean (Barroso *et al*, 2021)

The presence of SAH is a condition resulting from genetic/epigenetic, environmental, social, cultural and lifestyle factors3. Among the modifiable risk factors for hypertension are unhealthy diets, characterized by excessive salt consumption, diet rich in saturated fat and trans fats, low consumption of fruits and vegetables; Sedentary lifestyle; tobacco and alcohol consumption and overweight or obesity3. Non-modifiable risk factors include a family history of hypertension, age over 65 years, and coexisting diseases such as diabetes mellitus or kidney disease ((WHO< 2013); (Weber *et al*, 2014); (Oigman, 1987); (Miranda, 2023)

Hypertension has a significant impact on health and socioeconomic costs worldwide, especially in developed countries, where the use of processed foods is common. Regarding the complications of SAH can occur in the target organs, such as the heart (coronary artery disease), heart failure, atrial fibrillation and sudden death; brain (ischemic or hemorrhagic stroke), dementia; kidneys (chronic kidney disease) and arterial system (peripheral arterial obstructive disease) (Siqueira, 2023); (Malta *et al*, 2023).

Regarding hemodynamic variables, hemodynamics can be defined as the area of pathophysiology that is dedicated to the study of circulatory movements and the forces involved in blood circulation. Generally, blood pressure values depend on its fundamental hemodynamic variables: total systemic blood flow (cardiac output) and the resistance offered by blood vessels (Oigman, 1987); (Silva *et al*, 2020).

Blood pressure is determined by the product of cardiac output (CO) by peripheral vascular resistance (PVR). The manifestation of SAH is necessarily related to changes in these parameters (Matozinhos, 2011 *et al*); (Junior *et al*, 2006); (Winlansky *et al,* 2006).

Cardiac output is determined by the product between heart rate (HR) and stroke volume (SV). The increase or decrease of these factors can directly influence the blood pressure value. Circulating blood volume is a determining factor in stroke volume, which depends directly on sodium concentrations. Heart rate control can be influenced by neurological, endocrine and cardiac factors (Matozinhos, 2011 *et al*); (Winlansky *et al,* 2006).

When it comes to the treatment of SAH, it is done through a combination of non-pharmacological and pharmacological treatment, where the first includes the risk of SAH and CVD and the implementation of strategies that can reverse or prevent the progression of these factors, implying mainly in the change of the patient's lifestyle, regardless of blood pressure levels (Batista, et as, 2022); (Barrosos *et al*, 2021).

Adherence to treatment consists of accepting adherence to treatment by following the guidelines of the health professional who attended him. Such guidelines include the prescription or not of drugs, dietary measures, lifestyle changes, such as smoking and alcohol cessation, weight control, and encouragement of regular physical activity (Batista, et as, 2022); (Silva et al, 2022); (Haynes *et al*, 2021).

As non-adherence is identified as the main cause of uncontrolled arterial hypertension, which is a significant risk factor for cardiovascular events according to Araújo and Garcia, (2026), it is necessary to seek therapies that facilitate this process in order to promote improvement in the quality of life of hypertensive patients (Silva *et al*, 2022).

Low Intensity Laser (LLLT), or photobiomodulation (FBM) is a current treatment in the control of SAH, as it is capable of inducing a photobiological response inside cells, activating the production of adenosine triphosphate (ATP), nitric oxide (NO) and reactive oxygen species (ROS), also altering sodium-potassium pumps and calcium channels in cell membranes. Being a light that does not emit heat, LED (Light-Emitting Diode) and LASER (Light Amplification by Stimulated Emission of Radiation), have been the most used light sources for these experiments (Dos Santos *et al*, 2023); Koru *et at*, 1988).

Considering that blood pressure control and adherence to treatment is extremely important in the treatment of hypertension in order to minimize the aggravations and mortality rates due to cardiovascular diseases, it is necessary to seek methods that facilitate the control of this chronic disease.

The use of laser has been shown to be effective in the treatment of inflammatory diseases, however there is much to be explored about photobiomodulation so that this therapy can benefit several areas of health. There is evidence that photobiomodulation compensates for the degeneration of capillaries, in addition, it has been reported that photobiomodulation induces the release of nitric oxide from cells, which triggers vasodilation of nearby blood vessels, increasing blood and lymphatic flow (Dos Santos *et al*, 2023); (Valverde and Mitrofanis, 2022)

Recent evidence in several experimental animal models that photobiomodulation reduces hypertension. In one model, involving constriction of the renal artery, photobiomodulation generates a long-lasting hypotensive effect after a device has been implanted in the abdominal aorta. This effect is thought to be incited by a photobiomodulation-induced vasodilation following a release of nitric oxide. In another model of hypertension, involving the implantation of a cannula in the femoral artery, photobiomodulation applied externally to the abdomen considerably reduced blood pressure, together increasing serum nitric oxide levels (Colombo *et al*, 2021); (Kovalenko *et al*, 2018); (Maksimocich, 2019).

In view of the above, verifying the effects of systemic photobiomodulation on blood pressure control in hypertensive patients is promising and relevant in the current scenario, mainly with the aim of preventing health problems for patients and the consequent high cost to public health, minimizing the gaps in the literature in this area.

This study aimed to describe hemodynamic changes in hypertensive patients when treated with systemic photobiomodulation, and to evaluate whether patients diagnosed as hypertensive were affected by any comorbidity/complication due to post-photobiomodulation SAH.

METHOD

This is a single-center, controlled, randomized, double-blind clinical trial. The number of participants was determined using the G*Power software (version 3.1.9.2, Franz Faul, Universität Kiel, Germany), in which the mean and standard deviation values of the primary outcome variable (systolic or diastolic blood pressure) were inserted. The calculation was performed using ANOVA for independent samples, with a significance of 5% and a test power of 95%. The sample consisted of 44 participants under medical follow-up at the Integrated Health Outpatient Clinic of Universidade Nove de Julho, located in the city of São Paulo, Brazil, from March 2019 to January 2020.

Recruitment was carried out through nursing consultations with hypertensive patients treated at the outpatient clinic.

For the study, the following exclusion criteria were used:

INCLUSION CRITERIA

Hypertensive patients aged between 30 and 80 years who agreed to participate in the study accepted below and signed the ICF (Informed Consent Form). Diagnosis of SAH declared by stage I or II medical certificate.

EXCLUSION CRITERIA

Hypotension prior to photobiomodulation; pregnant women, patients with Glaucoma, patients with electronic implants, such as cardiac pacemakers, epilepsy, seizures, history of neoplasms or photosensitivity.

The project was approved by the Research Ethics Committee of Universidade Nove de Julho under registration CAAE 85714318.3.0000.5511 (Annex A). The protocol of this study was registered in the REBEC (Brazilian Registry of Clinical Trials), with identification RBR-7n55nz, received in February 2019, available in http://www.ensaiosclinicos.gov.br/rg/?q=RBR-7n55nz.

This study presented minimal risks since, according to the literature found, they include the decrease in blood pressure by photobiomodulation.

At first, an analysis of the multiprofessional medical records was carried out with a search for hypertensive patients, finding a population of 284 patients with hypertension. However, the sample that accepted participation in the study and met the inclusion criteria resulted in 44 individuals.

The objective of this study was to evaluate the effects of transcutaneous photobiomodulation under two protocols: exposure time of 60 minutes per day, Group A **(Laser 60),** and 30 minutes per day, Group C **(Laser 30),** with the respective placebo groups Groups B and D (**Placebo 60 and Placebo 30,** respectively):

- **Group A (Laser 60):** individuals using antihypertensive drug therapy and transcutaneous FBM sessions for 60 minutes daily, for 5 days, with repetition after 20 days with a total of 3 cycles.
- **Group B (Placebo 60):** subjects on antihypertensive drug therapy and placebo sessions of transcutaneous FBM for 60 minutes daily, for 5 days, with repetition after 20 days totaling 3 cycles. Placebo was performed by placing a beam shutter at the laser output, but no radiation was delivered to the target.

- **Group C (Laser 30):** subjects using antihypertensive drug therapy and transcutaneous FBM sessions for 30 minutes daily, for 10 days, with repetition after 20 days for a total of 3 cycles.
- **Group D (Placebo 30):** subjects on antihypertensive drug therapy and transcutaneous FBM sessions for 30 minutes daily, for 10 days, being repeated after 20 days with a total of 3 cycles. The placebo was performed by placing a beam shutter on the laser output, however no radiation was delivered to the target.

Blood pressure (primary variable) and heart rate measurements were performed before, during, and at the end of each session. The Mean Arterial Pressure (MAP) was obtained by the formula below:

FORMULA 1

$$PAM = \frac{systolic + (diastolic \times 2)}{3}$$

The data were analyzed using descriptive and inferential statistics and compiled in tables and graphs, with the help of the statistical program Origin 2017.

RESULTS

A single examiner was responsible for the randomization and initial interview. A second examiner was trained to perform anthropometric assessments, measurement of hemodynamic variables, and blood collection. A third examiner was trained to perform the FBM. As this was a double-blind study, the sample did not know the type of intervention that was being submitted and the statistical analysis of the results was performed by a fifth person, without knowledge of the groups.

In the table below, the dosimetry used in this study.

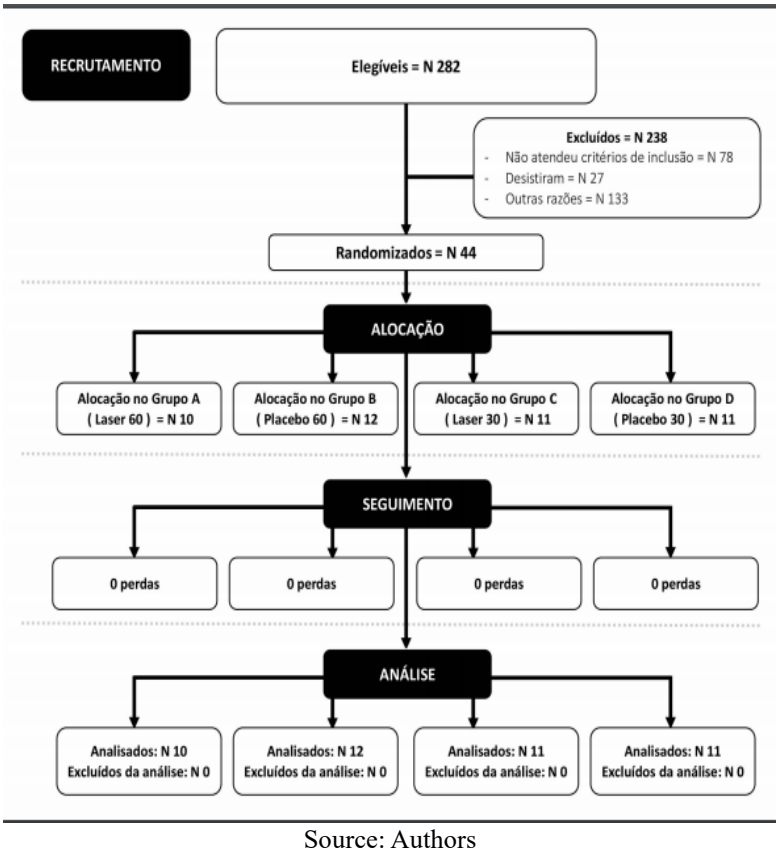
Table 1: Dosimetric parameters proposed for the study.

Protocols	Irradiation 30'	Irradiation 60'
Wavelength (nm)	660	
Mode of operation	Continuous	
Average radiant power (mW)	100	
Polarization	Random	
Opening diameter (cm)	0,06	
Irradiated Area (cm2)	0,003	
Irradiância (W/cm2)	35,386	
Exposure time per stop(s)	1800	3600
Radiant Exposure (J/cm2)	63694,26	127388,53
Radiant energy per session (J)	180	360
Number of irradiated points	1	
Application technique	Contact	
Number of sessions during therapy	30 (3 cycles of 10 sessions)	15 (3 cycles of 5 sessions)

Source: Authors

Figure 1 shows the recruitment and distribution of the participants in the study.

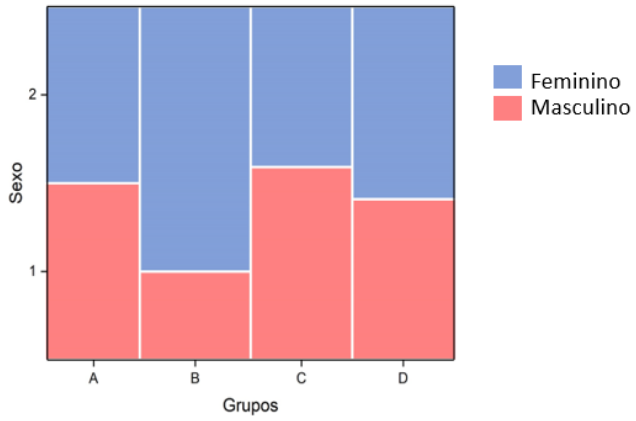
Figure 1: Flowchart of the procedures for inclusion, allocation, follow-up and analysis of participants, according to CONSORT.



Source: Authors

Most participants were female and this distribution did not vary between the groups (p= 0.49207) (Figure 2).

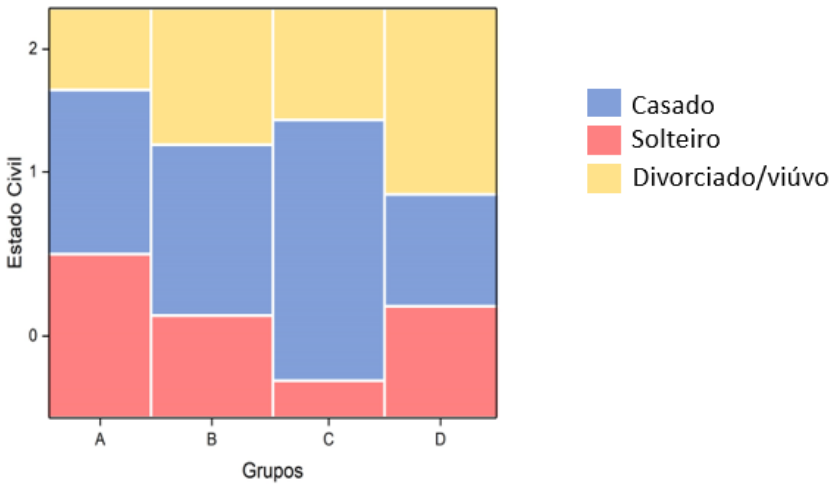
Figure 2: Gender distribution. São Paulo, 2019.



Source: Authors

The mean age of the sample was 62 years, ranging from 39 to 78 years. There was no difference between the groups in terms of age (p = 0.08335). Regarding marital status, the majority of the sample declared themselves married, with no significant difference between the groups (p= 0.55171), as observed in Figure 3.

Figure 3: Distribution of marital status. São Paulo, 2018.



Source: Authors

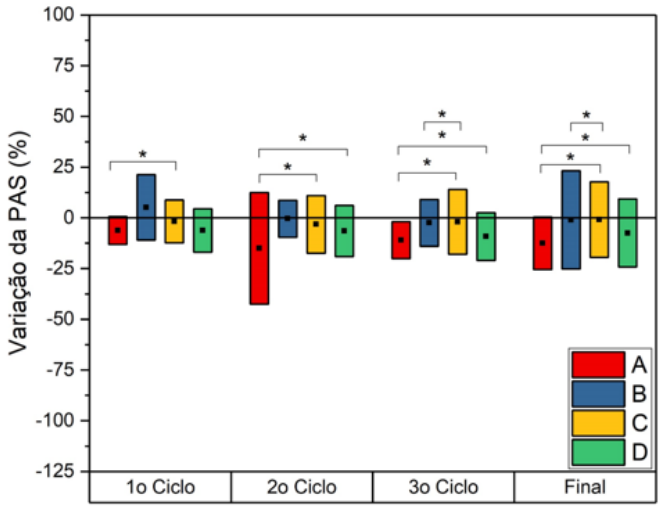
Regarding the hemodynamic data in tables (1, 2, 3 and 4), it is possible to verify the SBP, DBP, MAP, and HR values for each group before the beginning of the interventions (baseline), at the end of the cycles, and after the end of the interventions. Graphs of the variation of these variables in relation to baseline are also shown (Figures 4, 5, 6 and 7).

Table 1: Measured SBP values in each group in the different phases of intervention.

SBP (mmHg)				
Phases	**Group A N= 10**	**Group B N= 12**	**Group C N= 11**	**Group D N= 11**
Baseline	141.7±19.3	135.3±21.4	131.0±26.3	125.4±16.7
End 1st Cycle	132.4±16.0	140.6±20.1	126.6±14.3	116.5±11.5
End 2nd Cycle	118.2±39.0	135.3±17.1	123.9±11.9	116.4±12.8
Final 3rd Cycle	123.5±17.8	131.6±10.6	125.4±15.2	112.8±10.0
Final	123.4±20.0	131.0±23.1	126.1±15.1	114.0±12.0

Source: Authors

Figure 4 - SBP variation between the groups. São Paulo, 2019.



*= p< 0,05.
Source: Authors.

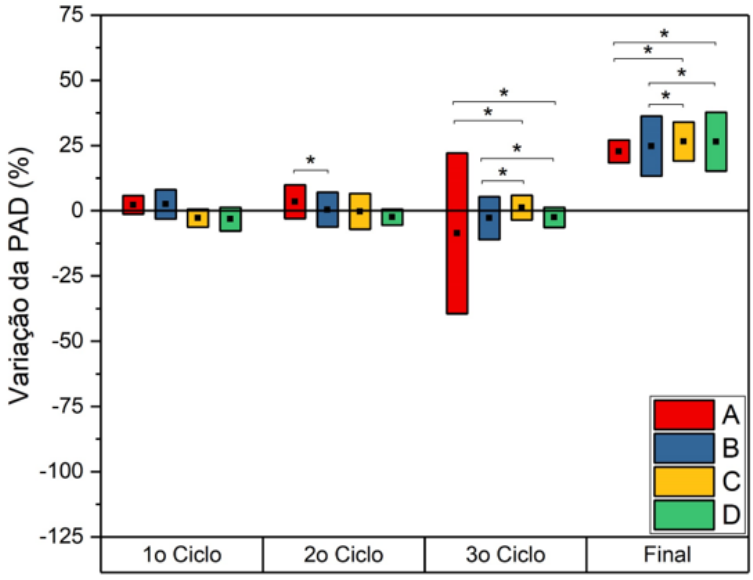
The results show significant differences in all phases analyzed. A decrease in SBP in group A (L60) was observed in all cycles, being in the first cycle in relation to group C (L30), in the second and third cycles in relation to groups C (L30) and D (P30). No significant differences were observed between groups A (L60) and B (P60) or between C (L30) and D (P30), i.e., there was no difference between the groups that received the FBM and their respective placebos when observing the variable PAS.

Table 2: Measured DBP values in each group in the different phases of intervention.

PAD (mmHg)				
Phases	**Group A N= 10**	**Group B N= 12**	**Group C N= 11**	**Group D N= 11**
Baseline	84.5±11.5	78.5±8.4	74.3±18.8	72.0±15.0
End 1st Cycle	83.5±12.2	81.5±10.9	77.0±11.7	67.7±9.4
End 2nd Cycle	81.1±13.3	78.7±9.1	75.1±10.8	67.0±11.3
Final 3rd Cycle	78.9±15.0	75.9±10.8	75.3±8.3	68.0±11.1
Final	103.6±13.6	97.4±8.8	93.2±20.8	89.8±13.8

Source: Authors

Figure 5 - DBP variation between groups. São Paulo, 2019.



*= p< 0,05.
Source: Authors.

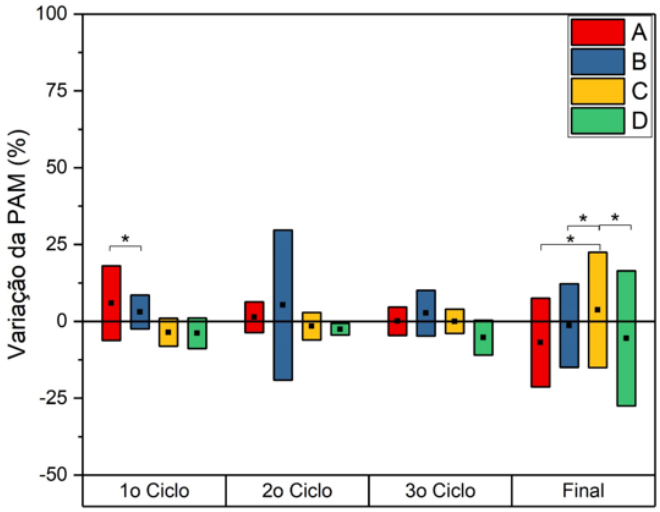
DBP did not show significant variation between the groups during the first cycle. In the second cycle, there was significance between groups A (L60) and B (P60). In the third cycle, there is a greater decline in DBP in group A (L60), but with significance between groups A (L60) and C (L30). That is, again there was no difference between group A and its placebo. It is observed that in the final phase there was an increase in DBP values in all groups, with the same differences observed in the third cycle.

Table 3: Measured values of MAP, in each group, in the different phases of intervention. São Paulo, 2019.

PAM (mmHg)				
Phases	**Group A N= 10**	**Group B N= 12**	**Group C N= 11**	**Group D N= 11**
Baseline	103.6±13.6	97.4±8.8	93.2±20.8	89.8±13.8
End 1st Cycle	100.1±13.2	97.6±12.6	93.0±11.2	83.9±8.7
End 2nd Cycle	97.0±14.4	97.4±9.7	91.3±10.1	83.4±10.3
Final 3rd Cycle	93.8±15.6	94.9±9.2	92.3±9.4	81.2±8.0
Final	96.1±16.9	95.6±12.4	93.4±7.5	82.8±11.6

Source: Authors.

Figure 6 - Variation in MAP between the groups. São Paulo, 2019.



*= p< 0,05.
Source: Authors.

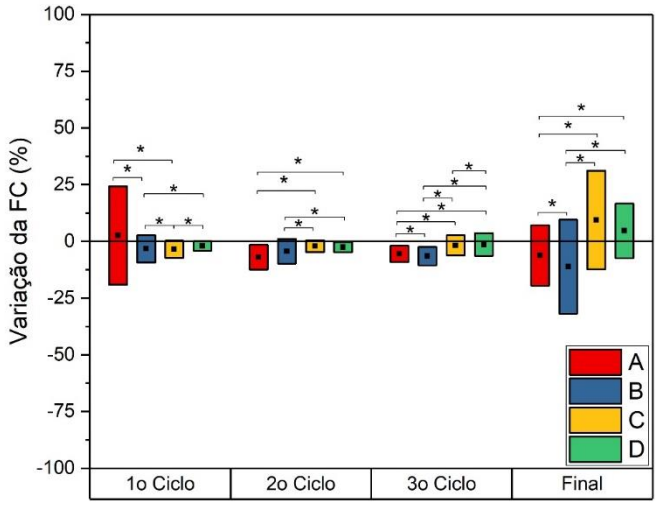
In the first cycle, there was a significant difference in MAP between groups A (L60) and B (P60). In the second and third cycles, there were no significant differences between the groups. In the final phase, group A (L60) had lower MAP than group C (L30), but there was no difference between groups A and D (placebo L30). It can be seen that group C increased MAP in relation to baseline (value above the horizontal line located at zero).

Table 4: Measured HR values in each group in the different phases of intervention.

FC (bpm)				
Phases	**Group A N= 10**	**Group B N= 12**	**Group C N= 11**	**Group D N= 11**
Baseline	82±14 AM	82±25 AM	71±7 AM	80±15
End 1st Cycle	82±13 AM	72±12 AM	73±5 AM	77±13 AM
End 2nd Cycle	75±9	75±10	71±6	78±16
Final 3rd Cycle	75±9	71±11 am	74±8	78±14
Final	76±10	68±9	77±11	83±17 am

Source: Authors.

Figure 7 - Variation in MAP between the groups. São Paulo, 2019.



p*≥ 5.

There was a statistical difference in HR in all cycles. In the first, group A had the highest HR in relation to groups B and C. Group C had the lowest HR in relation to the others. In the second cycle, the situation is reversed, with group A being the one with the lowest HR, but with significance only between C and D, that is, once again group A was not different from its placebo. In the third cycle, group A was different from B, C and D, with a decrease in HR. Group C was different from A, B and D, with higher HR. In the final phase, groups A and B had the lowest HR, while C and D had the highest.

DISCUSSION

The hemodynamic variables studied were SBP, DBP, MAP, and HR, which were analyzed during the 3 cycles, in all 4 groups: Group A, with exposure time of 60 minutes per day, and its controlled placebo, Group B; also Group C, 30 minutes a day, and its respective placebo-controlled group, Group D.

The wavelength, power, and irradiance remained the same in the irradiated groups. However, by varying the exposure time, the energy delivered and the radiant exposure also varied, as noted in **Table 1**. In group A, the radiant exposure was 127388.53 J/cm2, with 360 J per session. In group C, both values were reduced by 50%, due to half the irradiation time. To try to compensate for these differences, group C received twice as many sessions, 30, instead of the 15 sessions in group A. However, according to the results obtained, the irradiated groups behaved differently from each other. Another noteworthy observation was the placebo effect observed in groups B and D, which in some variables was as good as that of the truly irradiated groups.

In the last cycle and at the end of the interventions, SBP decreased in all groups, but when the intervention groups and their respective placebo were analyzed, there was no significant difference between them. There was significance between groups A and C, with lower SBP values in group A. The same results were observed in DBP, however, in the final phase, the values increased in relation to baseline (the means are above the horizontal line at zero). Regarding MAP, there was no significance between the groups in the 3rd cycle. In the final phase, group A was significantly smaller than group C and was not different from its placebo, group B. On the other hand, group C had a significantly higher MAP value than its placebo, group D. HR was also statistically lower in group A in relation to C and there was significance between group A and its placebo, however, HR was even lower in the placebo group (B), both in the last cycle and at the end of the interventions.

In the protocols used here, the wavelength was red (660 nm), unlike Tomimura, but similar to the recent animal study where hypotensive effects were found in rats submitted to FBM, also with a decrease in systolic and diastolic pressure and heart rate (Hudak, 1997)

Another study used transcutaneous FBM to test its efficacy in lowering blood pressure in three groups of patients: normotensive, prehypertensive, and hypertensive. The exposure time was 30 minutes, red laser, 2.5mW of power and 3J of energy. Systolic and diastolic pressure and pulse variables were measured before, during, after and 15 minutes after each treatment. The results showed no significant difference in normotensive individuals. However, there was a difference in pre-hypertensive and hypertensive patients. The authors suggested that FBM can be combined with antihypertensives in patients being treated for SAH (Kaller, 2008).

Thus, as well as the results cited in the literature, FBM decreased the participants' blood pressure levels, especially those submitted to the protocol with 60 minutes of exposure time (group A). In order to understand the behavior of the placebo groups, which also decreased blood pressure levels, although differently from their respective treatments, demographic and anthropometric analyses were performed to verify the homogeneity of the sample.

The groups studied are also similar in terms of pharmacological treatment, using vasodilators, diuretics, beta blockers, and angiotensin-converting enzyme inhibitors, recommended by the guidelines for the treatment of hypertension, in addition to many using hypoglycemic agents for the treatment of DM (Barroso *et al*, 2021).

Regarding the manifestation of complications resulting from SAH, data from the VII Brazilian Guideline on Hypertension state that 30% of deaths are due to CVD (Barroso *et al*, 2021.

Finally, all study participants received a protocol of guidelines for blood pressure control based on the identified risk factors, whose objective was to promote lifestyle change and appropriate use of the medication prescribed by the doctor.

Thus, it is believed that multidisciplinary care may have increased treatment adherence of all participants, including the placebo groups, who did not receive irradiation, but showed a decrease in the values of hemodynamic variables.

CONCLUSIONS

Modulatory effects were evidenced in the control of blood pressure in hypertensive patients after photobiomodulation. In the present study, 30% of the participants had complications resulting from hypertension before photobiomodulation and only one patient had a stroke followed by death after photobiomodulation due to pneumonia. This patient belonged to group C (L30), was severely hypertensive, difficult to control, and was already bedridden due to a previous stroke. The cause of death was pneumonia. It was observed that group A (L 60) had a better response to the reduction of hemodynamic variables than group C (L 30). It can be demonstrated that FBM Therapy has been shown to be an effective alternative in the treatment of several diseases, concluding, new studies are needed to further elucidate the proposed theme and to insert photobiomodulation as an adjuvant protocol in blood pressure control.

REFERENCES

1. Adamič, M., Haak, C., Nouri, K., Karrer, S., Haedersdal, M., Kaufmann, R., ... & Hohenleutner, U. (2007). Vascular lasers and IPLS: Guidelines for care from the European Society for Laser Dermatology (ESLD). *Journal of Cosmetic and Laser Therapy*, 9(2), 81-86.

2. Amaral-Moreira Mota, B., Moura-Lanza, F., & Nogueira-Cortez, D. (2023). Efetividade da consulta de enfermagem na adesão ao tratamento da hipertensão arterial sistêmica. *Revista de Salud Pública*, 21, 324-332.

3. Bernardi, N. R., Figueiredo, C. B., Oliveira, S. M., Ribeiro, M. M., & Nascimento, L. S. (2023). Adesão ao tratamento da hipertensão arterial sistêmica: fatores associados. *Revista Eletrônica Acervo Científico*, 43, e11842-e11842.

4. Barroso, W. K. S., Rodrigues, C. I., Bortolotto, L. A., Mion Jr, D., Sociedade Brasileira de Cardiologia, & Sociedade Brasileira de Hipertensão. (2021). Diretrizes brasileiras de hipertensão arterial–2020. *Arquivos Brasileiros de Cardiologia*, 116, 516-658.

5. Buso, G., Grassi, G., Tsioufis, C., Mancia, G., & Borghi, C. (2024). The global burden of resistant hypertension and potential treatment options. *European Cardiology Review*, 19.

6. De Moraes, T. F., Kato, I. T., Cavalcante, M. S., & Ramos, J. L. (2020). Energy-dependent effect trial of photobiomodulation on blood pressure in hypertensive rats. *Lasers in Medical Science*, 35, 1041-1046.

7. Figueiredo, N. N., & Asakura, L. (2010). Adesão ao tratamento anti-hipertensivo: dificuldades relatadas por indivíduos hipertensos. *Acta Paulista de Enfermagem*, 23, 782-787.

8. Júnior, A. G. R., Gonçalves, A. R., Santos, F. L., & Lima, A. P. (2006). Fisiopatologia da hipertensão arterial em diálise. *J Bras Nefrol*, 28(4).

9. Haynes, R. B., McDonald, H., Garg, A. X., & Montague, P. (2002). Interventions for helping patients to follow prescriptions for medications. *Cochrane Database Syst Rev*, 2(11), 7.9-1.4.

10. Hudak, C. M., & Gallo, B. M. (1997). *Cuidados intensivos de enfermagem: uma abordagem holística* (p. 1013-1013).

11. Karu, T. I., Pyatibrat, L. V., & Kalendo, G. S. (1988). Molecular mechanism of the therapeutic effect of low-intensity laser radiation. *Lasers Life Sci*, 2(1), 53-74.

12. Liu, Y., Wang, M., Yuan, Y., & He, J. (2023). Global incidence and death estimates of chronic kidney disease due to hypertension from 1990 to 2019, an ecological analysis of the global burden of diseases 2019 study. *BMC Nephrology*, 24(1), 352.

13. Malta, D. C., Gonçalves, R. F., Mazzarella, D. M., & Monteiro, R. A. (2023). Hipertensão arterial e fatores associados: Pesquisa Nacional de Saúde, 2019. *Revista de Saúde Pública*, 56, 122.

14. Miranda, C. H. (Ed.). (2023). *A Jornada para o Controle da Hipertensão Arterial no Brasil*. *Arquivos Brasileiros de Cardiologia*, 120(8), e20230533.

15. Nobre, F., Moreira, M. D., & Souza, A. P. (2013). Hipertensão arterial sistêmica primária. *Medicina (Ribeirão Preto)*, 46(3), 256-272.

16. Siqueira, J. S. S., & Da Silva Rodrigues, V. A. (2023). Hipertensão arterial infantil: uma revisão bibliográfica dos últimos 10 anos. *Saúde Dinâmica*, 5(1), 74-89.

17. Silva, W. L. M., Araújo, E. S., & Souza, C. R. (2020). Análise das variáveis hemodinâmicas após sessões de exercícios aeróbio e isométrico em idosos e jovens da Secretaria de Educação do Distrito Federal. *Secretaria de Educação do Distrito Federal*.

18. Tomimura, S., Nogueira, L. A., & Kawano, T. (2014). Hemodynamic effect of laser therapy in spontaneously hypertensive rats. *Arquivos Brasileiros de Cardiologia*, 103(2), 161-164.

19. Weber, M. A., Schiffrin, E. L., White, W. B., Mann, S., Lindholm, L. H., Kenerson, J. G., & Ram, V. S. (2014). Clinical practice guidelines for the management of hypertension in the community: a statement by the American Society of Hypertension and the International Society of Hypertension. *Journal of Hypertension*, 32(1), 3-15.

20. Woods, S. L. (2005). *Enfermagem em cardiologia*. Editora Manole Ltda.

21. World Health Organization et al. (2013). *A global brief on hypertension: Silent killer, global public health crisis: World Health Day 2013*. World Health Organization.

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