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Editorial

Dear authors, reviewers, and readers

It has been a month since I was given the privilege to serve as the Chief Editor of the International Journal for Innovation Education and Research (IJIER). It is a great pleasure for me to shoulder this duty and to welcome you to ***THE VOL-8, ISSUE-3 of IJIER*** which is scheduled to be published on **01st March 2020.**

International Journal for Innovation Education and Research (IJIER) is an open access, peer-reviewed and refereed multidisciplinary journal which is published by the International Educative Research Foundation and Publisher (IERFP). IJIER aims to promote academic interchange and attempts to sustain a closer cooperation among academics, researchers, policy makers and practitioners from a wide range of disciplines, which contribute to state of the art in science, education, and humanities. It provides a forum for the exchange of information in the fields mentioned above by welcoming original research papers, survey papers, and work-in-progress reports on promising developments, case studies, and best practice papers. The journal will continue to publish high-quality papers and will also ensure that the published papers achieve broad international credibility.

The Chief Editor, appointed by the Associate Editors and the Editorial Board, is in charge for every task for publication and other editorial issues related to the Journal. All submitted manuscripts are first screensed by the editorial board. Those papers judged by the editors to be of insufficient general interest or otherwise inappropriate are rejected promptly without external review. Those papers that seem most likely to meet our editorial criteria are sent to experts for formal review, typically to one reviewer, but sometimes more if special advice is needed. The chief editor and the editors then make a decision based on the reviewers' advice.

We wish to encourage more contributions from the scientific community to ensure a continued success of the journal. We also welcome comments and suggestions that could improve the quality of the journal.

I would like to express my gratitude to all members of the editorial board for their courageous attempt, to authors and readers who have supported the journal and to those who are going to be with us on our journey to the journal to the higher level.

Thanks,

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Bibliometric analysis for frugal innovation

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Abstract

Bibliometrics is a statistical technique used to measure aspects of academic production that contribute for developing sciences. The purpose of this article is to present research results highlighting in main works on frugal innovation. The research has been based in bibliometric theories, exploring bases to indicate main correlational areas, documents profiles and verify the level of growth these scientific documents. It was possible to generate visual density and Network maps by Vosviewer software, ranking of documents per authors and World ranking papers from Web of Science and Scopus bases. It was possible to identify and highlight main topics related to management area; keywords associated and related topics for this theme, also answering concepts presented by authors for frugal innovation.

Keywords: scientometry; bibliometry; jugaad; visual maps; bibliometric.

Introduction

Periodicals and scientific journals present itself as important media of transmitting knowledge and ways of scientific publication. Evaluating and qualifying publications through indexing is one of the most recognized qualification processes in the scientific community. With this, it is necessary in front of various national and international databases, to investigate with the support of bibliometric techniques the main productions for researcher´s thematic.

To recognize even his object of study, it is necessary to find one vision more complete, and how much it is possible to understand the universe that researcher has at his disposal optimizing processes and resources.

The relevant theme like frugal innovation attract attention to do a bibliometric study when we may perceive that there is an increasing of companies developing new products through emerging markets such as Brazil, India, China, South Africa.

With this, It´s necessary to believe that bibliometric studies linked to frugal innovation may be an important initiative to know scientific production and impact factors drawing a profile of newer studies.

So, It´s possible to investigate: how much and what are the main areas of these bibliometric studies are interested in the concatenation of the variables "innovation" and "frugal". What is the profile of these bibliographic productions by less from two big journal databases?

Therefore, based on these prerogatives that It´s possible to trace the objective for understanding the bibliometric panorama of the frugal innovation exploring *Web of Science* and *Scopus* trying to find countries that currently produce most these studies, understanding that frugal innovation have been usual applied in developing countries.

Method

Subjects

This study may be classified like exploratory using journal databases for getting qualitative and quantitave variables beyond insertion of terms like ‘frugal innovation’ exactly or with masks. (GIL, 2008)

The bibliographic research comprised is an investigation using resources that according to (Gil 2008) results from something that it has already been evaluated or appreciated previously by its respective author, characterizing technically as *ex-post fact*.

The research tested two international academic bases, which were Web of Science and Scopus. Exploring their results, were assessed quantitative and qualitative variables, per example: number of documents and their respective types and period, top authors with more documents, absolute and relative production per country, numbers of documents produced by languages, and main terms related to frugal innovation.

This work accomplished the following steps:

Step 1. Did a query, executed within a works index database (both the Web of Science as Scopus).

Step 2. Reached an application of appropriate filters, search words, types of publication, time lapse, etc., to delimit the sample of works that It was studied.

Step 3. The third stage contemplated the descriptive and temporal analysis of the articles obtained, contextualizing the scientific production (publications and citations) in time and identifying the main works in the area.

Step 4. It was identified the most relevant authors, institutions and countries, using rankings and cocitation maps.

Step 5. It was analyzed where the subject was being published research areas.

Step 6. The sixth step analyzed the keywords in indexing the sample work, as well as the main terms that could be identified in the articles, portraying which concepts are worked together and how they relate. Finally, the results of all these steps were jointly and analyzed with main conclusions about the research produced.

The Frugal innovation presents itself with a broad spectrum of applicability and, in the different areas of knowledge. For this reason, in order to maximize the research horizons for the theme focused on frugal innovation, being investigated using keywords in 4 languages: English, Portuguese, Spanish, and the Indian word of origin that justifies the frugal, known in some cases as "Jugaad", being an intentional choice because they are widely classified like languages of worldwide spectrum. As well as the two main international databases, widely used by researchers, Scopus and Web of Science, adopting the following strategy of according to the Table 1.

Statistics	Database	
	Scopus	*Web of Science*
"Frugal Innovation" OR "Inovação Frugal" OR "Innovación Frugal" OR "Jugaad"	158 docs	95 docs
Document search location	Title, abstract, keywords	Title, abstract, keywords
Document search profiles	All	All
Publication date	All years	All years
Type of search	Advanced	Advanced

Table 1. Research Strategies in Scientific Bases. Source: Scopus, Web of Science (2017).

Apparatus

The data processing for the comparative analyzes and their subsequent modeling of figures were performed by Microsoft Excel Student 2013 version, the production of the map with the ranking of countries that produced the most scientific papers were performed with support of free online tool mapinseconds.com and later worked with aid of the graphic application Coreldraw Student version 17. The students tools were acquired with own resources of the researcher. About the generation of network and density map, we chose the *software* Vos Viewer 1.6.5, free version, and It can be downloaded freely at http://www.vosviewer.com.

Design

The design shows like independent variables: *Annual documents production, document type classification, production per language, production per author, main related topics to frugal innovation, associated keywords, ranking of countries with the highest bibliometric production, semantic and network visual maps. All of these for answer the dependent variable: Bibliometry for Frugal Innovation in agree with Web of Science and Scopus database.*

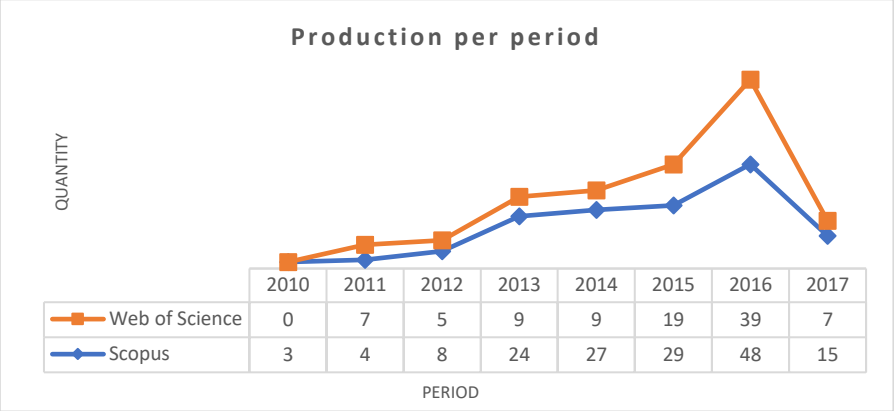
Procedure

The method applied for ranking the 10 most published countries on frugal innovation was supported by (Kothari 2010) explanation doing a comparative methodology. It was possible to select the Scopus and Web of Science data, classifying the 10 countries that had the largest sums of each. Among the results that presented the highest quantitative values in common were compared, comparing with the individual results of each of the bases, when the individual values were greater than the sum of both, resulting in Figure 7.

Results

Annual documents production

The bibliographic production of the Scopus and Web of Science databases has increased over the years, starting from 2010 with the lowest indexes, reaching the maximums in 2016 for both bases, as can be seen all the evolution in Figure 2.



	2010	2011	2012	2013	2014	2015	2016	2017
Web of Science	0	7	5	9	9	19	39	7
Scopus	3	4	8	24	27	29	48	15

Fig. 1. Bibliometric evolution of the bases on frugal innovation. Source: *Scopus* (2017), *Web of Science* (2017).

Source: Scopus (2017), Web of Science (2017).

Calculating the linear trend, based on the results obtained over the years, one can reach the value of R^2 = 0.49. While evaluating in the same statistical calculation profile, it is possible to verify for the Web of Science base the value of R^2 = 0.36 demonstrating a growth for both bases.

Quantifying the sum of documentary productions regarding frugal innovation, one can quantify 158 documents for Scopus and 95 for Web of Science, making a percentage of 62.45%, and 37.55%, respectively.

Classification by document type

The largest indicators of bibliometric production categorized by Scopus and Web of Science bases are from scientific articles, representing 86, 59 papers respectively. Summarizing further the other document profiles, stand out Scopus Conference Documents, totaling 37 units and Web of Science Procedure Documents totaling 23 units. Lower quantities produced by other document profiles have been shown in table 2.

Documents	*Scopus*	*Web of Science*
Article	86	59
Press Release	2	1
Brief survey	4	0
Book chapter	13	0
Conference Documents	37	0
Procedural Documents	0	23
Editorial	1	9
Notice	6	0
Review	8	3

Documents	*Scopus*	*Web of Science*
Conference Review	1	0
Total	158	95

Table 1. Profiles of production documents and their quantitative. Source: *Scopus* (2017), *Web of Science* (2017).

Bibliometric language production

Both the Scopus database and the Web of Science produced their largest quantities of documents in the English language, and the metrics can be tracked in Figure 3.

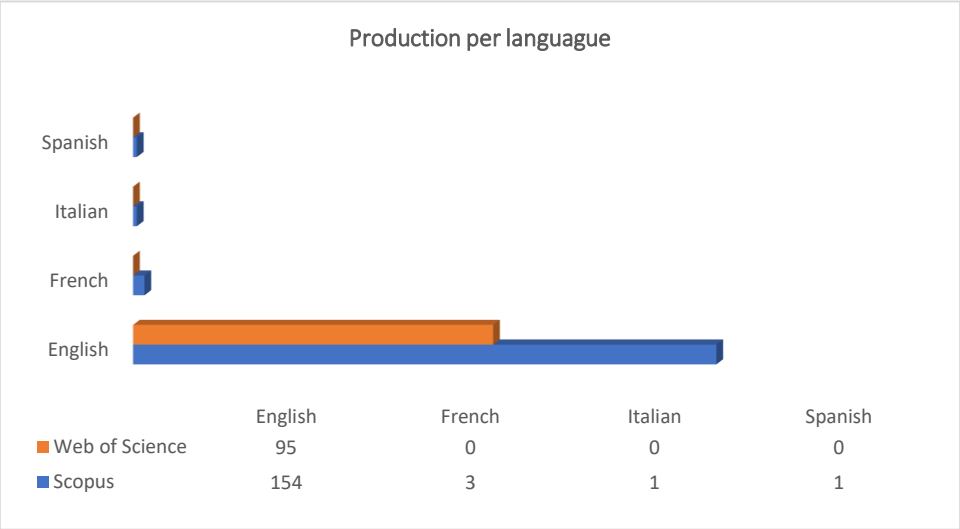


Fig. 2. Language-related metrics. Source: *Scopus* (2017), *Web of Science* (2017)

Accounting for the total of Scopus database, it can be found 159 documents, however it was verified that the base only counted 158 units, since 1 of the articles were disconsidered in the metric because there was duplicity of content, being differentiated only by be written in 2 different languages.

Authors with greater productions in documents for the theme involving Frugal Innovation

By tracing the metric comparison of higher productions by authors, it was found that in the sum of the bases, in common, there were authors Baekelandt, with (9) documents representing the largest metric, followed by Belkadi, Halme, Mourtriz and Vlachou representing 8, 8, 7 and 4 documents respectively. See Figure 4.

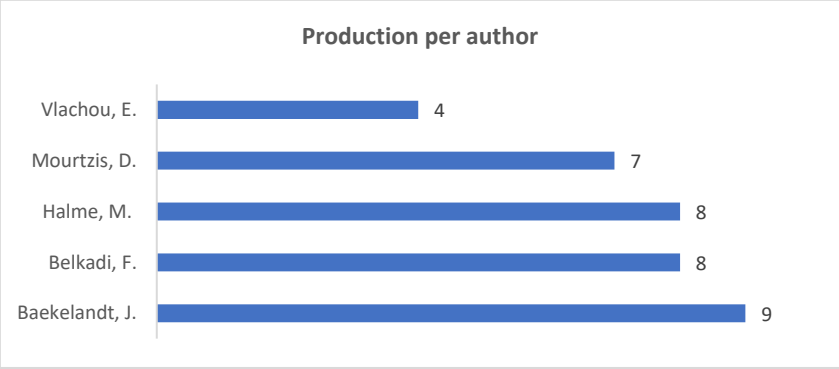


Fig. 3 . Quantitative representation of bibliographic production per top authors amounted in both bases. Source: *Scopus* (2017), *Web of Science* (2017).

Topics related to Frugal Innovation by Scopus Base

The Scopus database presents a trend of interdisciplinary publication with the large areas of knowledge, since they are present in the Exact, Social and Health Sciences, as can be observed publications categorized as: Business, Management and Accounting, Engineering, Computer Science, among others. See Figure 5.

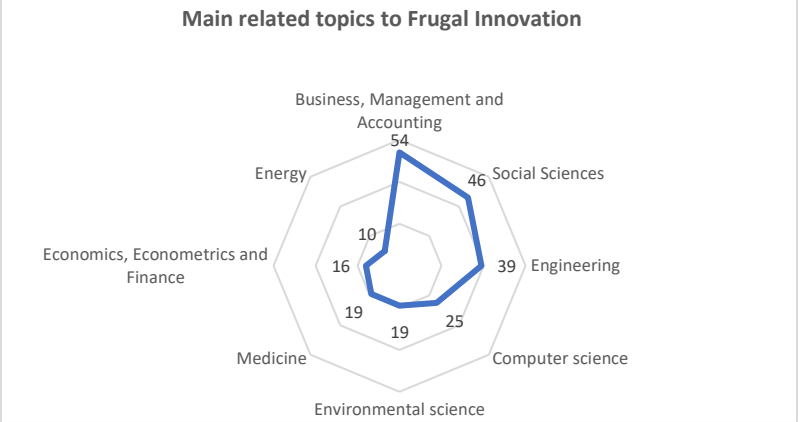


Fig. 4. Interdisciplinarity of Frugal Innovation. Source: *Scopus* (2017).

Topics related to Frugal Innovation by Web of Science

Web of Science presents in its results the linkage of frugal innovation with Management, Business, Industrial Engineering, Environmental Sciences, management research culture of operations research, demonstrating some similarities with Scopus Base. See Figure 6.

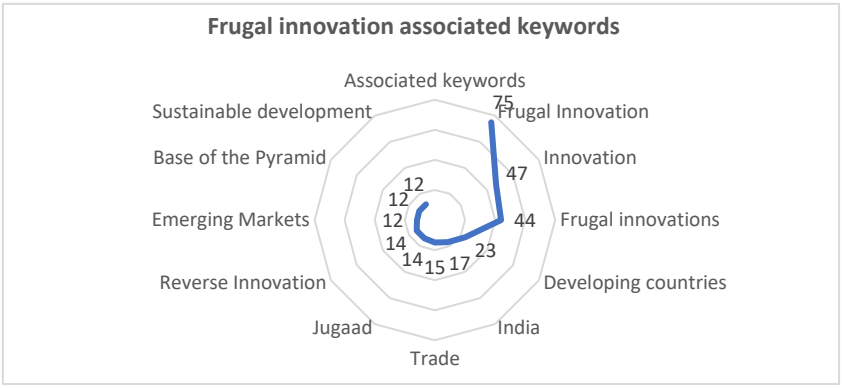


Fig. 5. Interdisciplinarity of the frugal innovation. Source: *Web of Science* (2017).

Ranking of Countries with the Highest Bibliometric Production for Frugal Innovation.

The world's largest scientific bibliographic production for the Frugal Innovation theme can be seen in countries of the Mid-West and with the greatest economic development, accounting for a total of 24% of production for the countries of the East, while around 76% of publications are concentrated in the United States, United Kingdom, France, Germany, Belgium, Finland, Greece and Canada. See Figure 7.

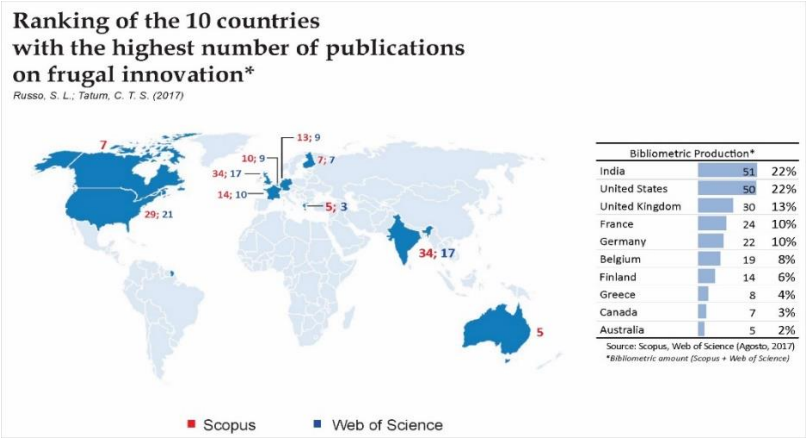


Fig. 6. Countries with greater productions for frugal innovation. Source: *Scopus*, *Web of Science*.

Density Visualization and Network Map on Scopus Base

Making the elaboration of the Network map based on the Vosviewer algorithm beyond words extracted from the Scopus base, can observe an intensity of connections with the terms reverse innovation, sustainability, business, pyramid. In a second cluster, one can observe stronger semantic relations between market and companies. In the third cluster, It was observed a better relation with Science, with more emphasis on periodic terms, institutes, management, marketing and public health. In more isolated clusters we can perceive information and health systems. With this, It´s inferred that frugal innovation has a strong relationship with health, management, science, information, economics, education and society. See Figure 8.

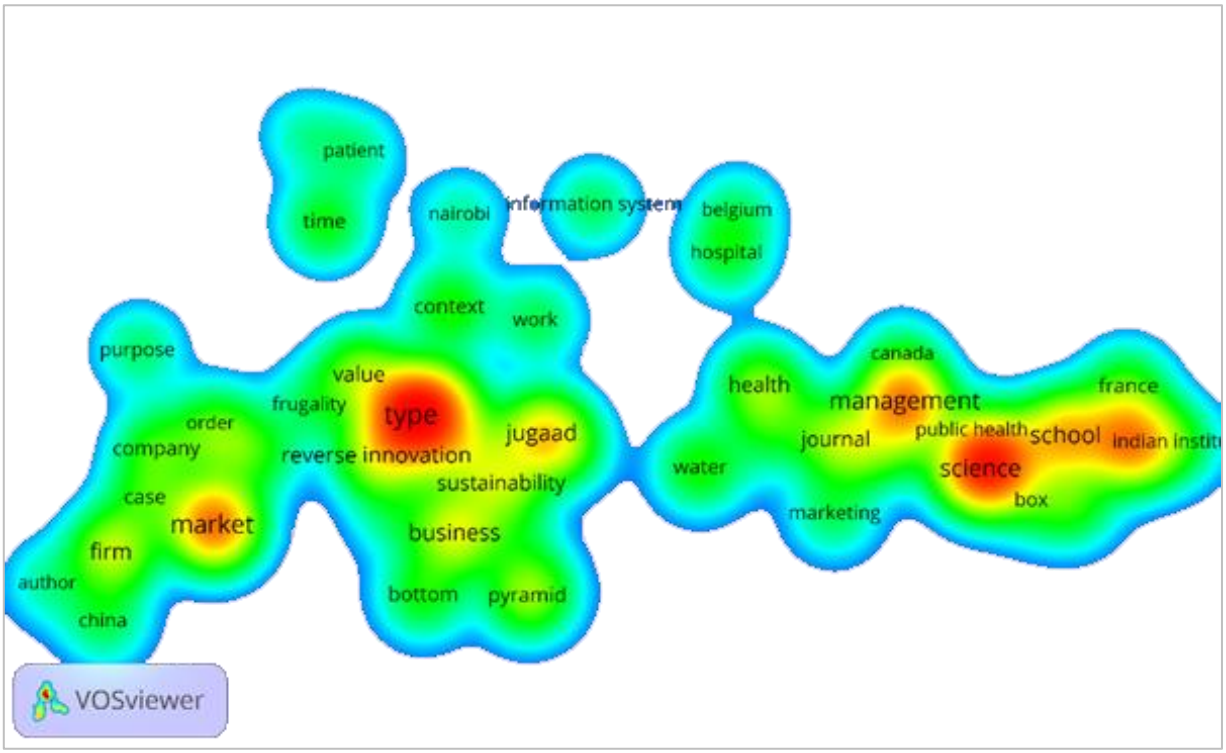


Fig. 7. Scopus network map for the Frugal Innovation theme.Source: *Scopus*, *Web of Science* (2017).

The relationship in the network map demonstrates the link between the main topics of each cluster, involving management in relation to the types of innovation. As well as like the business class, it presents a connection between the market and companies, as well as a link between business and academia, through science, management and academies. See Figure 9..

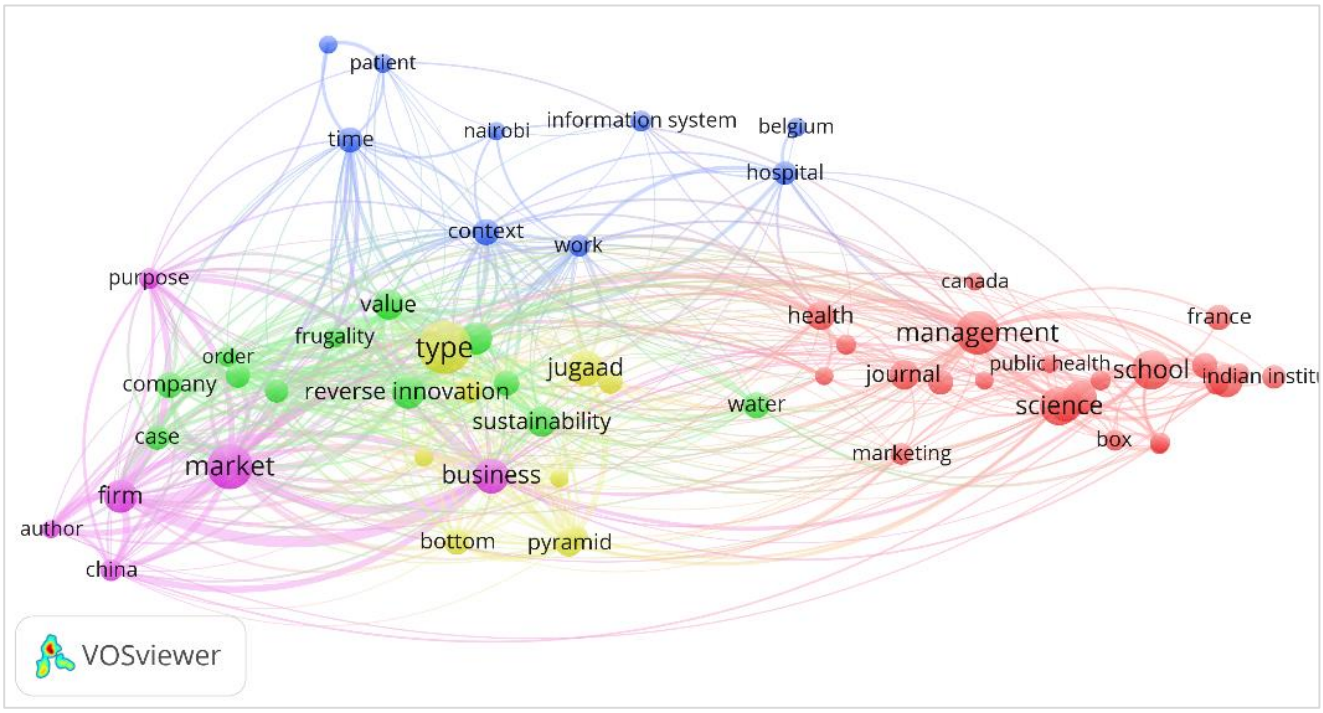


Fig. 8. Map of semantic link for frugal innovation in the base Source: *Scopus*, *Web of Science* (2017).

Density visualization at the Web of Science Base

Verified that there were strong links with terms: pyramid, which it is related to the economic base of society and the low cost of innovation, linking to companies, health, administration and development processes in innovation, with isolated clusters in health issues focused on patients and scarce resources. See Figure 10. Visualization of overlapping in network maps, one can perceive a fairly cohesive group of clusters getting involved between companies, economy and businesses and with the binding element, health through the term patients. See figure 11.

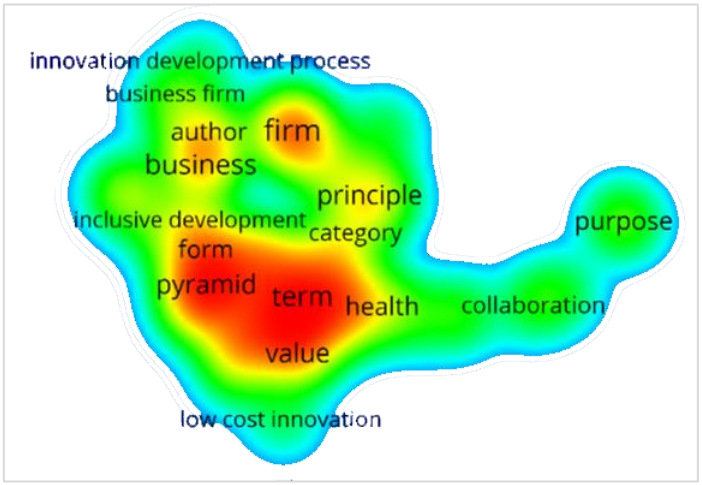


Fig. 9. Cluster desity by *Web of Science.* Source: *Web of Science*.

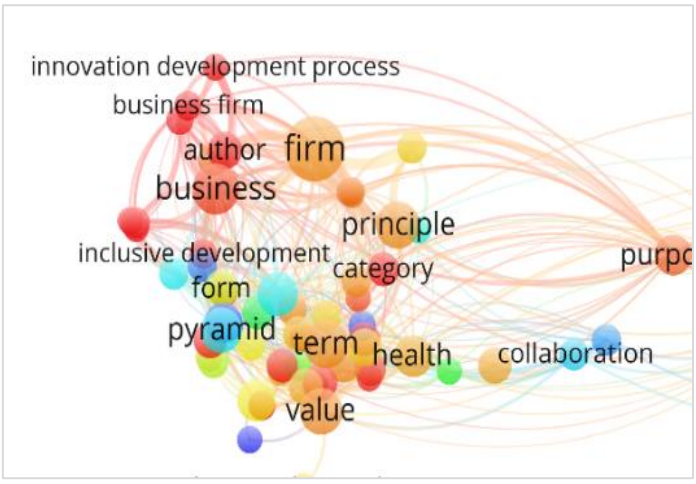


Fig. 10. Network map by *Web of Science.* Source: *Web of Science*.

The frugal innovation in the view of the authors of greater production by top authors

Extracting the authors of the larger quantitative metrics presented in item 4.4, it was possible to obtain relevant knowledge about the topic, exposing them through Table 3.

Authors	Papers	Results
Mourtzis, Vlachou, Boli, et al. (2016)	*Manufacturing Networks Design through Smart Decision Making towards Frugal Innovation*	Algorithmic construction for local market adaptation providing solutions for cost reduction efficiency and solutions for customer appreciation.
Mourtzis, Vlachou, Giannoulis, et al. (2016)	*Applications for Frugal Product Customization and Design of Manufacturing Networks*	Support integration in product designs and its industrialization network.
Hart, Sharma, e Halme (2016)	*Poverty, Business Strategy, and Sustainable Development*	Evaluates management theories due to business integration, poverty alleviation and sustainable development.
Hossain, Simula, e Halme (2016)	*Can frugal go global? Diffusion patterns of frugal innovations*	It explores a diffusion of frugal innovation knowledge in geopolitically routing globally.
Levänen et al. (2016)	*Implications of Frugal Innovations on Sustainable Development: Evaluating Water and Energy Innovations*	Evaluates the frugal innovation applied to sustainable development based on case studies on water and energy matrix.
Reynders e Baekelandt (2015a)	*Adnexectomy by poor man's transvaginal NOTES*	The study demonstrates the feasibility and safety of transvaginal natural orifice transluminal endoscopic surgery (vNOTES) for benign adnexal masses.

Authors	Papers	Results
Reynders e Baekelandt (2015b)	*Low-cost total laparoscopic hysterectomy by single-incision laparoscopic surgery using only reusable standard laparoscopic instruments*	Evaluates the viability and safety of total laparoscopic hysterectomy (TLH) through a simplified frugal device.
Belkadi et al. (2016)*	*Co-Definition of Product Structure and Production Network for Frugal Innovation Perspectives: Towards a Modular-based Approach*	It proposes a conceptual approach based on the selection of product modules that influence supplier selection and order allocation in a global production network.
Colledani et al. (2016)	*Technology-based product-services for supporting frugal innovation*	Case study applied to the machinery, household appliance and aeronautical industries with a view to the implementation of a formal structure in the context of frugal innovation.
Simula, Hossain, e Halme (2015)	***Frugal and reverse innovations - Quo Vadis?***	**It does a concept analysis and presents a conceptual framework for frugal innovation and reverse innovation.**

Table 3. Main works developed by authors of higher innovation metrics. *Source: Scopus*; *Web of Science*

From the understanding of frugal Innovation it was possible to understand by means of Mourtzis, Vlachou, Boli et al. (2016) that frugality presents the attributes of: functionality, robustness, accessibility, ease of use and growth. It emphasizes the aspect of observing a huge paradigm between the concept of innovation, its regional application and the demands of the local market, while on the one hand the State demands more social laws and environmental responsibility. On the other, there is a need to apply a product or service design with characteristics to serve local markets.

In the vision of Mourtzis, Vlachou, Boli et al. (2016) which is consistent with a great deal of research on frugal innovation being a producer of sustainable solutions and results. They conclude that it is possible to introduce new business models to reduce the complexity and total lifecycle costs of innovation, providing value and solutions that are accessible to customers in developing markets. Even, technological tools of information and communication have allowed better economic, social and attending environmental challenges.

Hart, Sharma and Halme (2016), based on studies of the minimization of the impacts of poverty on society, present a conceptual analysis on frugal innovation with regard to the relationship of poverty alleviation through business and entrepreneurship; still mentions the idea that frugal innovation resembles the Pyramid Base Theory of Radjou et al. (2012)

In the diffusion patterns studies of frugal innovation, (Hossain et al. 2016b) point out that innovation is important in the growth of countries. They also serve quite a lot for developed countries with stagnant

economies, influencing the market with the practice of reducing prices. In terms of the profile of frugal innovation customers, they prove to be different, as they seek affordable prices and good products that meet their needs.

Levänen et al., (2016) point out that frugal innovations are receiving increasing attention from scholars, practitioners, and policy makers. Just as they are being applied in multinationals, social enterprises, startups and individuals from developed and developing countries. They are considered a solution to approach sustainability concerns in low-income countries, using accessibility and availability as important points, especially in developing countries.

Reynders, Baekelandt (2015a) proves in practice that frugal innovation is possible to be applied in the provision of health services through reusable laparoscopic instruments, determining as characteristic low cost, proving once again the attribute of this innovation.

Discussion

Bibliometry

Perceiving the relevance of measuring bibliographic quantification was that Otlet (1934) wrote the Documentation Treaty, making his later study, recognized as a "statistical bibliography" by Hulme in 1923, and being inspired by Alan Pritchard's article, which he called "Statistical Bibliography or Bibliometrics?" in 1969, also showed by MANUEL *et al.* (2015).

According to contemporary theorists such as Andrade, Dominski and Coimbra (2017); Koseoglu et al. (2016); Santos et al. (2015), infer by acquirements that bibliometrics may have been comprehended as a statistical technique for quantification and qualification of bibliographical materials. 2005), adopting bibliometrics as a set of laws and empirical principles that contribute to establishing theoretical foundations of Information Science.

Oliveira and Russo (2017) *apud* Fonseca (1986) Bibliometrics is a technique for measuring production rates and disseminating scientific knowledge.

According to (Mueller 2013), this tool has the following objectives: analysis and mapping of authorship and co-authorship, collaboration and networks; evaluation and description of the literature, impact and indicators; production and productivity, visibility of authors and institutions; and citation and co-citation studies

Frugal Innovation

Among several concepts of innovation, contemporaries agree that innovation is: to do something new or different Cambridge Dictionary (2017), English Oxford Living Dicitionaries (2017), Nair et al. (2015) with that, It is possible to claim that is the word that supports the generation of new products, processes, services and marketing, as recommended by Schumpeter (1982) and (OECD 2005).

(Prahalad & Hart, 2002) presented approaches on innovation and poverty, affirming: "innovative actions tend to create opportunities for the poor by offering them choices and encouraging self-esteem."

Still, Prahalad & Hart (2002) claim: "The distribution of wealth and income-earning capacity in the World can be captured in shape of an economic pyramid. At the pyramid top stand the rich, with numerous opportunities to generate high levels of income.".

The frugal innovation, classified as open innovation, flexible and disruptive in agree with Mazieri (2016); Radjou (2016); Euchner (2016) becomes the focus of attention because it seeks to preserve the environment by reducing costs, materials, and is being widely accepted in business organizations. Since this innovation is an inspiring source for price cutting in the market competition, characterizing like an innovation to base of the pyramid, reaching the great masses of population, producing higher revenues for corporations.

Frugality was born in India, a country that suffered too much from the largest low-income population, but it was hurled enough inspiration for Radjou, Prabhu and Ahuja (2012) to affirm that "Less is more in the construction of Riches and Results", appearing later the bibliography known by "The innovation of the improvise".

It is motivated as innovation of improvisation with Radjou, Navi et al. (2012) explanation, which mentions in Hindu origin its word Jugaad, whose meaning can be explained like "an innovative repair, an improvised solution, based on ingenuity and intelligence."

Therefore, statements of (Navi Radjou et al. 2012) was that (Prahalad e Hart 2002) presented approaches about innovation and poverty, stating that: "Innovative actions tend to create opportunities for the poor people, offering them choices and encouraging self-esteem." In addition, "The distribution of wealth and the ability to income generation in the world can be captured in shape of an economic pyramid.

The Bibliometric study demonstrates to be an effective resource for the construction of knowledge, maximizing efficiency in the scientific production process, guiding the author to the focus of the best results for research.

The theme of frugal innovation is in the process of expanding the production of scientific documents linked to the various segments, demonstrating a flexible use of this innovation in the major areas of knowledge, such as: Exact and Technological Sciences, Social Sciences, Health Sciences, and Environment. Just as, it is possible to understand that the greatest metrics of the World production are found in developed countries, although frugal innovation has shown strong conception in India, China, Brazil, and still on the African continent.

Among the bases explored, it is predominant in the English language, and along with this profile of innovation, according to the authors of higher metrics in the theme, observe links to keywords that can be highlighted by: sustainability, affordability, cost reduction, simplicity.

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Effect of fat replacement by fructooligosaccharide in hamburger: physicochemical, technological and sensorial analysis

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Abstract

The aim of this study was to evaluate the influence of fat substitution by fructooligosaccharide on physicochemical, technological and sensory characteristics of hamburgers. Five hamburgers formulations were prepared: F1 - standard (0% FOS) and the others added 1.25% (F2), 2.50% (F3), 3.75% (F4) and 5% (F5) of FOS. The Acceptability similar to standard sample was found for hamburgers with up to 3.75% prebiotic addition. However, all formulations had acceptability index above 70%. Cooking yield, moisture

retention, shrinkage and fat retention have been increased as FOS was added. Substitution of fat by FOS increased carbohydrate and fiber content and decreased lipid and calorie hamburgers content. FOS addition did not change red and yellow values, however it increased brightness of product. FOS is an ingredient with potential for addition in beef hamburger, improving physicochemical and technological parameters and with little influence on sensory characteristics.

Keywords: Prebiotic; meat products; healthiness.

1. Introduction

Meat and meat products are essential diet components, providing high amounts of protein, fatty acids, vitamins and minerals [1]. Hamburgers are foods widely appreciated by different publics, due to their practicality to produce, cook and consumption. However, they are known to have low dietary fiber and high fat content, especially in saturated fatty acids [2]. Excessive consumption of this type of fat, coupled with low fiber intake, may increase the risk to developed noncommunicable diseases such as diabetes, cancer, obesity and cardiovascular disease [3,4]. In this regard, strategies are needed to add healthier ingredients in hamburgers to improve nutritional profile [5,6].

Currently, consumers are seeking a more practical and healthy diet. This fact has forced the food industries to rethink the way they produce their products, using ingredients that are more nutritious and have some health benefit. In this sense, the fat replacement in meat products by raw materials considered functional, such as dietary fibers, has gained prominence in the world scenario, beside adding economic food value to food [7,8]. The fat is an important ingredient in food as it has a positive influence on softness, juiciness and flavor, among other attributes [9]. Therefore, fat reduction may directly affect acceptability as it may interfere with technological aspects of meat product [10]. Studies have already shown the feasibility fat replacing fat in meat products with ingredients such as sugar cane and sesame oil [10], green banana flour [11], cellulose fiber [9], fructooligosaccharide (FOS), inulin [12] and pectin [8]. In these products, good sensorial acceptability and improvement in technological and nutritional characteristics were verified with incorporation of different compounds as fat substitutes.

FOS is a type of non-digestible carbohydrate knowing by body as prebiotic, as it selectively stimulates the growth and activity of particular species of bacteria in colon [13,14]. FOS is extracted from plants such as onion, artichoke, garlic, chicory root and yacon potato. It is low in calories, high in dietary fiber and not cariogenic. Furthermore, because its functional properties, it can help strengthen immune system, lower lipid, cholesterol and blood glucose levels [15]. Considering this context, the using FOS as a fat substitute in meat products becomes a viable alternative, aiming to improve nutritional profile of products and promote consumer health benefits [16]. However, research has already shown occurrences of impairments technological and sensory after prebiotics addition in different foods, such as meat products [12], pasta [17], chocolates [18] and breads [19]. Knowing this, the aim of this study was to evaluate the influence of fat substitution by fructooligosaccharide on physicochemical, technological and sensory characteristics of hamburgers.

2. Materials and methods

2.1. Beef patties processing and cooking

Five hamburgers formulations added with different FOS levels were prepared in triplicate: F1: standard (0%), F2 (1.25%), F3 (2.50%), F4 (3.75%) and F5 (5%). Percentages were defined by means of preliminary sensory tests carried out on the product. In addition to FOS percentages, following ingredients were used: beef (shoulder clod) (77.9%) ice flakes (15%), homogenized pork fat (F1: 5%; F2: 3.75%; F3: 2.50%; F4: 1.25% and F5: 0%), sodium chloride (1.5%), onion powder (0.2%), garlic powder (0.2%) and black pepper (0.2%).

To hamburgers elaboration, meat (approximately 14 kg) was ground in a meat grinder (C.A.F., Brazil) in 3 mm disk and temperature about 4 ºC. Subsequently, ground beef was homogenized in commercial blender (Super Cutter Sire, Brazil) for 1 minute. Onion and garlic powder, black pepper, sodium chloride, ice flake and pork fat were added to mixture and homogenized again for 3 minutes at temperature 7 ± 1 °C.

FOS was incorporated into mass and homogenized for additional 3 minutes at 7 ± 1 °C. Addition levels of ground beef and FOS varied in each formulation as described above. The resulting mass of each formulation was burger shaped (weight 100 g, 10 cm in diameter and 1 cm thick) using manual hamburger press (Picelli, HP 128, Brazil). Products were stored in plastic bags of low-density polyethylene and frozen in conventional freezer (-18 °C) until the analysis moment.

Frozen burgers were grilled on electric plate with grill on upper and lower sides (Britânia Grill, Mega 2N, Brazil) heated to 200 °C. Hamburger internal temperature was controlled by digital thermometer (Tp 101, Brazil) until reaching 71 °C at its geometric center [20]. The average cooking time was 7 to 8 minutes.

2.2. Consumer study

Participated in sensory analyses 80 untrained volunteer subjects, hamburger usual consumers. Consumers had aged between 18 and 29 years and were recruited among students and staffs of Universidade Estadual do Centro-Oeste (UNICENTRO), Guarapuava, Paraná, Brazil. For conducting the sensory test, hamburgers have been cooked as previously described. All samples were evaluated by means of acceptance test using 9-point hedonic scale, with extremes ranging from: dislike extremely (1) to like extremely (9) [21]. Were evaluated attributes related to appearance, aroma, flavor, color and texture, beyond overall acceptance. For purchase intent test 5-point attitude structured scale was used, varying from: definitely would not buy it (1) to definitely would buy it (5) [21]. Sensory acceptability index (AI) was calculated by multiplying average score reported by consumers to product by 100, dividing result by the maximum score given to product within the hedonic scale for 9.0 points. Each sample was served to consumers in white plates coded with randomly selected 3-digit numbers in monadic form and using balanced design [22]. Sensory evaluations were performed by consumers under fluorescence lighting. After consuming each sample, consumer was instructed to drink water for palate cleansing. Samples were evaluated in triplicate in separate session.

2.3. Physicochemical composition

All analyzes were performed on three replicates in triplicate for cooked hamburger, FOS and pork

fat. Water activity (Aw) was determined using Aw analyzer (Novasina, Labswift model, Switzerland), at 20 °C. pH was measured using pH-meter (Tecnopon, MPA-210 model, Brazil). To stablish color, five hamburgers were used per treatment, evaluated in five different hamburgers points. Color was evaluated by system of Commission Internationale de L'Eclairage (CIE), lightness (L^*), redness (a^*), yellowness (b^*), colorimeter reading (Konica Minolta, Chroma Meter CR 4400 model, Japan) with illuminating calibration D65 and angle of observation 10º, previously calibrated.

Moisture, ash, protein, fat and dietary fiber content were determined by AOAC methods [23]. Moisture content was determined by drying in greenhouse (105 ± 2 ºC). Fat content was determined according to Soxhlet method, using petroleum ether. Protein was analyzed according to Kjeldahl method. Factor 6.25 was used for nitrogen conversion to crude respectively. Ash was performed by muffle furnace. Total, soluble and insoluble dietary fiber was determined by enzymatic method. Carbohydrate content was evaluated by means of theoretical calculation (by difference) in triplicates results, according to the formula:

$$\% \text{ carbohydrate} = 100 - (\% \text{ moisture} + \% \text{ protein} + \% \text{ lipid} + \% \text{ ash} + \% \text{ fiber dietary})$$

Total caloric value (kcal) was calculated theoretically using Atwater factors [24] for lipid (9 kcal g^{-1}), protein (4 kcal g^{-1}) and carbohydrate (4 kcal g^{-1}).

2.4. Technological characteristics

Five hamburgers from each formulation were cooked in same procedure as mentioned previously then cooled to room temperature at 23 ºC for 2 h. Following cooking characteristics were evaluated: cooking yield and fat retention [25], shrinkage [26] and moisture retention [27]. All experiments were done in triplicate. Hamburgers were measured according to following equations:

$$\% \text{ cooking yield} = \frac{\text{weight of cooked sample}}{\text{weight of raw sample}} \text{ x } 100$$

$$\% \text{ fat retention} = \frac{(\text{weight of cooked sample}) \text{ x } (\% \text{ fat in cooked sample})}{(\text{weight of raw sample}) \text{ x } (\% \text{ fat in raw sample})} \text{ x } 100$$

$$\% \text{ shrinkage} = \frac{(\text{diameter of raw sample} - \text{diameter of cooked sample})}{\text{diameter of raw sample}} \text{ x } 100$$

$$\% \text{ moisture retention} = \frac{\% \text{ cooking yield x } \% \text{ moisture content of cooked sample}}{100}$$

2.5. Statistical Analysis

Results were analyzed in randomized blocks using analysis of variance (ANOVA). The means were compared by Tukey's test at 5% significance level ($p \leq 0.05$). The Software R was used to perform statistical calculations.

2.6. Ethical Issues

Study was approved by the Ethics in Research Committee of UNICENTRO, Brazil, under the number 2.451.570/2017.

3. Results and discussion

3.1. Consumer study

Sensory results test of cooked hamburgers added at different FOS levels are described in Table 1. Higher scores ($p<0.05$) for appearance, flavor, overall acceptance and purchase intention attributes were found for sample F1 compared to F5. There was no significant difference ($p>0.05$) between other samples. Formulations F1, F2 and F3 were better accepted than F5 for flavor. The rest samples had similar acceptance in this attribute. Hamburger texture and color were not influenced by FOS addition ($p>0.05$). Similar results were observed in sausage with FOS addition [28,29,30] and mortadella with inulin addition [31]. According Salazar et al. [29], FOS addition in meat products generally does not modify sensory characteristics. Thus, changes observed in hamburger can be attributed to the fat reduction, as it negatively influences some sensory aspects, reducing acceptability of the product. In the flavor case, low fat level may decrease concentration of fat-soluble compounds [32], such as aliphatic hydrocarbons, aldehydes, ketones, alcohols, carboxylic acids and esters [33], which are released during chewing [34], which reduces acceptance. Similarly, this have occurred with aroma parameter, as lipids act as solvents for aromatic compounds [35]. These results corroborate with Olivares et al. [36] who studied low-fat sausage.

Product appearance was hampered by fat reduction, although consumers did not notice significant differences in texture and color. Fat-reduced hamburgers looked drier, as also reported by Bolumar et al. [37] studying 35% fat reduced in sausages. Despite the lower grades attributed to formulation with addition of 5% FOS, all samples presented AI above 70%, classifying them with good sensory acceptance [38]. Thus, it is demonstrated the feasibility of adding FOS as a fat substitute in hamburger, which promotes healthier food intake.

Table 1 - Sensory scores (mean ± standard deviation) obtained for hamburger with different levels addition of fructooligosaccharide (FOS)

Parameter	0%	1.25%	2.50%	3.75%	5%
Appearance	7.70±0.95^{a}	7.23±1.18^{ab}	7.42±1.13^{ab}	7.19±1.27^{ab}	7.06±1.35^{b}
AI (%)	85.56	80.33	82.44	79.89	78.44
Aroma	7.76±1.19^{a}	7.68±1.10^{a}	7.72±1.14^{a}	7.36±1.28^{ab}	7.09±1.49^{b}
AI (%)	86.22	85.33	86.55	81.78	78.78
Flavor	7.85±1.16^{a}	7.49±1.42^{ab}	7.56±1.41^{ab}	7.23±1.65^{ab}	7.13±1.45^{b}
AI (%)	87.22	83.22	84.00	80.33	79.22
Texture	7.14±1.56^{a}	6.9±1.67^{a}	6.94±1.60^{a}	6.91±1.68^{a}	6.78±1.64^{a}
AI (%)	79.33	76.67	77.11	76.77	75.33
Color	7.53±1.24^{a}	7.14±1.44^{a}	7.20±1.37^{a}	7.08±1.60^{a}	7.11±1.39^{a}
AI (%)	83.67	79.33	80.00	78.67	79.00

Overall Acceptance	7.6±1.30[a]	7.41±1.42[ab]	7.23±1.49[ab]	7.15±1.52[ab]	6.96±1.51[b]
AI (%)	84.44	82.33	80.33	79.44	77.33
Purchase Intention	4.19±0.71[a]	3.94±0.97[ab]	3.88±1.02[ab]	3.84±1.01[ab]	3.73±1.02[b]

Different letters in the same row differ significantly by the Tukey's test ($p<0.05$); AI: Acceptability Index.

3.2. Physicochemical composition

The physicochemical composition results of cooked hamburgers added at different levels of FOS are presented in Table 2. Prebiotic addition to hamburger proportionally increased moisture, carbohydrate and fiber content in product, however reduced lipid and calorie content. This is because FOS is free of lipid and contains low calorie contribute (1.46 kcal g^{-1}) [39] compared to pork fat that has 0.8 kcal g^{-1} lipid and 7.86 kcal g^{-1} [40]. There was no significant difference ($p>0.05$) between ash and protein content of the formulations, since both FOS [39] and pork fat [40] do not contain these nutrients in their composition. Higher moisture content in F5 is due to hygroscopic capacity of soluble fibers present in FOS (98%), which retain water within the hamburger protein matrix [41]. Similar results have been found in other surveys with the prebiotics addition in meat products [31,30,42].

There was no statistical difference in Aw results between samples, as already reported in literature [28,30]. FOS addition levels up to 2.5% increased pH in hamburger, while higher levels reduced this parameter. Higher FOS contents are likely to increase the lactic acid formation by the bacteria present in meat, which reduces pH in product [43,44]. Similar results were observed in sausage with addition of 0 to 30% inulin and pectin [8].

Table 2 - Physicochemical composition (mean ± standard deviation) of cooked hamburger with addition of different levels fructooligosaccharide (FOS)

Parameter	**0%**	**1.25%**	**2.50%**	**3.75%**	**5%**
Moisture (g 100 g^{-1})	52.69±0.04[e]	54.95±0.05[d]	56.05±0.09[c]	56.55±0.06[b]	62.95±0.08[a]
Ash (g 100 g^{-1})[α]	5.35±0.08[a]	5.36±0.07[a]	5.34±0.05[a]	5.33±0.08[a]	5.37±0.09[a]
Protein (g 100 g^{-1})[α]	50.55±0.10[a]	50.58±0.08[a]	50.66±0.11[a]	50.69±0.12[a]	50.57±0.10[a]
Lipid (g 100 g^{-1})[α]	28.79±0.08[a]	27.81±0.09[b]	25.90±0.10[c]	24.12±0.06[d]	20.38±0.08[e]
Carbohydrate (g 100 g^{-1})[α*]	15.31±0.19[e]	16.25±0.21[d]	18.10±0.18[c]	19.86±0.15[b]	23.68±0.13[a]
Energy value (kcal 100 g^{-1})[α**]	522.55±0.88[a]	517.61±0.53[b]	508.14±0.45[c]	499.29±0.47[d]	480.42±0.63[e]
Soluble fiber (g 100 g^{-1})[α***]	ND	1.28±0.13[d]	2.55±0.15[c]	3.83±0.18[b]	5.10±0.17[a]
Insoluble fiber (g 100 g^{-1})[α***]	ND	ND	ND	ND	ND
Total fiber (g 100 g^{-1})[α***]	ND	1.28±0.13[a]	2.55±0.15[a]	3.83±0.18[a]	5.10±0.17[a]
pH	5.84±0.02[b]	5.98±0.03[a]	6.06±0.03[a]	5.55±0.08[c]	5.63±0.06[c]
Water activity	0.95±0.02[a]	0.95±0.03[a]	0.95±0.04[a]	0.95±0.07[a]	0.95±0.05[a]

Distinct letters in the same row differ significantly by the Tukey's test ($p<0.05$); [α]Values calculated in dry basis; [*]Include dietary fiber; **Theoretical calculus: lipid (9 kcal g^{-1}), protein (4 kcal g^{-1}) and carbohydrate (4 kcal g^{-1}); ***Dietary fiber; ND: not detected.

Results for objective color analysis for hamburgers are presented in Table 3. The FOS addition

significantly increased the *L** values as FOS have shown higher brightness (98.02 ± 0.4) than pork fat (74.43 ± 0.43). However, there was no change in *a** and *b** values (p>0.05). In hamburger, formation of a translucent whitish gel from the prebiotic fiber prevents changes in values of *a** and *b** [28], which preserves characteristics of the standard product. Similar effects were reported by Menegas et al. [45] after addition of 7% inulin in fermented chicken sausage.

Table 3 - Color parameters *L**, *a** e *b** (mean ± standard deviation) of cooked hamburgers with addition of different levels fructooligosaccharide (FOS)

Formulation	**Lightness (*L**)**	**Redness (*a**)**	**Yellowness (*b**)**
0%	45.34±1.75^{c}	4.36±0.19^{a}	9.34±0.07^{a}
1.25%	47.59±1.78^{b}	4.26±0.32^{a}	9.37±0.75^{a}
2.50%	47.51±0.55^{b}	4.28±0.24^{a}	9.35±0.31^{a}
3.75%	47.29±1.34^{b}	4.20±0.07^{a}	9.32±0.03^{a}
5%	50.38±1.25^{a}	4.21±0.19^{a}	9.38±0.16^{a}

Distinct letters in the same column differ significantly by the Tukey's test (p<0.05).

3.3. Technological characteristics

Hamburgers technological characteristics results with addition of different levels fructooligosaccharide (FOS) are show in Table 4. The FOS addition to hamburgers proportionally increased cooking yield, fat retention and moisture values. Only 5% increment of FOS increased (p<0.05) the product % shrinkage. The soluble short chain fibers present in FOS interact with meat proteins forming a network that prevents water migration from product to surface [46]. Thus, there was increase in moisture retention and, consequently, in yield of hamburger cooking. Nevertheless, the use of very low levels fat may negatively affect technological characteristics of this product [47,48,16]. In meat products, fat provides flavor and texture, further promotes emulsion of ingredients while maintaining structure of food. Thus, it is possible to explain the greater shrinkage found in F5, since it is fat free, which increases water loss [49]. There was greater fat retention in hamburgers added with FOS (F3, F4 and F5, p<0.05), corroborating Tornberg et al. [50], Berry [26] and Troy et al. [47]. Hamburgers with higher fat content have higher fat loss during cooking. This is due to the greater likelihood that fat droplets will meet and expand since these products naturally have a higher lipid content. In addition, protein matrix of low lipid hamburger prevents fat from escaping from the product [50].

Table 4 - Technological characteristics (mean ± standard deviation) of cooked hamburger with addition of different levels fructooligosaccharide (FOS)

Formulation	Cooking Yield (%)	Fat Retention (%)	Shrinkage (%)	Moisture Retention (%)
0%	30.57±1.48^{d}	57.25±0.83^{c}	15.34±1.30^{b}	15.97±0.68^{d}
1.25%	31.36±1.76^{cd}	57.07±0.85^{c}	16.70±2.80^{b}	17.23±0.97^{c}
2.50%	32.91±1.00^{bc}	65.43±0.88^{b}	16.77±3.02^{b}	18.45±0.56^{b}
3.75%	33.34±1.11^{b}	68.83±0.99^{a}	16.40±1.04^{b}	18.85±0.63^{b}
5%	36.71±1.09^{a}	68.76±0.78^{a}	20.56±0.37^{a}	23.11±0.69^{a}

Distinct letters in the same column differ significantly by the Tukey's test ($p<0.05$).

4. Conclusions

It is concluded that FOS can be used as fat substitute in beef hamburger, withal it improves its nutritional profile, increasing carbohydrate and dietary fiber content and, reducing lipid amount and calories in product. It also has favorable influence on technological parameters of hamburger, increasing the cooking yield and moisture retention. Replacing up to 3.75% fat with hamburger FOS maintains sensory acceptability similar to standard product, with good commercialization expectations.

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Transversal Study Describing the Applicability of the Conicity Index in the Age Group of Children

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Abstract

The excess body mass predominantly in the abdominal region of the body, favors the emergence of several diseases among them are dyslipidemias and cardiovascular disorders. In this context, the conicity index (CI) is a viable alternative to indicate abdominal obesity. The objective of this study was to verify if the body mass index (BMI) and the CI have some correlation, and if the children's CI can be inserted in the cutoff range, using its original formula. This was an analytical and descriptive quantitative methodology with a cross-sectional design. Children of both sexes between 9 and 11 years of age participated in this study. Waist circumference-WC (m), height (m) and body mass index (kg) were used as variables for the CI and BMI calculation. After the collection of these variables, the tabulation was performed, and later SAS® Studio statistical software was used to perform the statistical analyzes. Sixty-six children (27 males and 39 females) were evaluated. It was observed that the CI and BMI data do not correlate with each other. However, the values obtained by calculating the 95% confidence interval of the mean of the children are contained in the range 1,00 and 1,73.

Keywords: adiposity; abdominal obesity; children;

1. Introduction

In Brazil, overweight and obesity in children have increased significantly in recent times [1]. For the World Health Organization (WHO), the number of overweight or obese children will increase to 70 million by 2025 ([2]; [3]).

Obesity is defined as too much body fat accumulation in adipose tissue [4], favoring health damage such as depression, dyslipidemia, cardiovascular disease, venous stasis, cancer [5]; [6]; [3], reduced autonomic nervous system functioning on the heart [7] changes in metabolism, respiratory changes, as well as damage to the locomotor system such as arthritis and arthrosis [8], [9].

It is known that fat concentration, especially in the abdominal region of the body (android), is a determining factor for the development of several diseases, especially cardiovascular diseases, dyslipidemia, type 2 diabetes mellitus, as well as changes in renal mechanism. due to the compressor effect [10], [11].

In this context, anthropometric tools are used to assess the body composition of children, as early

identification of overweight or obesity is of paramount importance to prevent future injuries [12].
There are several methods for assessing body composition in children, and currently the Body Mass Index (BMI) is one of the most used to classify obesity, however, this index represents the global mass [13]. In addition to BMI there is another form of analysis, namely waist circumference (WC), which is closely related to visceral adiposity that is of great concern [14], [15], [16].

In the 1990s, the Conicity Index (CI) was developed by Rodolfo Valdez, which represents an indicator of abdominal obesity, and is considered as a great alternative to assess the propensity or not of cardiovascular risks in adults, children and adolescents. makes use of WC [17];[18];[19];[20];[21].

For obtaining CI require routine body measurements such as body mass, height and WC. Its calculation still makes use of a fixed constant 0,109, which results from the root of the ratio between 4π (derived from the deduction of the circumference of a cylinder circle) and the average adult human density of 1050 kg / m^3 [22]. The value when obtained by the calculation can be evaluated by the cutoff point 1,00 to 1,73 (dimensionless value) and values close to 1,73 represent a high indication of potential cardiovascular risks, although when close to 1,00 presents low risk [23].

The standard calculation of the CI makes use of the average density of the adult human being, in this context it can be predicted that its use in the infant age group induces errors in the classification of abdominal obesity.

2. Objective

The aim of this study was to verify whether BMI and CI have any correlation, and whether children's CI may be inserted into the cutoff range using their original adult formula.

3. Material and Methods

3.1 Method

It was a quantitative analytical and descriptive research with cross-sectional design.

3.2 Inclusion criteria and Sample

It was considered as inclusion criteria, male and female children aged 9, 10 and 11 years. It was analyzed 66 children (27 male and 39 female) aged 9 to 11 years.

3.3 Ethical aspects

This study was submitted to the Ethics Committee for Research involving Human Beings and had its approval number (Certificate of Presentation for Ethical Appraisal - CAAE) n°. CAEE 80105217.2.0000.8114, which was approved by Opinion n°. 2442602.

3.4 Procedure

The children were invited through a newsletter delivered to some schools in a municipality in the interior of the state of São Paulo in March 2017, so that their parents and/or guardians could accept and leave a telephone number for later contact to clarify this study.

3.5 Anthropometric variables

In the first phase of the study were collected: CI, BMI, WC and height, for this we used an inelastic tape measure, with extension of 2 meters of millimeter scale, in order to measure the WC in an upright position, becoming tape at the smallest circumference between the ribs and the iliac ridges. To obtain height and body mass, a Welmy Led® anthropometric digital scale with a capacity of up to 200 kg was used, and the children remained in light clothes and without shoes, and in an upright posture to obtain better data.

3.6 Body mass index (BMI) calculation

For the second phase of the study, the objective was to calculate the children's BMI using Equation (1) below:

$$BMI = \frac{BM}{H} \tag{1}$$

where,

BMI – body mass index (kg);
H – height (m).

3.7 Conicity Index (CI) Calculation

For the third phase of the study, CI was calculated and the following variables were used: WC, body mass, height and constant 0.109 applying them in the following mathematical equation: Equation (2) proposed by Valdez (1991):

$$CI = \frac{WC}{0.109\sqrt{\frac{BMI}{H}}} \tag{2}$$

where,

WC – waist circumference [m];
BMI – body mass index (kg);
H – height (m).

3.7 Statistical analysis

After collecting these variables, the data were tabulated using the Excel spreadsheet and, subsequently, the SAS® Studio statistical software was used to perform the statistical analysis of the collected data.

4. Results

Seeking to achieve the intended objectives and based on the proposed methodology, 66 children were evaluated, being 27 boys (40.91%) and 39 girls (59.09%). Initially, the descriptive measures of the variables under analysis were calculated to summarize and describe the data, as shown in Tables 1 and 2 below.

Table 1 used the general data without considering the gender class and age of the individuals in the sample, since an exploratory analysis of the data is considered of paramount importance given a collective approach to the phenomenon under study.

With these results we seek to survey a series of statistics of the same nature, enabling a global view of measures of centrality and dispersion in the variables under analysis, as well as the organization and description for the collected data set. The mode, median and average for the 66 children in the sample highlight that the data are well distributed in each of the 5 variables considered, as highlighted in Table 1.

Table 1. Descriptive statistics of: body mass, height, WC, BMI and CI.

Variable	Minimum	Maximum	Standard deviation	Fashion	Median	Average	95% Confidence Interval for Average
Body mass index (kg)	24,80	55,80	8,27	33,10	39,80	39,34	(37,31; 41,37)
Height (m)	1,28	1,63	0,07	1,37	1,40	1,41	(1,39; 1,43)
WC (m)	53	86	9,29	58	64	66,54	(64,26; 68,82)
BMI	13,81	25,82	3,11	17,63	18,66	19,46	(18,69; 20,22)
CI	1,03	1,46	0,08	1,04	1,14	1,16	(1,14; 1,18)

Legend: BMI: body mass index; CI: conicity index.

Subsequently, in order to seek relationships between genders and ages, as well as to verify the behavior of the phenomenon within these classes, descriptive statistics of data with gender and age separation was performed, as shown in Table 2

Table 2. Descriptive statistics of the data with selection of gender and age

Age	Sex	N	Variables	Minimum	Maximum	Standard deviation	Fashion	Median	Average	95% Confidence Interval for Average
9	F	16	Body mass index (kg)	26	53,90	8,13	-	37,35	37,71	(33,38; 42,05)
			Height (m)	1,32	1,49	0,05	1,32	1,38	1,39	(1,36; 1,42)
			WC (m)	58	82	8,29	58	61,50	65,93	(61,51; 70,35)
			BMI	13,85	24,60	3,45	-	18,36	19,38	(17,54; 21,22)
			CI	1,07	1,28	0,06	-	1,17	1,16	(1,13; 1,20)
	M	12	Body mass index (kg)	27,80	53,30	9,06	27,80	39,15	39,31	(33,55; 45,07)
			Height (m)	1,28	1,47	0,06	1,33	1,37	1,38	(1,34; 1,42)
			WC (m)	54	82	9,56	59	67,50	68	(61,92; 74,07)
			BMI	15,71	25	3,38	15,71	20,77	20,34	(18,19; 22,49)
			CI	1,03	1,25	0,06	1,18	1,18	1,17	(1,13; 1,21)
10	F	18	Body mass index (kg)	27,90	51,30	7,36	31	36,55	38,46	(34,79; 42,12)
			Height (m)	1,30	1,55	0,06	1,37	1,39	1,41	(1,37; 1,44)
			WC (m)	54	81	7,66	54	62,50	63,33	(59,52; 67,14)
			BMI	15,30	23,74	2,49	16,51	19,09	19,11	(17,87; 20,36)
			CI	1,04	1,25	0,05	1,04	1,10	1,11	(1,08; 1,14)
	M	11	Body mass index (kg)	24,80	55,80	9,28	-	43,70	42,76	(36; 52,49)
			Height (m)	1,34	1,63	0,07	1,46	1,46	1,46	(1,41; 1,51)
			WC (m)	53	86,00	10,16	-	68	68,36	(61,53; 75,19)
			BMI	13,81	25,82	3,38	-	20,13	19,77	(17,50; 22,04)
			CI	1,07	1,28	0,06	-	1,14	1,16	(1,11; 1,21)

Legend: N: sample size; F: female; M: male; WC: waist circumference; BMI: body mass index; CI: conicity index.

Since the fashion highlights the maximum frequency in the observed variable, the median represents the most robust statistic among the measures of centrality in the face of the data distribution and the average can be distorted by a small number of extremely high or low values, the fact of these three measures are significantly close, mainly the median and the average, we can assume that there are no discrepancies in the data collected, and this allows us to assume the average as the main parameter for the variables of the phenomenon under study in the scenario of children in general, disregarding the classes gender and age.

However, in the class scenario, there is a controversial behavior to that observed in table 1, in the sense that, with the absence of fashion and a very small number of observations in the classes, although it is still possible to keep the mean as a parameter for the distribution, it is necessary, however, a normality test to find correlations between the covariates considered.

In this line, figures 1 and 2 show the distribution for the variables BMI and CI where the Normal and Kernel curve are drawn in each of them to search for indications that the variables are normally distributed and adopt the relevant tests for the correlation analysis of interest.

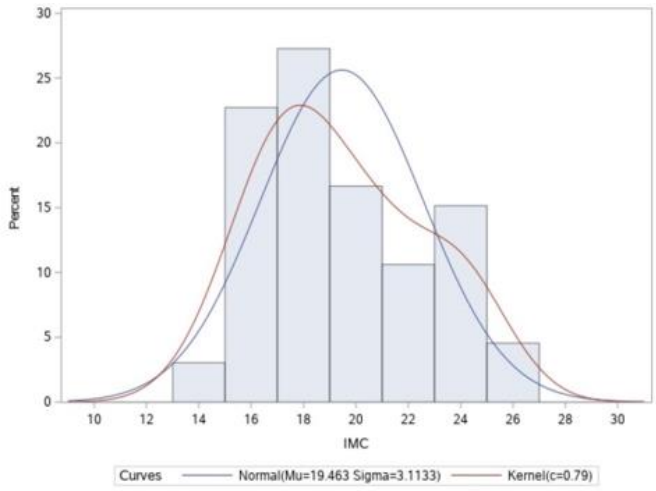

Figure 1: Distribution of the Normal and Kernel curves in relation to the BMI variable.

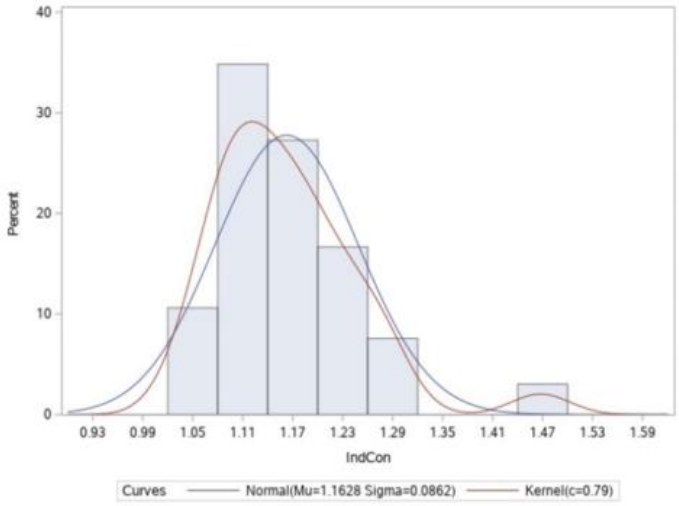

Figure 2: Distribution of the Normal and Kernel curves in relation to the IC variable.

In no case is normality indicated due to the Normal and Kernel curve as they are so distinct and do not follow the plots of the plotted histograms. As a result, normality tests were adopted and compared: Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von Mises and Anderson-Darling at a level of 5% significance. Through these, it was found that the variables are not normally distributed, given the p-values < 0.05 in each of the variables. Table 3 presents the results of the normality tests for the variables BMI and CI according to the methods adopted.

Table 3: Normality test for the variables BMI and CI.

Test	**Test Statistics**		**p-value**	
BMI				
Shapiro-Wilk	**W**	0,960013	**Pr < W**	0,0322
Kolmogorov-Smirnov	**D**	0,120192	**Pr > D**	0,0188
Cramer-von Mises	**W-Sq**	0,140063	**Pr > W-Sq**	0,0328
Anderson-Darling	**A-Sq**	0,875641	**Pr > A-Sq**	0,0238
CI				
Shapiro-Wilk	**W**	0,900343	**Pr < W**	<0,0001
Kolmogorov-Smirnov	**D**	0,09628	**Pr > D**	0,1315
Cramer-von Mises	**W-Sq**	0,165225	**Pr > W-Sq**	0,0158
Anderson-Darling	**A-Sq**	1,224984	**Pr > A-Sq**	<0,0050

Legend**:** BMI: body mass index; CI: conicity index.

In this way, the tests implemented, as well as the confidence intervals for the population means of interest, were obtained using the t-Student test. Then, the BMI and CI variables were taken to check if there is a significant correlation between them. In the case in which the classifications were disregarded, it is observed that under 5% of significance the hypothesis of the two variables is not correlated, that is, they are rejected, since p-value = 0,001 < 0,05 as shown in Table 4 below. However, given the correlation coefficient of 0,39557, there is a positive and weak correlation, as it is greater than 0 and less than 0,5.

Table 4: Pearson's correlation coefficient between the variables CI and BMI.

Statistic (N = 66)	**Value**
Pearson's Correlation Coefficient	0,39557
p-value	0,0010

Legend: N: sample size.

Then, the correlations between the investigated classifications are presented. Table 5 shows the correlation between genders and Table 6 between ages.

Table 5: Pearson's correlation coefficient between genders and the variables BMI and CI.

Statistic F (N = 39)	**Valor**
Pearson's Correlation Coefficient	0,22630
p-value	0,1660
Statistic M (N = 27)	**Valor**
Pearson's Correlation Coefficient	0,71930
p-value	< 0,0001

Legend: N: sample size; F: Female; M: Male.

Table 6: Pearson's correlation coefficient between the ages of 9,10 and 11 and the BMI.

Statistic (N = 28) 9 years	**Value**
Pearson's Correlation Coefficient	0,46750
p-value	0,0121
Statistic (N = 29) 10 years	**Value**
Pearson's Correlation Coefficient	0,76109
p-value	< 0,0001
Statistic (N = 9) 11 years	**Value**
Pearson's Correlation Coefficient	0,13143
p-value	0,7361

Legend: N: sample size; F: Female; M: Male.

Table 7 below shows the number of observations, the mean and the standard deviation of the male (M) and female (F) gender in the gender classification of the CI variable. For each class, we then have an average with a margin of error ± $\frac{Standard\ Deviation}{\sqrt{N}}$, respectively, ± 0.015614984 and ± 0.010875907, for female and male children, highlighting that the children's CI are contained in the interval 1,00 and 1,73 as proposed by Valdez et al. (1993).

Table 7. Gender classification of the CI variable.

Gender	N	Average	Standard Deviation
F	39	1,158756	0,09751555
M	27	1,168582	0,06792002

Legend: N: sample size; F: Female; M: Male.

5. Discussion.

Excess body mass in the abdominal region has been the focus of studies to investigate cardiovascular risk [24]. For [25] emphasize that the applicability of BMI is not an accurate identification method for cardiovascular risk, when it is related to obesity. However, CI has been largely correlated with metabolic and cardiovascular risk factors in all age groups [26]; [17]; [25]; [28].

[19] conducted a study in Brazil with 774 children and adolescents of both sexes aged 10 to 14 years, whose objective was to define CI cutoff points to predict changes in the lipid profile, but used the original formula. As for the cutoff points of the CI, according to the same authors, the cutoff point for boys aged 10 to 11 was 1,16, and for boys aged 12 to 14 years it was 1,14. In girls, the cutoff point was 1,14 for the 10-11 year old age group and 1,12 for the 12-14 year old age group.

In the present study, all values obtained by calculating the CI were within the cutoff established by [23] using his standard formula, which indicates that there are no outliers. The mean CI was 1,16 of the total

sample without separating gender and age. The values of this study when compared to the study by [19] female children aged 10 and 11 years, the average was 1,11, and 1,28 respectively, being higher at the age of 11 years, this represents that in this study female children aged 11 years have a high risk for lipid changes based on [19]. In male children aged 10 and 11 years, the average was 1,16, and 1,15 respectively.

[29] carried out a cross-sectional study in Salvador, Bahia with 968 adults, aged between 30-74 years old, who proposed cut-off points for CI in adults, being 1,25 for men, 1,18 and 1,22 for women up to 49 and from 50 years of age, respectively.

Analyzing the values obtained in this study and comparing it with the cutoff points suggested for adults, it appears that the mean CI of the children in this study approached the cutoff point suggested for adults, hence the importance of analyzing the formula of the CI to avoid false positives in the classification of abdominal obesity in children.

The BMI evaluates the global body composition, different from the CI, which emphasizes abdominal adiposity, as it uses WC as variables for its calculation. According to [30];[29] BMI is an anthropometric tool that can be obtained quickly, however, factors such as bone tissue, muscle mass and especially the growth phase of children, influence their numerator and consequently their classification, impairing the interpretation to assess obesity and interfering in the correlation between BMI and CI.

6. Conclusion.

Based on the results obtained in the present study, it is concluded that the CI and BMI have no correlation, and values obtained by calculating the 95% confidence interval of the average of the children in this study are contained in the 1,00 and 1,73 intervals using the standard formula. Therefore, further studies are suggested in order to correct the CI formula for children and adolescents in order to compare whether there is a difference in the value to be obtained by the standard and the corrected formula.

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Eulerian Video Magnification for Cleaning and Inspection of Air Conditioning Ducts With Rover Robot

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Abstract

This paper presents a diversied artifice of a Rover robot prototype in order to inspect abnormalities in air conditioning ducts and ventilation through an integrated rotating high-resolution camera system Eulerian Video Magnification is a method capable of revealing temporal variations of a body in videos that are impossible to see with the naked eye. Using this method, it is possible to visualize the flow of microorganisms present in the ducts, in which the images are R.W. transmitted in real time to the operator, allowing the cleaning with rotating brushes that adapt themselves according to the pipeline geometry, linked to the rover making the removal of impurities which are found on the walls, as well as the application of fungicides and bactericides, and finally the mechanism structure allows the manipulation of small objects held by a claw, which ensures greater operating flexibility compared to existing systems on the market. Due to weather problems being the main responsible for the considerable rise in temperature around the world, this has led man to seek ways by which people have comfort in both residential and industrial context. The most widely used alternative to soften or even solve this problem indoors has been the use of air conditioning systems. Despite the many advantages that these systems provide, there is great concern with the quality of air being supplied to the user according to the procedures and requirements of NBR 15848: 2010.

Keywords: Rover, Inspection, Cleaning, Ducts, Flexibility, Eulerian Video Magnification.

1. INTRODUCTION

"Robotics is the intelligent connection of perception to action" (Brady, 1984). A robot is then characterized as a mechanical and articulated device that can get information from the environment through sensors and software, take decisions based on this information and previous settings, and interact with the environment using actuators. The cameras are sensors commonly used in robots, and the computing vision field addresses the problem of emulating human vision and interpreting the world in 3D based on 2D images. Computer Vision offer not only the image itself, but above all with the logical act of assuming facts about the world and using known models to infer what the image represents. (Szeliski, 2010).

In order to improve and expand the use of Rovers robots, an inquiry about the shortcomings of existing systems was held. However, they are common activities that expose workers to dangerous situations, and obviously, the use of improvement in robotics and automation to solve the problem is considered. But in

order to use these improvements, it is necessary at this time, to select the areas that present high financial returns due to the high cost of equipment. In order to use the equipment in any activity, the financial nature of the problem is considered, even at the expense of ethical issues involving the safety and well-being of workers. In order to provide the protection and cost- benefit needs, it is necessary to produce a versatile, compatible with current technologies with attractive price and agility similar to men, replacing their presence where there is a risk.

According to the Ministry of Health (BRAZIL, 1998), the worldwide concern with the quality of indoor air in air-conditioned environments and the wide and increasing use of air conditioning systems in the country are related, because of weather conditions. It is very alarming the lack of maintenance in these air conditioning ducts, both as for those who make this kind of confined service that demands a lot of work, as for those that inspire this kind of air, due to the situations in which they are found, as it is shown in Fig. 1 and Fig. 2 and can thus bring great respiratory damage, according to NBR 14679: 2012 (BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS, 2012) establishes the procedures and minimum guidelines for implementation of corrective cleaning services of treatment systems and air distribution characterized as contaminated by microbiological, physical or chemical agents.

Figure 1. Ducts with dirt accumulation.

Figure 2. Insect presence housed in ducts.

Due to the complexity of HVAC systems, it is mandatory for companies to have their maintenance plans, guidance and control of air quality in air-conditioned environments, with technical responsibility annotation of a mechanical engineer and registered by the CREA (Regional Council of Engineering and Architecture). This technical manager shall provide technical maintenance reports and physical, chemical and microbiological reports about air quality available at any time. Thus, air-conditioning ducts offer everyday risks in theaters, shopping malls, buildings, mainly in hospitals or in any public place where there is an air-conditioning or installed ventilation system, the danger is imminent due to accumulation of dirt.

2. INNOVATION CONCEPTION

Professionals who used to perform the task of performing maintenance on ventilation and air conditioning ducts, stay in extremely unhealthy conditions, labor-intensive and high-risk professional areas due to the high content of dust and micro-organisms, it also creates a situation where the professional's health is exposed to various diseases caused by bacteria and fungi, so it opposes the precariousness of this type of maintenance which exposes the health of those that breath in these types of air-conditioned environments, everyday risks, to perform this function using a mobile robot using the Eulerian Video

Magnification shown extremely efficient since the bacteria are localized precisely, less work, because the very interconnected system to the robot is in charge of the extermination of these causative agents of disease, the process is a relatively low cost compared to existing systems, allowing not only corrective maintenance, more particularly around preventive system.

2.1 Conventional Systems

Most equipments uses direct contact of the operator to perform the operation and the partial disassembly of the ducts to analyze the conditions, which requires a visual inspection, an example is the large pipes that require a long time to carry out this type maintenance and also site interdict, then what should be an easy activity becomes difficult and extreme complication, reflecting unmotivation by those who go through this process.

3. PROJECT AND MATERIALS

Robotic systems are electronic and mechanized devices designed to perform scheduled work or controlled by humans to provide their needs. It can be divided into two main parts: software (program, which has no physical existence) and hardware (physical machine parts, engines, gear, weapons, sensors, etc.).

3.1 Software

The Software is classified as a logical part, a program written in a language interpretable by a machine (the processor of a computer or other equipment) and allows algorithm execution to perform tasks for which the software was designed. These programs consist of a sequence of instructions (commands) and data statements, which are storable on a digital environment defining how the hardware should behave when they do not conduct drive sensors or switches.

3.1.1 Eulerian Video Magnification

The underlying technology used by the software is called Eulerian Video Magnification (EVM), which essentially tracks the variation of individual pixels over time and then exaggerates those differences

3.2 Hardware

3.2.1 Processing

Hardware component responsible for processing data and turning it into information. It's called CPU (central processing unit) and the data is transmitted to the board on which the information will be processed, what in turn transmits them to input and output terminals (I / O) as actuators, sensors, cameras and other devices.

3.2.2 Motors and Actuators

The engines are the driving force responsible for the movement of equipment, devices that convert electrical energy into mechanical energy. This mechanical energy is developed by rotating a shaft that

rotates at a certain speed and torque in which the rotation axis provides movement to the plant or parts of it.

Physical quantities involved as power, torque and speed are the three basic variables that must be considered under the terms of the movement to be made.

The servomotors are commonly used, composed by an internal control system which checks the input position with the output position and a DC motor and a reduction gear responsible for the increasing of its torque.

4. DEVELOPMENT

4.1 Intuitive Control Concept

The main feature that distinguishes the configuration of this Rover from others is the use of techniques and methods used in other areas, developing a system that can have robotics advantages over the operator's safety, a decrease in the amount of PPE and it adds robots flexibility with concept of intuitive operation, where the operator does not need intensive training to handle it, as through a camera.

Through an enhanced digital microscopic camera USB 1000x, connected to the video Eulerian software Magnification (EVM), enables location of the bacteria, especially legionella, belonging to the mesophilic group, which are the worst cause of fatal respiratory diseases. The thermal application enables classifies it according to the optimum temperature for growth of between 30 and 37 ° C, this being the same temperature found in the cooling ducts. This technology allows you to take the variations in temperature and movement and converts them into frequency, which facilitates locating outbreaks of bacteria present in the ducts and apply the appropriate cleaning method.

This equation to estimate the size for a spatial filter needed to reveal a signal at a certain noise power level, as in Eq. (1).

$$s(\lambda) = s(r) = \sigma'^2 = k\frac{\sigma^2}{r} \tag{1}$$

Where S(λ) represents the signal over spatial frequencies, and since the wavelength, λ, cutoff of a spatial filter is proportional to its radius, r, the signal may be represented as S(r). The noise power, σ^2, can be estimated using to the technique. Finally, because the filtered noise power level, σ'^2, is inversely proportional to r^2, it is possible to solve the equation for r, where k is a constant that depends on the shape of the low pass filter. Finally, the magnified signal is added to the original image and the spatial pyramid collapsed to obtain the final output as shown in the Fig. 3 below.

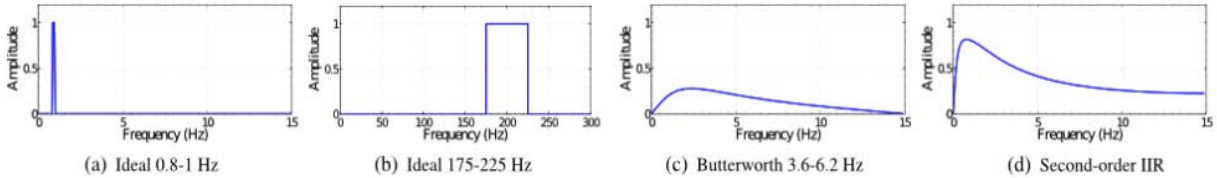

Figure 3.Examples of temporal filters.

4.2 Development Criteria

In order to make the idea to work, it was necessary to think about any method for the robot to transmit the image to the operator to enable In order to make the idea to work, it was necessary to think about any method for the robot to transmit the image to the operator to enable not only the autonomous movement inside the ducts but also the realization of inspection in real time to track outbreaks of bacteria housed in the same. For this, a wireless interfacing was used to connect the robot to the operator using the rotating brushes to perform the cleaning of it, allowing the manipulation of objects through a claw with parallel fingers and the application of bactericides and fungicides by the robot's integrated system.

After the research about the methods used in robotics, such as handling robots explorers and Rovers that aim to examine a particular environment or space and reveal through sensors and camera physical and biological characteristics, developing something that that is simultaneously feasible, flexible and affordable, using the virtual presence of men where they can't access, or where their presence is undesirable.

4.3 Elaboration of Mechanical Design

In the initial design process, it was developed a 3D modeling of the prototype using the CAD tool, shown in Fig. 4 below, its structural part, which was subsequently used in the mechanical manufacturing process, sharing the possibilities of improvements regarding the cost-benefit, also facilitating the construction of the prototype to sketch the operation.

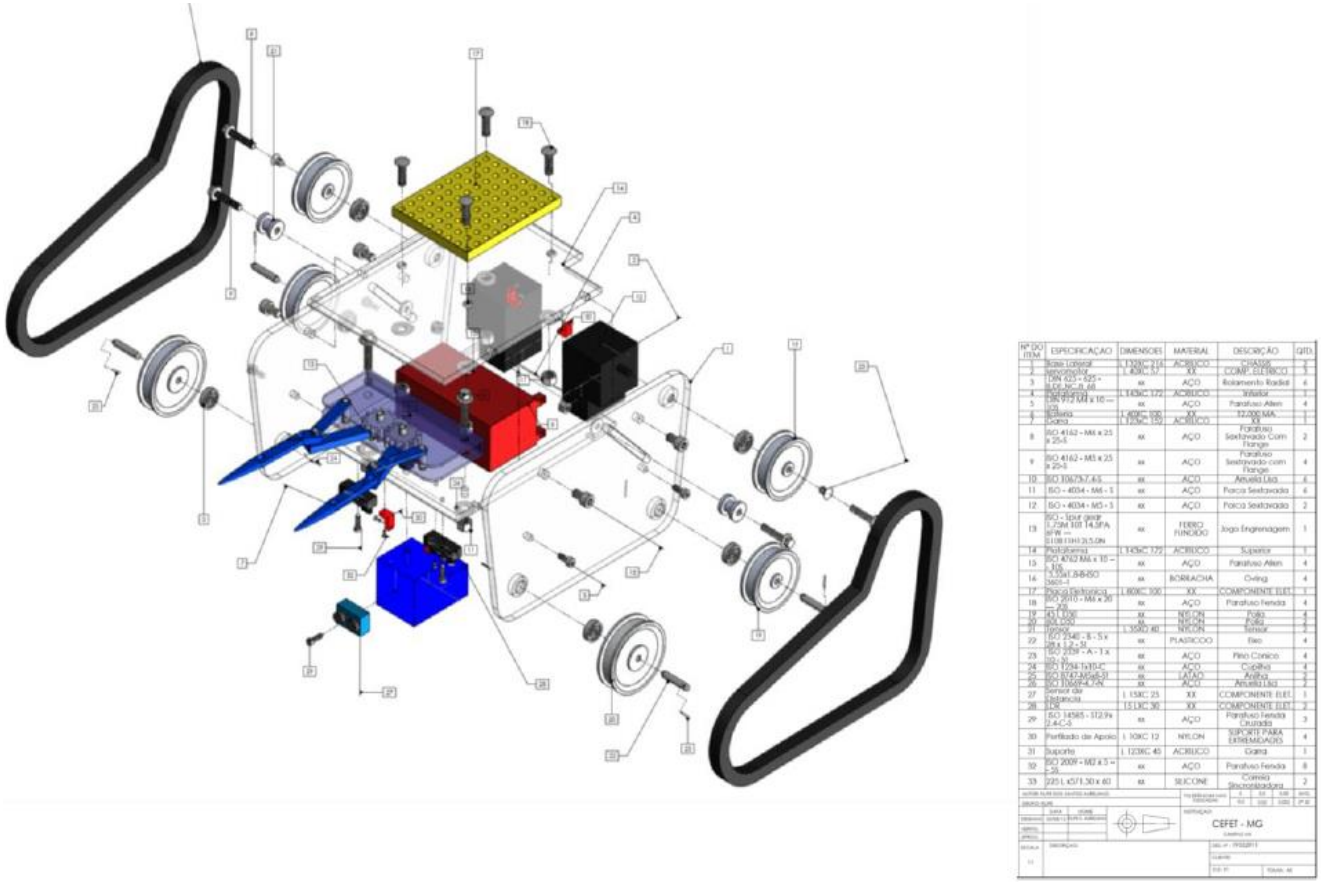

Figure 4. Structure Mechanics.

4.4 Displacement

In its displacement, it was expected the use of wheels, however analyzing in depth, it was found that the use of mats becomes more feasible because they increase the adherence to the ground and, consequently, its tensile capability in difficult terrain, allows the distribution of the prototype's weight evenly over the surface areas of the mat and curves around its own axis which does not occur with conventional wheels, thereby providing the shift in air ducts and ventilation as shown in Fig. 5 below, with easier adjustment.

Figure 5. Locomotion by mats in a duct.

4.5 Disposal of Electronic Components

The Electronic parts that compose the Rover are better characterized and detailed in the illustration of Fig. 6, where it makes use of a 6V lead battery for the actuators and a Lipo 11.1V battery power for the hardware Raspberry Pi B charging, which ensures a range of three and half hours without interruption when the exhausted batteries, automatically has a feed by an external source. The IC offers 74HC14N buffers able to transform input signals, well-defined, free of noise on its outputs which are connected to the actuators and the H bridge that makes the reverse rotation.

Figure 6. Disposal of Electronic Components.

4.6 Communication Interface

In the onboard system control, the Raspberry Pi B platform features including camera, wireless connection to handling and a greater response speed to the other existing controls, as this type of robot uses robotic vision applications including inspection, classification, navigation, recognition and manipulation. Through the Secure Shell (SSH) communication interface is made the robot navigation using the Raspibian Operating System (GNU Linux), a software application in C language WiringPI library, to control their movements, environmental analysis and manipulation objects, communication topology is most characterized in the flow chart in Fig. 7 below, demonstrated its flow control.

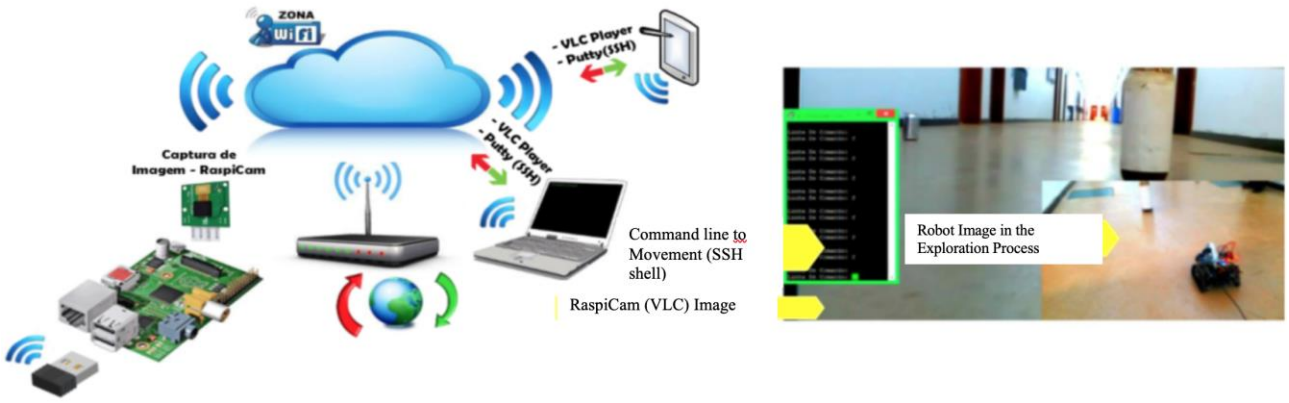

Figure 7. Communication Interface.

5. ANALYSIS

After the research development, it was possible to build the functional prototype that behaved as predicted in simulations where the operator needs only a mobile phone or a computer for handling the distance of Rover robot to perform cleaning and inspection of these products without the need of disassembling them or interdicting the site to carry out the task, performing the same service that was done by a team of technicians that was imposed to unhealthy situations. Already sketching out the system development viability for industrial use, but it is still needed to be characterized more effectively that even at the prototype stage, already shows characteristics that enable its use.

A practical test was held as it is seen in Fig. 8, demonstrating the feasibility of implementing cleaning and inspection of these pipelines, performing control of their movements through wireless networks by a mobile phone, making the use of your IP address to be access to Rover, in a simulation of the real physical system (SFR). This demonstration was also useful for prove the efficiency of developed controls that act friendly and intuitive, even in delicate tasks such as inspection.

Figure 8. Simulation of the real physical system.

The problems and solutions using the Robot Rover can be listed as:

• Problem: The air pollution in public places has become of great concern, the lack of maintenance in these air conditioning ducts, as those that inspire this kind of air can thus bring great respiratory damage.

• Solution: In order to analyze the duct, the Rover robot was connected to the Eulerian Video Magnification software in conjunction with a microscopic camera, in which it was possible to analyze the flow of bacteria in certain regions, as shown in Fig.9 (bacteria indicated in the regions graph black). In which it used a macroscopic camera that enabled their precise and responsive displacement in the ducts.

Eliminating direct contact these unhealthy places and allowing not only corrective maintenance more mainly preventive in which it inspects the system and determine the level of contamination where it is.

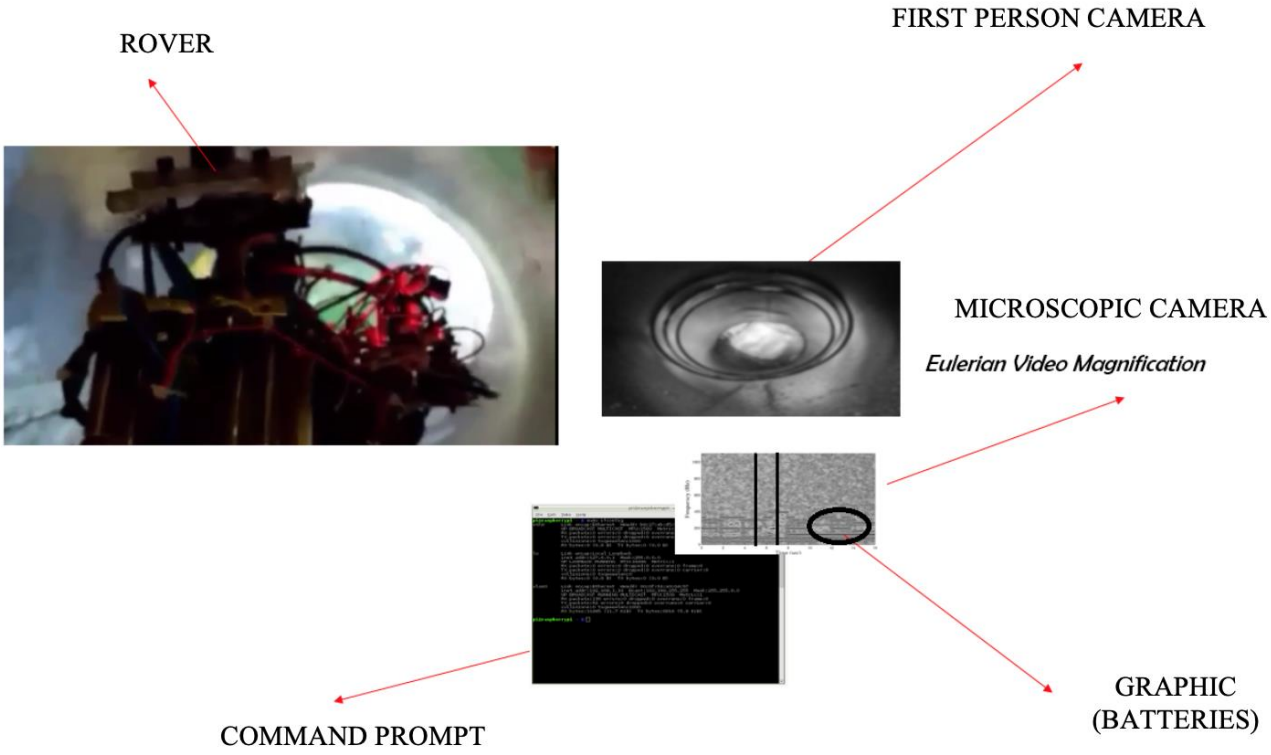

Figure 9. Microscopic analysis.

6. DISCUSSIONS

This study is different and can be considered an innovation by presenting a diversified artifice of a robot prototype explorer Rover, to inspect abnormalities in air conditioning ducts and ventilation through a rotating camera in which the images are transmitted in real time to operator, another increased microscopic camera 1000x connected to Eulerian Video Magnification software (EVM) and also perform cleaning with rotating brushes coupled to the Rover making the removal of impurities which are employed on the walls of these conduits, applying fungicides and bactericides and, also, the engine structure allows the manipulation of small objects held by a gripper, which ensures greater operational flexibility compared to existing systems on the market.

This is considered a simple innovation, its implementation would take men to a new era regarding occupational safety and achieving the explored area of inhospitable environments, allowing with no risks the performing of dangerous activities that today mutilate and degrade human health, in a totally safe and viable way.

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9. RESPONSIBILITY NOTICE

The authors are the only responsible for the printed material included in this paper.

Problems evidenced by nursing care in blood transfusions: an integrative review

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Abstract

Objective: *Analyse the primary studies that highlighted the problems related to Nursing assistance in the practice of blood transfusions.* ***Materials and Methods:*** *Integrative literature review with a search of journals indexed in SCOPUS; CINAHL; SCIENCE DIRECT; PUBMED and WEB of SCIENCE databases, with the descriptors blood transfusion; Exchange Transfusion; Hemotherapy Service; nursing care; Patient Care Planning; Evidence Based Nursing.* ***Results and Discussion****: The sample consisted of 12 primary articles. Two qualitative studies obtained a moderate and strong level on the COREQ scale. In the STROBE score assignment, ten articles were selected with scores above 12. As for the level of evidence, 91.6% have level 4 and 8.4% level 3. Regarding the professionals' knowledge about blood transfusion, although they have knowledge of the subject, they declare the need for continuous training for quality assurance and, also, those who know the process, but do not adequately perform the steps for patient safety, need training. Regarding patient safety, the knowledge deficit of professionals can be detrimental to patient safety, which can lead to potential harm and increased morbidity and mortality of patients in the process of hemodialysis.* ***Conclusion:*** *The transfusion practice requires qualified professionals to ensure quality care and patient safety. Therefore, there is a need for ongoing education programs that include training and capacity-building related to the subject, as well as the multiple factors arising from lack of quality and unhealthy forms of work that overload professionals and lead to error.*

Keywords: Blood Transfusion; Hemotherapy; Hemotherapy Service; Nursing Care

1. Introduction

Hemotherapy has been recognized as an important treatment strategy for clinical cases that include genetic

diseases such as sickle cell disease, transplants, chemotherapy and various types of surgeries [1]. Blood transfusion therapies in Brazil are governed by rules and resolutions. Thus, the Federal Council of Nursing regulated the competencies and attributions of the Nurse in hemotherapy through Resolution n. 306, of April 25, 2006, which establishes the responsibility for planning, execution, coordination, supervision, and evaluation of hemotherapy procedures in health units [2].

The hemotherapy sector is complex and requires specific knowledge from professionals in order to improve the quality of care provided and patient safety [3]. Therefore, transfusion therapy should be clearly documented, as well as the nursing care provided in this process. The essential data such as date, time of beginning and end of the procedure, vital signs during transfusion therapy, clinical changes, blood component bags data, as well as the initial follow-up, ten minutes before or after the therapy, the annotation, the register, and the nursing interventions are essential elements for the patient's safety and the quality of the nursing service [4].

In view of the technological advance and the vigilance that the transfusion process requires, the patient is not exempt from risks, which may include, among others, transfusion reactions [5]. From this perspective, it is possible to understand the importance of the nurse's role in blood transfusion therapy, since the professional competence is aligned with the commitment to enforce all regulations and legislation in force that refer to the transfusion process [6].

This proposal comes from one of the objectives of an ongoing doctoral thesis entitled "Hemotherapy in people with sickle cell anemia in use or not of hydroxyurea". Patients with sickle cell disease need blood transfusions as a treatment, especially those with sickle cell anemia who at some point in their life needed a transfusion.

Therefore, this research has its relevance when summarizing the studies focused on the aspects related to Nursing care in relation to blood transfusion. In this way, it aims to provide more information to professionals, as well as subsidies that ensure effective patient safety. Therefore, the objective of this research was to analyze the primary studies that highlighted the problems related to Nursing assistance in the practice of blood transfusions.

2. Materials and methods

This is an integrative review, whose methodological approach is broad as it allows the inclusion of experimental and non-experimental studies [7].

In the first stage, the guiding question was built from the PVO strategy (Population, Variables and Results/*Outcomes*)(8) (Table 1). So, the guiding question was: "What are the problems with nursing care in blood transfusion?"

Table 1 - stratification of the research problem with the PVO strategy, 2019

P = Population	Blood Transfusion
V = Variables	Problems
O = Results (*Outcomes*)	Nursing assistance

In the second step, the inclusion criteria were: complete articles available in the databases listed, which

address the problems related to nursing care in blood transfusion in any language and with time clipping between 2009 and 2019. The exclusion criteria were review articles, editorials, letters to the editor, abstracts, expert opinions, reviews, books, book chapters, theses, dissertations, monographs and Course Conclusion Work.

The third step occurred with the search of the articles in the databases: SCOPUS; *Cumulative Index to Nursing and Allied Health Literature* (CINAHL); SCIENCE DIRECT; *National Library of Medicine National Institutes of Health* (PubMed); Web of Science and was held in January 2019 by two independent reviewers.

It was used the descriptors indexed in *Medical Subject Headings* - MeSH: "*blood transfusion";* "*Exchange Transfusion"; "Hemotherapy Service"*; "*nursing care"; "Patient Care Planning"; "Evidence Based Nursing"*. There was a crossover between them to ensure a broad search on all bases with the OR and AND Boolean operators.

In the fourth stage, the pre-selection of studies was carried out by two independent researchers to read the titles and abstracts**.** 10,266 articles were found, 7893 were excluded for duplicity. With the application of the relevance test (inclusion and exclusion criteria), 5,520 records were removed. After reading, 187 articles were selected.

During the fifth stage, the articles were selected and read in full and 12 primary studies that addressed the thematic. For better understanding, a flowchart was developed that follows the PRISMA *Statement* recommendation [9] (Figure 1).

To extract the data, we used a tool previously elaborated with the variables: Database; Authors; Periodical, Year and Country; Delineation and level of evidence and Results/Conclusions (Table 2).

In steps six and seven, to critically evaluate the studies and identify the level of evidence, three protocols were used, evaluated by two independent reviewers. For quantitative studies at scale S*trengthening the Reporting of Observational Studies in Epidemiology* - STROBE [10]. In qualitative studies to *Consolidated Criteria for Reporting Qualitative Research* – COREQ(11) and the protocol of A*gency for Health care Research and Quality* (AHRQ), which ranks the level of evidence in hierarchy: 1 - Systematic reviews; 2 - evidence obtained in individual studies with experimental design; 3 - evidence from almost-experimental studies; 4 - evidence from descriptive studies or of a qualitative nature; 5 - derived from case reports or experience; 6 - based on expert judgement.

The contradictions between the researchers were analyzed and discussed until there was a consensus [12]. The COREQ quality rating was attributed as follows: "strong" where 66% or more of the quality assessment criteria were met; "moderate" if 33% to 65.9% of the questions were answered and "weak" if 32% or less of the criteria were answered. For the STROBE quality classification, studies that obtained more than 11 points (50%) were considered included.

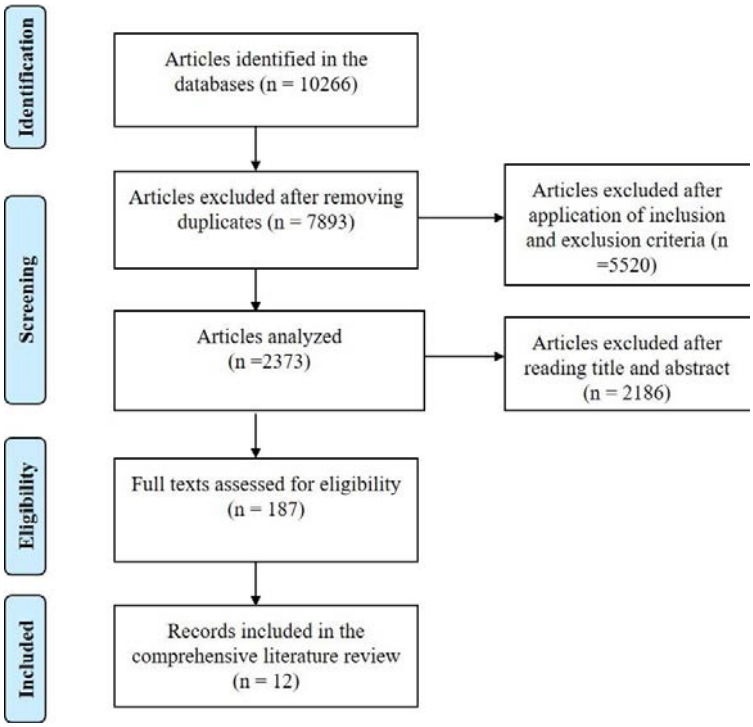

Figure 1. Selection flow of primary studies from the integrative review on Nursing Care in blood transfusion, 2019

3. Results and discussion

The sample consisted of 12 studies, which were submitted to analysis and described in Table 2.

Table 2 - Description of the studies on the problems related to nursing care in blood transfusion, 2019.

Database	Author	Journal, Country and Year	Critical Assessment	Results/Conclusions
PUBMED	Graaf *et al.* [13]	Asian journal of transfusion Science, Uganda, 2009.	STROBE: 12 Level: 4	Bad practice plays a role in morbidity and mortality related to blood transfusions. There is a need for a transfusion policy and current practice guidelines.
PUBMED	Heddle *et al.*[14]	Transfusion, United States of America, 2012	COREQ: strong Level: 4	Multiple factors can contribute to errors during pre-transfusion verification. New research should be developed to improve safety.
PUBMED	Hijji *et al.*[15]	Journal Of Clinical nursing, Emirados Árabe, 2013	STROBE: 17 Level: 4	It highlighted knowledge deficits that could be detrimental to patient safety.
PUBMED	Murphy *et al.*[16]	Transfusion, United States of America, 2014	STROBE: 22 Level: 4	Many barriers to good transfusion practices: differences in knowledge, excessive optimism of current practice and heterogeneous practices.
SCOPUS	Tavares *et*	Latin American	STROBE:	Interventions, such as continuing education, as

	al.[6]	Journal of Nursing, Brazil, 2015.	17 Level: 4	well as periodic practice training should take place.
SCOPUS	Reis *et al.*[17]	Einstein-São Paulo, Brazil, 2016.	STROBE: 12 Level: 4	High percentage of inadequate completion of transfusion monitoring forms, which can lead to errors.
CINAHL	Amaral *et al.*[18]	UFPE Nursing Magazine on-line, Brazil, 2016.	STROBE: 13 Level: 4	Need for continuing education and in-service training for a more appropriate conduct through any intercurrence.
SCOPUS	Kavaklioglu *et al.*[19]	Northern Clinics of Istanbul, Turquia, 2017.	STROBE: 12 Level: 4	There should be additional training to ensure patient safety and avoid mistakes.
CINAHL	Cherem *et al.*[20]	Gaucha Nursing Magazine, Brazil, 2017.	COREQ: moderate Level: 4	The promotion of training for the quality and safety of care in neonatology is necessary.
PUBMED	Nunes *et al.*[21]	Advances in nursing. Colombia, 2017	STROBE: 19 Level: 4	Self-confidence, protocols, training programs and work in a single job are factors associated with increased knowledge and surveillance during procedures.
PUBMED	Vaghar[22]	Journal Of Medicine and Life, Irã, 2018	STROBE: 18 Level: 3	Educational programs can positively influence knowledge and performance, especially on inadvertent side effects.
SCOPUS	Khetan *et al.*[23]	Asian Journal of Transfusion Science, Índia, 2018.	STROBE: 16 Level: 4	Need for awareness of bedside blood transfusion policy and guidelines and regular audits.

As for the language, four articles were published in Portuguese and eight in English. The oldest publication was in 2009 and in 2018 the most current, but the periodicity was from the year 2012.

The country with the largest number of publications on the subject is Brazil (four studies), followed by the United States of America (two studies). Other publications came from countries such as Uganda, Colombia, United Arab Emirates, Turkey, Iran and India.

Of the studies analyzed a total of ten were quantitative outlines and two were qualitative in nature. Among the database searches, six were published in PUBMED, four in SCOPUS and two in CINAHL.

Regarding the objectives of the studies, seven proposed to evaluate the knowledge of professionals on hemotherapy, mainly focusing on transfusion practice; four to evaluate the aspects of nursing care in blood transfusion and one to analyze the procedure itself.

As for the critical evaluation, both qualitative studies were moderate and strong on the COREQ scale. Ten articles were also analyzed by STROBE with scattered scores ranging from 12 to 22 points and as for the level of evidence eleven publications have level 4 and one level 3.

The periodicity of the articles occurred after the year 2012, which shows the relevance and actuality of the proposed theme. There are few qualitative studies, this limitation can be justified by the fact that

hemotherapy is a still recent specialty in nursing [24].

For better discussion and understanding of the results that addressed the problems related to Nursing assistance in blood transfusion, the findings in the studies were structured in thematic nuclei.

3.1 Knowledge about blood transfusion

Regarding the knowledge of professionals about blood transfusion, some researches have shown that, although they have knowledge of the subject, they declare the need for continuous training for quality assurance and, also, those who know the process, but do not adequately perform the steps for patient safety, need training [19,2]. There is evidence that describes a large number of nurses as professionals who have no knowledge about transfusion practice, with levels of deficit in all aspects related to hemotransfusion [1,15].

When analyzed the knowledge and performance regarding transfusion practice before and after training intervention for Nurses and nursing staff, evidence showed that there was an increase in knowledge and performance of professionals [19,22,25]. Thus, it was observed that permanent education for nursing professionals on hemovigilance guidelines is the most assertive way to improve the quality of care provided [6,20].

The approach should be broad and emphasize from basic care, techniques, to care through intercurrences, adverse reactions, inadvertent side effects, in favor of increasing knowledge and surveillance during care [18, 21, 22].

It is worth mentioning that the implementation of procedures, training programs and awareness raising are not enough to guarantee the performance of professionals. There are several other related problems, such as distractions, interruptions, excessive workload, stress, familiarity or lack of this with the procedures and even with the patients, and also lack of knowledge of the policies and difficulties of access to information [14].

3.2 Patient safety and risk management

The evidence demonstrating that the knowledge deficit of professionals, with the risk of potential damage and increased morbidity and mortality of patients in the process of hemotransfusion is detrimental to patient safety is increasing [3, 13, 26].

A study performed in four hospitals with nurses asked about the follow-up and monitoring of the patient during blood transfusion, 58% responded that they followed up and monitored the patient during the transfusion process, against 8% who said they did not follow up the transfusion until the end and 33% responded that they only follow up [27].

In Brazil, the entire blood transfusion process should be monitored from beginning to end and followed for ten minutes at the bedside by the professional who installed it [28]. Nurses are professionals who are directly and constantly with the patients and thus involved in increasing safety, minimizing errors and ensuring good blood transfusion practices [17,19].

Many factors, which may induce human failure during nursing care in blood transfusion, range from ignorance of appropriate techniques to some critical points, such as: application of the patient identification bracelet; sample collection; sample testing; emission of the blood product, in addition to the process of

verification before blood transfusion [15,16,29].

There is fragility in both the transfusion practice and the problems related to the bureaucratic filling out of forms that carry information necessary to identify clients who are using this therapy [17]. It is necessary to control and increase the safety of the patient during transfusion practice and analysis of the main critical points that allow the error [14].

Therefore, the advancement of public policies, clinical guidelines and standard procedures with updated approaches in blood transfusion practices and internal audits are necessary to analyze the conditions of care and the implementation of standards [13,23]. These events direct the professionals to perform new researches which aim at improving evidence regarding patient safety and quality of care [14].

4. Conclusion

When analyzing primary studies which focused on problems related to nursing care in the practice of blood transfusions, by means of the integrative review method, failures pertinent to the nursing team's performance were evidenced, which contribute to incidents in transfusion practice, as well as to worsen patient safety. In view of this, the most frequent aspects in relation to the hemotherapic practice observed: The most studies show a deficiency in the theoretical and technical knowledge of the nursing professional. After interventions, such as training and capacity-building on transfusion, nursing professionals *score* above average.

The relevance of this integrative review for the practice of nursing care in hemotherapy is configured as an alert for the qualification of professionals, which aims to ensure quality care and safety to the patient. Thus, there is a need for on going education programs that aggregate training and capacity-building related to the theme, as well as the multiple factors arising from lack of quality and unhealthy forms of work that overload professionals and lead to error.

In view of the above, further research is needed by producing scientific articles in the field of hemotherapy and nursing care that employ research representations with a higher level of evidence, with a view to quality and the ideal margin of safety for the patient.

5. Acknowledgement

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Responding Strategies in Jordanian Arabic: A Socio-Pragmatic Study[1]

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Abstract

This study aims to examine the types of response strategies employed in the interactions between Jordanians and the employees of the call-centre-customer service (CCCS) of a major telecommunications company in Jordan. It focuses on their linguistic behaviours upon responding taking into account the degree to which they adhere to Leech's (2014) maxims. Naturally-occurring interactions and designed situations were used to collect data from 28 Jordanian Arabic speakers participated in this study. The results of the study show that participants adhere to a number of the maxims in that responses are made politely whether the act is achieved or not. Furthermore, it has been revealed that participants are impacted by the social and cultural norms of the Jordanian society.

Keywords: Responding; Agreement, Politeness strategies; Jordanian Arabic; Social norms

1 Introduction

In pragmatics, speech acts have been the focus for a number of linguists, such as Austin (1962), Searle (1969), Grice (1975), among others. The concept of speech act was first coined by Austin (1962). He stated that words are actions in themselves because they are uttered either to do something or to get something done by others. When we speak, according to Austin, our words involve three aspects of act: locutionary which is the ostensible meaning as it refers to the actual words of the speaker; illocutionary act refers to the communicative value the utterance carries, so it the intended meaning; the third type is the perlocutionary act which refers to the influence of the speech on the hearer. Searle (1976) suggests five types of illocutionary acts that include the speaker and the hearer: representatives (assert, deny, claim), expressives (thank, apologize, congratulate), directives (requests, commands, orders), commissives (promise, offer) and declaratives (declare, appoint, resign).

For the conversation to be successful, a kind of cooperation between the speaker and the hearer is essential. On the part of speaker, it is necessary to be clear enough in a way to allow the hearer understand the act.

[1] This article is extracted from a PhD thesis written by the first author and supervised by the co-authors.

Grice (1975) proposed the cooperative principle (CP) as a framework for language use. It is intended to describe the ordinary linguistic behaviour of people when interacting. According to this principle, participants in a conversation should maintain four maxims: relation, quality, quantity and manner. Grice (1989) states that if these maxims are maintained by the interlocutors, there will be "the effective exchange of information" (p. 28).

2 Literature Review

In this study the speech act of responding is investigated in light of Leech's (2014) General Strategy of Politeness (GSP). Relying on Grice's conversational principles, Leech (1983) proposed the Politeness Principle (PP) in order to develop a pragmatic framework in which politeness is viewed as a regulative factor in communication operating within a set of principles and maxims. He is mainly concerned with the pragmatic phenomenon of indirectness because, as he argues, politeness is the reason why speakers violate the cooperative principle. Thus, leech attached his PP to Grice's (1975) cooperative principle (CP) accounting for the reasons of violation of this principle. This Politeness Principle works within a set of six maxims. However, Leech (2014) introduced the General Strategy of Politeness (GSP) as a single superconstraint that grasps all the maxims which, when employed, shows that *S* tries to make sure that offense is avoided. Leech's GSP states that "In order to be polite, *S* expresses or implies meanings that associate a favourable value with what pertains to *O* [*O* = others including H] or associates an unfavourable value with what pertains to *S* (*S* = self, speaker)" (2014, p. 90). He increased the number from six to ten. As seen in Table 2.1 below, the pos-politeness maxims are with odd numbers which are *S*-oriented whereas the neg-politeness maxims are with even number which are *H*-oriented. All maxims are labelled in a sequence number (1-10) preceded by the letter M standing for Maxim.

Table 0.1 The component maxims of the General Strategy of Politeness (taken from Leech (2014, p. 91))

Maxims (expressed in an imperative mood)	Related pair of maxims	Label for this maxim	Typical speech event type(s)
(M1) give a high value to *O*'s wants	Generosity, Tact	Generosity	Commissives
(M2) give a low value to *S*'s wants		Tact	Directives
(M3) give a high value to *O*'s qualities	Approbation, Modesty	Approbation	Compliments
(M4) give a low value to *S*'s qualities		Modesty	Self-devaluation
(M5) give a high value to *S*'s obligation to *O*	Obligation	Obligation (of *S* to *O*)	Apologizing, thanking
(M6) give a low value to *O*'s obligation to *S*		Obligation (of *O* to *S*)	Responses to thanks and apologies

(M7) give a high value to *O*'s opinion	Opinion	Agreement	Agreeing, disagreeing
(M8) give a low value to *S*'s opinion		Opinion reticence	Giving opinions
(M9) give a high value to *O*'s feelings	Feeling	Sympathy	Congratulating, commiserating
(M10) give a low value to *S*'s feelings		Feeling reticence	Suppressing feelings

M1 can be direct as seen in offers, invitations and promises. M2 is used to soften *S*'s imposition on H such as the case with requests which are direct as they allow H an opportunity to refuse. M3 is used in compliments which are familiar occurrences and virtual necessity whereas the insincere or excessive ones are considered as flattery in which CP clashes with PP. Criticisms of *O* are hedged and muted, especially when the social role of *S* is a dominant one or if *O* is a third party rather than the hearer. M4 appears in *S*'s self-criticism which is a kind of modesty that produces a denial or paying a compliment in return from H. M5 represents a situation in which *S* apologises for some offense he or she did to H, so *S* presents a polite speech act that shows prominence to his or her fault and obligation to *O*. Responses to apologies or thanks by *O* reduce the fault or the debt of *S* towards *O*, a polite speech act represented by M6. M7 states that *S*'s agreement with *O*'s opinions is preferred while *S*'s disagreement is dispreferred, usually preceded by delay or hesitation. M8 refers to softening the force of *S*'s opinion by using certain forms such as, I think, I guess, etc. M9 is used in sharing others their feelings such as in congratulations and condolences. So, *S* shows sympathy to *O*. M10 somehow corresponds negatively to M9. Here it is polite for *S* to give low value to his or her feelings.

Studies on linguistic politeness are countless in number. The literature on this phenomenon is very rich. In the Jordanian Arabic (henceforth, JA) many studies have been conducted in terms of speech acts aiming for establishing a kind of relation between them and some selected social variables (e.g., Al-Qudah, 2017; Abushihab, 2015; Bani Mofarrej & Al-Abed Al-Haq, 2015; Al-Harahsheh, 2014b; Al-Khawaldeh, 2014; Almutlaq & Jarrah, 2013; Al-Sobh, 2013; Rababa'h & Malkawi, 2012; Al-Momani, 2009; Farghal & Al-Khatib, 2001**,** among others). As for the present study, it focuses on the differences in the expressions of responding acts by Jordanian males and females found in their naturally-occurring interactions with the call-centre-customer service of a leading telecommunications company in Jordan.

Investigating how Arabs attach politeness in their interactions, Samarah (2015) conducted a study to find out what types of expressions are the most common. Rather than selecting one particular dialect, he focuses on spoken Arabic in general under the title 'Politeness in Arabic Culture'. Following no clear methodological approach, he concludes that there are two main factors that control Arabic politeness, namely, religious faith and social convention. Religious faith expressions usually contain a reference to God such as /baraka llahu fik/ 'God bless you' in performing thanking and /allah yisamhak/ 'May God forgive you' when the speaker is being offended (p. 2011). Religious faith expressions have more power than the social convention expressions as far as politeness is concerned. He mentions some semantic categories under which Arabic politeness can be analysed including sociability, gratitude, benevolence and

felicitation, guilt, permission, appreciation, hospitality and generosity, and respect (p. 2015). As for the Arab society, he argued that high-class people follow religious recommendations when they are in doubt whether to rely on the social conventions or religious recommendations (p. 2015).

Farghal and Al-Khatib (2001) explore the responses to compliments in Jordanian Arabic produced by Jordanian college students. The analysis of the data shows that simple compliment responses were preferred by the students to those complex responses. The results of the study also revealed that the gender of the speaker seems to be an important factor in the formulation and acceptance or rejection of a compliment. For example, male participants use simple responses when responding to males rather than females but use more non-verbal responses when interacting with the opposite gender. Moreover, male participants have a tendency to accept compliments more than females do whether responding to males or females. Similarly, Al-Faqeer (2006) investigates the strategies that children employ in responding to compliments in Jordanian Arabic. Using a corpus of 418 responses, the results indicate that participants use simple responses more frequently when compared with complex responses. The results also show that non-verbal type of response is one of the most striking features of children's language. It is also revealed that literal compliments were clearly understood by children between 6-9 years old, whereas understanding ironic compliments seemed to be somehow problematic for them. Children between 10-12 years old did not encounter any problem in responding to literal and ironic compliments. Responses to thanking is investigated by Al Rusan (2018). The study explores the strategies employed by native speakers of Jordanian Arabic when performing thanking responses through natural observation of the participants in real-life situations. The results of the study show that the most frequent type of responses is acceptance followed by denial, whereas the non-verbal gestures and no response strategies were the least common ones. Moreover, as for the length of the response, it is correlated with thanking expression; the more sincere the thanking expression is, the longer the response is. The author argues that thanking responses may function as a tool to strengthen relationships between interlocutors.

Criticism, as a speech act, in Jordanian Arabic is investigated by Al Kayed and Al-Ghoweri (2019). Using DCT, they collected data from 73 undergraduate Jordanian students living in Jordan. The results of the study indicate that participants have a tendency to employ indirect strategies in performing the speech act of criticism more than the direct strategies suggesting that criticism is perceived by Jordanians as a face threatening act.

Al-Khawaldeh (2014) compares the linguistic expression of gratitude in Jordan and England in order to find out how gratitude is perceived and realised cross-culturally. She collected the data from 46 Jordanian Arabic native speakers and 46 English native speakers using DCTs, role-plays and interviews. The results revealed that there are significant differences between the two cultures in the perception, number and the type of strategies employed when communicating gratitude. The author argued that gratitude should be viewed as a means of establishing and maintaining social relationships instead of being viewed as face threatening act.

Al-Harahsheh (2014b) analyses twelve dyadic conversations produced by students of a Jordanian university in order to find out the gender influence on their Jordanian Arabic in terms of the politeness strategies they employ. He divided the participants into two groups: the mixed-sex group and the same-sex group; each group was divided into two sub-groups: friends and strangers. The results of the study revealed that gender

plays a significant role in the choice of the participants' style of communication as women show a tendency to maintain social relationship with other interlocutors and avoid disagreement. Moreover, they try to get the listener engaged in the interaction more than men do using more facilitative strategies. Al-Harahsheh (2014b) concludes that in terms of cooperation with the other interlocutors, women seemed to be more professional conversationalists than men.

The above studies investigated a number of speech acts in the Jordanian context relating them to different social variables including age, gender, region, religion, relationships, etc. Although their focus was speech acts in Jordanian Arabic, none of them, according to the best knowledge of the researcher has targeted the interactions between Jordanian people and government or private organisations in general, and the context of CCCS of telecommunications companies in particular. Thus, this constitutes a gap in the literature on politeness behaviour in the Jordanian Arabic context. Therefore, this study aims and hopes to enrich the literature on the JA context by bridging the above-mentioned gap.

3 Methodology

Data for this study were collected from 28 participants; they were randomly chosen from the employees of the CCCS of the telecommunications company and customers. Their ages, genders and social statuses were uncontrollable as the researcher could not do any pre-interaction arrangements with them because interactions were naturally-occurring ones. The participants were divided into two groups: the customers (C) and the call centre's employees (E). The study involved qualitative data collection using recordings of naturally-occurring interactions that took place between the customers and the call centre's employees and the use of imaginary situations designed by the researcher to elicit precise information about certain response strategies. Being spoken in Arabic, the data was transcribed and translated into English then divided into groups according to the response strategies used by the participants.

2 Findings and discussion

When a person makes a request, an opinion, a compliment, etc., he or she expects a response. So, responding to such utterances can be achieved in a number of ways. One way is agreement with what is said by the speaker. In this respect, Leech (2014) labelled Maxim 7 as Agreement Maxim which states, "Give a high value to *O*'s opinions" (p. 96); he emphasizes that agreement is the preferred response to the speaker's opinions or judgments whereas disagreement is the dispreferred response. Agreement can be in different forms. One way is by the use of a word or a phrase that shows direct agreement with the speaker. In the following sub-sections 2.1-7 response strategies will be discussed.

2.1 Agreement by /ʔɪnʃa:lla/ 'God willing'

The term /ʔɪnʃa:lla/ is a combination of three words: /ʔɪn/ 'if', /ʃa:ʔa/ 'will' and /ʔalla:h/ 'Allah'. However, as a result of phonological process in Jordanian Arabic the three words are merged into one. In the religious context, it is used as a future marker since Muslims link and condition the success of their future deeds with the willing of Allah, so whenever referring to any future activity, they use /ʔɪnʃa:lla/.

Example 1	21	E2	*tudxul ʕar rısa:law tıħðifha* Open the message and delete it.
	22	C2	*ʔınʃa:lla* God willing.

In example 1, E2 makes a request to C2 in line 21 indicated by the use of the indirect imperative verb. In line 22, C2 says /*ʔınʃa:lla*/ which, in this context, means 'I will do that'. Another instance of agreement with the speaker's wish or request in shown in example 2 below.

Example 2	31	E8	*bnıtmanna nku:n ʕınd ħusnıẓ ẓan* We hope that we met your expectations.
	32	C8	*ʔınʃa:ʔalla* God willing.

The response is performed by C8 in line 32 which is a response to the wish made by E8. By saying /*ʔınʃa:ʔalla*/ C8 agrees with what E8 said that his expectations are met.

In the above two examples, C2 and C8 are implementing Leech's Maxim 7 in that they give high value to the speaker's request as they agree to what is said by the speakers indicated by the use of /*ʔınʃa:ʔalla*/. This term involves the use of God's name, Allah. Samarah (2015) states that such politeness expressions with God's name are used to amplify the expression of politeness. However, in this study, especially in /*ʔınʃa:ʔalla*/, it has another function which is to show agreement with what others said.

2.2 Agreement by /*tama:m*/ 'OK'

Another agreement marker is /*tama:m*/ which means 'good' or 'OK' (lit.: exactly). According to the available data for this study, it is used to indicate the speaker's agreement to what is said. Its use is found to be very frequent by participants of this study. However, because of the similarity in the use of such marker, only two examples are discussed below to avoid repetition.

Example 3	9	E5	*walay hımmak (.) tħammalnı laħaẓa:t* Don't worry. Be patient for moments.
	10	C5	*tama:m* OK.

In example 3, E5 in line 9 requests C5 to be patient which means to allow him some time to check his line. The request is /*tħammalnı laħaẓa:t*/ for which C5 in line 10 responses by /*tama:m*/ with the indirect meaning 'I will be patient'.

Example 4	62	E6	*bnınzıl bılxıyya:ra:t latıħıt laħatta nla:ħıẓ ʔısmıl mustaxdım* We go down in options to see the username.

	63	C6	*tamaːm* OK.

Similarly, in example 4 E6 requests C6 to check the options in order to find the username. C6 response is simply /*tamaːm*/ which means here 'yes, I'll do'.

2.3 Agreement by /*ukeɪ*/ 'OK'

Being country's first foreign language, English presence is very clear in Jordanian's conversations not only at the site of this study but also at other formal and informal communication. In the data of the present study a number of English terms are used by participants such as 'offer', 'available', 'mobile', 'service', 'customer', and 'OK', among others. However, since the main theme of this study is not to discuss the English language influence on Arabic, the researcher will focus on the use of 'OK' as a response to certain requests in interactions between callers and CCCS employees. Similar to /*tamaːm*/, /*ukeɪ*/ 'OK' is very frequent in the available date and used by most of the participants. For instance, in example 5, C8 in line 11 complies with the request of E8 that she needs some time to check his line in her attempt to solve his problem. C8 says /*ukeɪ*/ to mean 'yes, take your time'.

Example 5	11	E8	*tamaːm (.) hallaʔ bɪnnɪsbɪh lalxaṭ ʕafwan ʔɪl fɔːr dʒɪː mfaʕʕalu baṭɪːʔ lanɪtʔakkad mɪnha tɪmhɪlnɪ laħazaːt* OK. Now as for the line sorry 4G, it is activated and slow. Be patient for a while so I can make sure.
	12	C8	*ukeɪ* OK.

In example 6 line 28, again C8 repeats the same politeness strategy of agreement by using /*ukeɪ*/ as a polite response to E8's statement that there is something she wants to say giving a high value to her opinion implementing Leech's Maxim 7.

Example 6	27	E8	*ʔɪlʕafu bas mulaːħaẓa* You're welcome. I have a note.
	28	C8	*ukeɪ* OK.

2.4 Agreement by a statement

Agreement to the speaker's request is a polite response to that request as discussed above. This agreement can be indirect; it can be implied in a statement that the hearer uses his/her pragmatic competence in order to understand that meaning.

Example 7	9	E2	*yareɪt tɪtħammalnɪ* I hope that you can be patient.

10 C2 *xuð ra:ħtak*
Take your time.

In example 7, E2 makes a request to C2 to allow him some time to provide C2 with the answer. C2's response in line 10 is /*xuð ra:ħtak*/ 'take your time' (lit.: take your rest). The pragmatic meaning according to the context is something like 'I don't mind. Take your time' or 'I agree to allow you the time you want'. In example 8, C7's request is indirect since he does not make any request explicitly; rather, he describes the problem he has with his Internet connection.

Example 8 10 C7 *ʔɪnnɪt ʕɪnd: bufṣl bɪrdʒaʕu bɪʃbɪk laħa:lu (.) bufṣl bɪṭawwɪl bɪṭawwɪl kθɪ:r*
The net disconnects and reconnects again. After it disconnects, it takes long long time to reconnect.

11 E7 *zawwɪdnɪ bɪrraqam*
Give me the number.

E7's response is clear and unambiguous. This means that E7 agrees to solve the problem that C7 has with his connection and in order to do that she needs his number as she says in line 11 /*zawwɪdnɪ bɪrraqam*/ 'give me the number' indicating that that agreement is granted and having C7's number is the first step to perform the action.

Agreement to do the required action can be achieved by promising the requester to perform his/her request. Such promises can be indicated by a number of markers, for instance the use of /*walay hɪmmak*/ 'don't worry'. In example 9 below, the implied meaning of /*walay hɪmmak*/ is not only 'don't worry' but also something like 'I promise you to do this action for you' which is an agreement at the same time. In this example, the marker /*walay hɪmmak*/ is followed by a request which confirms the agreement to do the activity and act as the first step in doing the caller's request. Since E5 asks C5 not to worry, he is considering his feelings and showing some sympathy with him saying 'don't worry'. Therefore, it can be counted as an adherence to Leech's (2014) Sympathy Maxim: (M9) give a high value to *O*'s feelings.

Example 9 6 C5 *baddɪ:: ʔaɤalbak baddɪ ʔaħwwɪl raqamɪ xa:ṣ (.) keɪf*↗
I want to bother you. I want to change my number to a private one. How?

…

9 E5 *walay hɪmmak (.) tħammalnɪ laħaẓa:t*
Don't worry. Be patient for moments.

The use and function of /*walay hɪmmak*/ by the participants of this study differ from Samarah's (2015) explanation of the same term. He stated that people use it to apologise when their advice for someone was disappointing and did not bring any results. Although he classified it as a polite expression used by Arabic speakers, the function he mapped it on differs from the finding of this study.

Responding in an agreement to do the speaker's request is found frequent in interviewees' responses to the designed situations. For instance, in response to situation 2, represented below, the respondents show the use of promises indicating their agreement to perform the action.

> You received a call from a subscriber requesting to add a service that is available for his or her subscription category. The caller praised the company's services. What would you say to the caller? **Situation 2**

In example 10, the respondent (R2) is a male participant with five years of experience in the company. R2 thanks the caller for his/her praise of the company assures them that he will add the service they require by saying 'few seconds only and the service will be added'. So, the agreement to do the activity is implied in his statement.

Example 10 R2 *tama:m (.) ʃukran ʔılak sayyıd fula:n (.) ʔakı:d (.) θawa:nı bas bıtku:n mazyu:fa ʕındakıl xıdmıh*

OK. Thank you Mr. so and so. Sure, few seconds only and this service will be added.

Similarly, R1 in example 11 is a female participant who has been working in the company for 14 years. She thanks the caller and promises him/her to add the activity by saying /*ʔıla:n baẓı:fha ʔılak*/ 'I will add it for you now', a statement based on the prior agreement of R1 to do the activity of adding the service.

Example 11 R1 *ʃa:kıra ʔıttıṣa:lak (.) ʔıla:n baẓı:fha ʔılak*

Thank you for calling. I will add it now.

In example 12, R5's response is little different in that he achieved the service just before responding to the caller which means that he agreed to do the activity and the promise of agreement is already achieved, he says /*tam ʔıẓa:fatıl xıdmıh*/ 'the service has been added'. Before saying this, he thanked the caller, and at the end of his turn he assures his availability for any other help or service the caller needs.

Example 12 R5 *ʃukran ʕala luʧfak (.) tam ʔıẓa:fatıl xıdmıh wıħna mawdʒu:dı:n bʔay xıdmıh*

Thanks for your kindness. The service has been added. We are available for any service.

What can be observed here is that the responses produced by female participants are shorter and less sophisticated than those made by male participants. Such a difference between the two genders agrees with findings of Eckert (1998) and Holmes (2008) who stress that women's language is more conservative than that of men. However, as far as the Jordanian context is concerned, the difference between men and women in relation to their linguistic style opposes the findings of Al-Harahsheh's (2014b) study in which he states that women try to get the listener engaged in the conversation by using more facilitative strategies showing more cooperation with the hearer than men do.

2.5 Agreement by repeating part of what is said

Showing agreement can be accomplished by repeating what the speaker says or part of it; such repetition confirms the truthfulness or the possibility of achieving what is said. In example 13 line 31, E3 requests C3 to do the evaluation and he indicates his wish for the highest evaluation, he says /*ʔɪnʃa:lla nku:n ʕɪnd ħusn ẓannaku tɪʕṭɪ:nal ʔaʕla*/ 'we hope that we met your expectations and give us the highest'. In line 32, C3 responses by repeating /*ʔɪnʃa:ʔalla:*/ which implied that 'you met my expectations and I agree to give the highest'.

Example 13	31	E3	*ʔɪt taqyyɪ:m mɪn wa:ħad laʕaʃra (.) wa:ħad ʔaqal taqyyɪ:mu ʕaʃral ʔaʕla (.) ʔɪnʃa:lla nku:n ʕɪnd ħusn ẓannaku tɪʕṭɪ:nal ʔaʕla* Evaluation is from one to ten. One is the least and ten is the highest. We hope that we met your expectations and give us the highest.
	32	C3	*ʔɪnʃa:ʔalla: (.) yaʕṭɪ:kɪl ʕa:fyɪh* God willing. May God grant you health.

In example 14, E6 requests C6 to do certain processes to adjust the settings of his device. After each step, C6 responses by repeating some of what E6 said. In line 25 he repeated the word /*ʔɪlʔɪʕda:da:t* / 'settings', he repeated /*ʔɪlmazɪ:d* / 'more' and /*ʃabaka:tɪl ha:tɪf wɪl dʒawwa:l*/ 'mobile networks' in lines 31 and 33 respectively.

Example 14	24	E6	*tama:m ʔawwal ʔɪʃɪ: bnɪtwadʒdʒa lɪl ʔɪʕda:da:t ʔawɪẓ ẓabɪṭ* Good. First thing we go to the settings or configuration.
	25	C6	*hayɪl ʔɪʕda:da:t* Here it is.
	…		
	30	E6	*nɪxta:rɪl mazɪ:d* We choose 'more'.
	31	C6	*hayɪl mazɪ:d* This is 'more'.
	32	E6	*ʃabaka:tɪl ha:tɪf wɪl dʒawwa:l* Mobile networks.
	33	C6	*nɪxta:r ʃabaka:tɪl ha:tɪf wɪl dʒawwa:l (.) tama:m* Mobile networks. OK.
	…		
	64	E6	*ʕɪnd ʔɪsmɪl mustaxdɪm bnuktub nɪt* Under the user name we type net.
	65	C6	*nɪt tama:m* Net OK.
	66	E6	*kalɪmatɪl muru:r taħtɪyyu muba:ʃara ʔayẓan bnuktubha nɪt* Below that the password we also type net.

	67	C6	*nɪt tama:m* Net OK.

In lines 64 and 66, E6 requests C6 to use the word /*nɪt*/ 'net' as both the username and the password. For both requests, C6 responses with the repetition of the word /*nɪt*/ being the most important item in the request with more confirmation by adding /*tama:m*/ 'OK'.

In example 15, the female caller, C10, wants to confirm her information about the period of time, she says /*ʔarbaʕ ʔaʃhur yaʕnɪ*/ 'it means four months?'. E10 responses with the repetition of most of what she said /*ʔarbaʕ ʔaʃhur*/ 'four months' and continues explaining the matter.

Example 15	2 6	C 10	*ʔarbaʕ ʔaʃhur yaʕnɪ* That means four months?
	2 7	E 10	*ʔarbaʕ ʔaʃhur naʕam* Yes, four months.

The participants' responses discussed above show agreement to the requests or ideas of the other participants, so they are giving values to others' opinions and judgements by minimizing disagreement and maximizing agreement with them. In doing so, participants of this study adhere to Leech's Agreement Maxim: (M7) Give a high value to *O*'s opinion. Leech (2014) stresses that to agree with what others state or suggest is the preferred response to that suggestion or idea.

2.6 Responding with invocation or appreciation

Participants' responses to the speakers' requests or suggestions include invocation or some expressions of appreciation whether the request is achieved or not. Living in a Muslim society influenced by Islamic traditions and norms, the participants' strategies include a reference to God (Allah). For instance, the invocation structure /*ʔalla yɪdʒza:kɪl xeɪr*/ 'May God reward you well' is found to be used by them in a number of responses.

Example 16	10	C4	*yaʕnɪ ma: bɪltaʁɪ* That means it cannot be cancelled?
	11	E4	*ṣɪdqan ha:ða huwal muta:ħ* Honestly, not available.
	12	C4	*ṭayyɪb ʔalla yɪdʒza:kɪl xeɪr* OK. May God reward you well.

In example 16, E4 could not help C4 in cancelling certain service or option and confirms his inability in line 11 by saying 'honestly, not available'. In spite of the fact that C4's request was not achieved, he politely responds with a wish for E4, he says /*ʔalla yɪdʒza:kɪl xeɪr*/ preceded by /*ṭayyɪb*/ 'OK' accepting what is said by E4, so the strategy is confirmation + invocation. Same marker is also used in conversation 7 shown

in example 17. C7 uses /*ʔalla yıdʒza:kıl xeır*/ along with other markers of gratitude and appreciation as a kind of reward for her efforts.

Example 17

54	E7	*ʔumu:rak tama:m* ↗ Is everything OK?
55	C7	*ʔaʃkurık (.) ʔaʃkurık xaytı ma: qaṣṣartı (.) yaʕṭı:kı ʔalf ʔalf ʕa:fyıh (.) ʔalla: yıdʒza:kıl xeır* Thank you, thank you, sister, thanks. May God grant you health. May God reward you well.

The combination of invocation and thanks by Jordanians as a polite response has been indicated in the study of Farghal and Al-Khatib (2001). Moreover, the use of many markers by C7 in line 55 while responding to E7 indicates that C7 is maximising his praise to E7, so he is giving a high value to E7's abilities of doing her work. This means that C7 is adhering to Leech's (2014) Approbation Maxim: (M3) give a high value to *O*'s qualities.

Another marker that includes God's name used in responding to speaker's actions or requests is /*ʔalla yısıʕdak*/ or /*ʔalla yısıʕdık*/ 'May God grant you happiness', the alternation between the two depends on the gender of the addressee. In example 18, C4 uses this invocation marker two times in his responses to E4. It is a polite response to what E4 said in lines 13 and 15. According to the data of this study, invocation is used in by both genders. For example, in conversation 4 it is a male-to-male communication whereas in conversation 7, shown in example 19, it is a male-to-female one. In both /*ʔalla yısıʕdak*/ is found to be a marker of making a wish for the speakers in an attempt to thank them for their efforts. The same structure /*ʔalla yısıʕdak*/ is also used Farghal and Al-Khatib's (2001) participants in their responses.

Exampl e 18

1 3	E 4	*ʔay xıdmıh ʔuxra* ↗ Any other service?
1 4	C 4	*ʔalla yısıʕdak* May God grant you happiness.
1 5	E 4	*kulıl ʔıħtıra:m mula:ħaẓa ʔaxı:ra mın baʕıd ʔıðnak* All respect. A last note after your permission.
1 6	C 4	*ʔalla yısıʕdak* May God grant you happiness.

Example 19

38	C7	*ʔaʃkurık xaytı wallahı ma: qaṣṣartı* Thank you, sister. Thanks.
39	E7	*ʔalla yısʕdak*

May God grant you happiness.

Happiness wishes include the structure */yısʕıdlı masa:k/* 'have a happy afternoon (lit.: May God make your afternoon full of happiness). In example 20, E5 asks C5 whether he would like any other service. C5 response is */yısʕıdlı masa:k/* which means that 'I don't want any other service and I wish you a happy afternoon', so this is a polite response since it has supplication for E5 for his efforts.

Example 20

45 E5 *ʔılʕafu (.) ʔay xıdmıh θa:nyıh* ↗

Welcome. Any other service?

46 C5 *yısʕıdlı masa:k*

Have a happy afternoon.

Another marker that has invocation is */ʔalla:h yaʕṭı:kıl ʕa:fyıh/* 'May God grant you health' which is very frequent especially at the beginning of the conversations as a salutation or after having your request or work achieved by someone. It has at least another form which is */yaʕṭı:kıl ʕa:fyıh/* where the word */ʔalla:h/* is omitted as it is implied in the verb */yaʕṭı:kıl/* giving no difference to the meaning.

Example 21

43 E10 *tama:m* ↗

OK?

44 C10 *xalaṣ ʔa: yaʕṭı:kıl ʕa:fyıh (.) ʃukran*

Yes, done. May God grant you health. Thanks.

45 E10 *ʔallay ʕa:fı:k (.) ʃa:kırlıt tıṣa:lıku ʔahlaw sahla fı:kı*

May God grant you health. Thanking your call and welcome.

In example 21, E10 completes his task and asks C10 whether everything is OK; C10's response includes the use of */yaʕṭı:kıl ʕa:fyıh/* which has the intended meaning of 'everything is Ok and I wish that God give you good health'.

Sometimes this wish is amplified by adding a number as a premodifier for the noun 'health'. In example 22, C7 indicates his thankfulness to the female employee (E7) for her efforts by using a number of markers including */yaʕṭı:kıl ʕa:fyıh/*, but he amplifies the noun 'health' by adding */ʔalf ʔalf/* 'thousand thousand' before it.

Example 22

54 E7 *ʔumu:rak tama:m* ↗

Is everything OK?

55 C7 *ʔaʃkurık (.) ʔaʃkurık xaytı ma: qaṣṣartı (.) yaʕṭı:kı ʔalf ʔalf ʕa:fyıh (.) ʔalla: yıdʒza:kıl xeır*

Thank you, thank you, sister, thanks. May God grant you health. May God reward you well.

In responding to participants' efforts, especially the employees, callers used the structure /*ma: bıtgaṣṣır*/ as a marker of appreciation. It is somehow similar to English 'I know you will do'.

Example 23

78	E6	*ʔılʕafu walay hımmak xıdmıh θa:nyıh* ↗ Don't worry. Any other service?
79	C6	*la: ma: bıtgaṣṣır* No, thanks.

In example 23, E6 asks C6 whether he needs any other service; C6 responds with 'no' followed by /*ma: bıtgaṣṣır*/ which means that 'I don't want any other service and if I want one, I know you will do that', so it is something like 'I admit that you are helpful'. Example 24 consists of two extracts from conversation 7; the caller (C7) is male and the employee (E7) is female.

Example 24

37	E7	*raħ tku:n ʔumu:rak tama:m* Everything will be OK.
38	C7	*ʔaʃkurık xaytı wallahı ma: qaṣṣartı* Thank you, sister. Thanks.
…		
54	E7	*ʔumu:rak tama:m* ↗ Is everything OK?
55	C7	*ʔaʃkurık (.) ʔaʃkurık xaytı ma: qaṣṣartı (.) yaʕṭı:kı ʔalf ʔalf ʕa:fyıh (.) ʔalla: yıdʒza:kıl xeır* Thank you, thank you, sister, thanks. May God grant you health. May God reward you well.

E7 assures C7 that everything will be OK, but there is a need to do some configuration; in response to this, C7 thanks her for her help and appreciates her efforts. His response includes two markers: /*ʔaʃkurık xaytı*/ 'thank you, sister' and /*wallahı ma: qaṣṣartı*/ 'by God you did everything you could do'. The inclusion of the act of swearing /*wallahı*/ 'by God' in the latter marker is meant to intensify the response. The act of swearing seems to be common in Jordanians' interactions as it appears in this study in both types of data: conversations and the designed situations (e.g., situation 10). This seems inconsistent with Al-Khawaldeh (2014) who found it used only in role-plays in her data.

In line 55, again he thanks and appreciates her efforts by using /*ʔaʃkurık*/ 'thank you', /*ʔaʃkurık xaytı*/ 'thank you, sister', /*ma: qaṣṣartı*/ 'you did everything you could do', the amplified /*yaʕṭı:kı ʔalf ʔalf ʕa:fyıh*/ 'May God grant you health', and /*ʔalla: yıdʒza:kıl xeır*/ 'May God reward you well'. Such intensification of the responses by C7 in lines 38 and 55 makes the responses strongly polite which can be attributed to either or both of two facts: first, it is towards the end of the conversation, and second he meant to be very polite because E7 is female and he follows the norms of the Jordanian culture in dealing politely with women, elders, strangers, etc. Following the social and cultural norms, according to Leech (2014), is

the sociopragmatic facet of politeness that strengthens the politeness value. Moreover, like other Arab cultures, the Jordanian culture is based on reciprocity in which people give each other help and advantages, especially when the power factor is equal. Therefore, it is necessary to reward the person who helps you in something in a way to reflect appreciation for the time and efforts of that person. Alrefai (2012) states that such a reward can be in the form of a prayer for that person or in the form of a promise that the favour will be returned in the future. As for the context of this study, the relation between the callers and the CCCS employees is temporary as it ends at the end of the call, so they use only invocation or appreciation.

2.7 Responding with an apology giving a reason or a suggestion

Participants of this study, especially the employees, apologise for not being able to help customers with some of their requests. Either the requested act is not available or they are not allowed by the rules of their company to do so. In these situations, they apologise to the caller for not doing so providing the reason for their inability to perform the act or suggesting what the caller can do to get his request done.

The designed situation number 1, shown below, aims to elicit a rejection for a request made by the caller. The responses of the interviewees include a term of apology, for instance, most of them begin with /*baʕtıðır mınnak*/ 'I apologise' followed by a reason for this apology and sometimes a suggestion for the caller to get his request done.

> You received a call from a subscriber requesting to add a service that is not available for his or her subscription category. Although you told the caller that it is not possible, s/he insisted on his or her request.
>
> What would you say to the caller rejecting the request? **Situation 1**

In example 25, R2, a male participant with five years of experience, says /*baʕtıðır mınnak*/ 'I apologise' followed by the reason why he cannot help the caller 'this service is not available on this offer'. Moreover, R2 suggests that 'we may change your line to another offer on which this service is available'. This way of rejecting the request is a polite one since it includes an apology, reason and suggestion.

Example 25	R2	*baʕtıðır mınnak marra θaːnyıh basıl xıdmıh mıʃ mawdʒuːda ʕala haːðal ufar (.) ʔıða bıtħıb mummkın nħawlak ʕala ufar θaːnı tkuːnıl xıdmıh avılabıl ʕaleı*	I apologise once again, but this service is not available on this offer. If you like, we may change your line to another offer on which this service is available. (situation 1)

The same strategy is used by R4 in example 26. R4, who is a female participant with six years of experience, tries to be very polite in her response as she apologises, gives the reason and suggests a solution for the caller. Each of these acts is made twice trying to reduce the negative effect she caused to the caller's desire.

Example 26	R4	*baʕtıðır mınnak (.) haːyıl xıdmıh mıʃ mıtwafrıh laʔıʃtıraːk ħaʒırtak (.) mumkın tuṭlub xıdmıh θaːnyıh ʔaw tıttadʒıh ʔıla markızıl xadamaːt mumkıny saːʕduːk bhaːðal mawʒuːʕ bas ʔanaː baʕtıðır mınnak mıʃ mın ṣalaːħıyyaːtı ʔaʒıːf haːyıl xıdmıh*	

I apologise. This service is not available for your subscription. You may request another service or contact the service centre; they may help you in this regard, but I apologise. It is not in my power to add this service. (situation 1)

In response to situation 10, the nine-year expert female participant (R7) apologises two times and gives two reasons for her refusal of giving the caller the number he is asking for. In example 27, she says 'the number is not available' and 'I cannot give you such information'. The participants' strategy of apologising with a reason for not doing the activity has been indicated in the literature as well. For instance, Al-Khawaldeh (2014) states that her Jordanian participants opt for apologising by giving reasons or excuses starting their apology by the word /*ʔaʕtıðır*/ 'I apologise'.

Example 27 R7 *bnıʕtıðır mınnak (.) ʔırraqam mıʃ mıtwaffır ʕınna (.) baʕtıðır mınnak ma: bagdar ʔaʕţı:k ha:yıl maʕlu:ma:t*

We apologise. The number is not available. I apologise, I cannot give you such information. (situation 10)

A less complicated structure is used by R2 in response to situation 10 shown in example 28. R2 is a male participant with five years of experience. He apologises, gives the reason for not performing the action and suggests a solution to the caller directing him or her to speak to the inquiries where the request can be achieved.

Example 28 R2 *walla baʕtıðır mınnak bas ha:yıl xıdmıh mıʃ mawdʒu:da ʕınna mumkın ħa:wı tıħkı maʕıl ʔıstıʕla:ma:t ʔakı:d raħı fi:du:k*

I apologise, this service is not available here. You may try to speak to the inquiries; sure, they will help you. (situation 10)

In example 29, the male participant, R2, apologises to the mistaken caller saying /*bnıʕtıðır mınnak*/ 'we apologise'. R2's response to situation 9 consists of an apology and two suggestions. Although R2's response includes an apology, it somehow corelates to Leech's (2014) first maxim, viz., M1: give a high value to *O*'s wants. Giving a high value to the caller's want is indicated in this example by the use of two suggestions.

Example 29 R2 *bnıʕtıðır mınnak bas law tra:dʒıʕ ʔıʃ ʃarıkal muzawwıda ʔılak mumkıny fi:du:k ʔakθar ʔaw ʧarrıfna tɔ:xıð mın ʕınna xaţ*

We apologise, you may contact the provider; they may help you or you may visit us and take a line. (situation 9)

Apology may not be said directly in the participants' responses; it might be implied in the structure and understood in the reason or suggestion made by the speaker. For instance, in example 30 the respondent (R6) does not produce any verbal apology to the caller; instead, she begins with /*mumkın*/ meaning 'may' or 'Is it possible?' responding to the child caller in situation 7 is 'May I speak to your mother? Where is your mother?'. In this response the apology is implied and understood from the speakers' utterances.

Example 30 R6 *mumkın ʔatwa:ṣal maʕ ma:ma↗ weın ma:ma baddı ʔaħkı maʕ ma:ma (.) ma:ma mawdʒu:da↗*

May I speak to your mother? Where is your mother? I want to speak to your mother. Is your mother there? (situation 7)

5 Conclusion

This study is an attempt to examine the types of politeness strategies employed in the interactions between Jordanians and the employees of CCCS of a major telecommunications company in Jordan. It focuses on their linguistic behaviours upon responding speech act. The researcher analysed the request strategies and the responses strategies as produced by the participants of this study indicating the types of each and the degree of politeness involved in the different strategies. Moreover, the researcher mapped these strategies on the previous studies conducted in the area where possible showing the similarities and differences between the findings of this study and those of the previous ones.

The results of the analysis show that participants employ a number of strategies in their responses to others' requests, wishes, opinions, etc. Showing agreement to what has been said includes using '/*ʔınʃa:lla*/ 'God willing', /*tama:m*/, /*ukeı*/ 'OK'. They also use certain statements to indicate their agreement with the speaker on what he or she said, such as 'take your time' and 'don't worry'. Other agreement strategies include the repetition of some of what is said by the other interlocutor and by using certain invocation or appreciation. However, disagreement is found to be communicate politely. It usually begins with /*baʕtıðır mınnak*/ 'I apologise' followed by a reason for not doing the activity with or without a suggestion. The results of the study have revealed that sociocultural norms of the Jordanian society including Islamic culture were followed to a great extent in a number of the response strategies used by the participants of this study showing politeness and respect. Therefore, it can be concluded that the acquisition of these norms is essential for learners of Jordanian Arabic.

As for Leech's Maxims, based on their various response strategies, participants adhered to a number of maxims. For instance, in their strategy of agreement with what is said by the other interlocutor they give high value to the other's opinion, thus implement Maxim 7. Moreover, the inclusion of /*walay hımmak*/ 'don't worry', in their responses is a way to consider the feelings of the other interlocutor and show sympathy with them which can be counted as an adherence to Maxim 9. Furthermore, participants maximise the praise to the other in giving high value to their abilities of doing their work which is an adherence to Leech's Maxim 3 as in example 17 above.

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Health management trends: The Internet of Things as a modernization and care tool

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Abstract

The modernization of health institutions is one of the biggest trends of our time. Part of the 4th industrial revolution, the Internet of Things, that allows a more personalized care and greater appreciation for the patient, can be a reality that is in the process of being consolidated worldwide. In Brazil, through the promulgation of decree number 9.854 of June 26th of 2019, the democratization and popularization of these technologies have started. This integrative review intends to verify the introduction of IoTs in the Brazilian scenario by investigating the potential as well as the weaknesses of this new technology. The research suggests that IoTs are a unique content that may improve productivity and process efficiencies but are still permeated by caveats that indicate system deficiencies and the need of further studies.

Keywords: Internet of Things; RFID; Information Technology; Health management;

1. Introduction

Nowadays, the use of information and communication technologies (ICT) is being establish and expanding. Increasingly, people are seized by a technological spirit that makes them connected most of the time. All of these gadgets and devices are essentially connected to a network that allows them to exchange and receive information. In health, the inclusion of information and communication technologies (ICT) is something that has been used by managers of large and small institutions. As such, their use not only allows an improvement in the services offered, but also makes them more effective and efficient, as well as providing higher quality processes and less patient wear (Barbosa, 2018).

In addition, information and communication technologies and the emergence of new media have enabled

the development of smart cities concept, which have occupied more space in the society. Performance indicators and these technologies were commonly referred to as a knowledge-based social capital, which broadly served to denote what can be achieved through communication tools and networks derived from a social network individual or social unit.

The Internet of Things concept was introduced by information and communication technologies, which is a technological paradigm that interconnects the physical and digital worlds, in a way that creates an informational space, where people's perceptions of the scenery around them are broadened and connected. In the conceptualization of IoTs, intelligent individuals and objects are hyperconnected on the Internet in any environment at all times, producing and consuming information that they are able to communicate with each other (Rozsa, Dutra, Pinto, & Muriel-Torrado, 2017). As a ubiquitous technology, IoTs everywhere, will revolutionize the information access/availability and the automation of entire sectors of the economy and social life, based on machine-to-machine communication, such as logistics, agriculture, transportation of people, industrial production and more specifically in health. (Magrani, 2018).

Hyperconnectivity is a central term in IoTs, serving to designate the willingness of people to communicate at any time with each other, i.e, person-to-person (P2P), person and machine (human-to -machine, H2M) and machine-to-machine (M2M), which leads to a continuous flow of information and data creation. Thus, the greater the number of devices, the greater the data production capacity (Magrani, A internet das coisas, 2018).

This research aims to study, through an integrative literature review, how Brazilian society has been linked to IoTs and how it has spread in this context, thus discriminating the potentialities and vulnerabilities that such a system may entail.

2. Literature Review

IoTs have been climbing steps and gaining more acceptance and attention in the world context and market over the last decade. Thus, the IoT market is expected to grow from $ 591.7 billion in 2014 to $ 1.3 trillion by the end of 2019 (Verizon, 2017). To comprehend IoT growth, the lowest expected growth in 2025 is estimated at $ 4 trillion and a favorable estimate at $ 11 trillion (Mckinsey Global Institute, 2015).

IoTs have been progressing, becoming a powerful communication model, gathering more researchers around it in the present century (Wu T. , Wu, Redouté, & Yuce, 2017). By connecting numerous objects - such as sensors, vehicles, homes and appliances to the internet – and allowing the sharing of information, data and resources, they are providing a holistic monitoring that encompasses the most diverse content (Wu, Rüdiger, & Yuce, 2017).

In terms of health this means applying wireless sensors that can monitor even the patient's physiological conditions through devices attached to the body. This data can then be transmitted to a cloud that in turn is accessed by the end user or tool, which upon inspection of the user or the surrounding environment may provide physiological or environmental measures that will be taken care of the patient (Wu, Wu , & Yuce, 2018).

Wearable devices are generally employed to monitor physiological signals such as heart rate, respiratory rate, electrocardiography, body temperature, blood pressure and others. In addition, for medical

applications the area network (WBAN) can be used to monitor environmental conditions around the person. In this way, applications can provide useful information to deepen understanding of the patient's condition and the environment in which he lives, providing valuable information for in-depth gain and knowledge about the patient and the environment in which he lives (Antolín, Medrano, Calvo, & Pérez, 2017).

In Wu, Wu , & Yuce (2018), the authors demonstrate a network system with a wearable hybrid sensor that lends itself to monitoring environmental conditions such as temperature, humidity, solar ultraviolet (UV) overexposure, CO2 levels and vital signs, which are important in dealing with diseases such as skin cancer, eye disease, breathing problems and headaches. The objective of these sensors was to monitor and coach employees, which demonstrates the immense utility of IoT technologies in the care and prevention of possible diseases. It was also shown that they could promote data collection that allows their manager to have elements able to study about such admonitions.

With the advent of IoTs many applications have been proposed not only for disease monitoring, but also on prevention, revealing that such tools may become important in disease endeavors and even in some cases to prevent possible outbreaks. For example, smart watches are integrated with electrocardiogram (ECG), with temperature and oxygen saturation sensors in the blood, allowing for data collection such as blood pressure, glucose and temperature of people who can live in rural areas transmitted via LoRa (a long range, low power wireless protocol designed for use in building IoT networks) (Chen, Ma, Song, Lai, & Hu, 2016).

The IoTs scenario is recent - mainly in the health area – so the resulting hyper connectivity depends on a close relationship between intelligent objects (sensors), big data and computational intelligence, the so-called ABC of information technologies, and communication (analytics + big data + cloud computing) that underlie and structure IoTs. This triad is responsible for boosting and making health more independent and with possible expansion of daily care for patients and non-patients, who can use these sensors to manage a health (Magrani, 2018).

IoTs are probably one of the most modern contributions that technological and innovation tools are providing, however, many aspects still tend to be discussed and analyzed by professionals, researchers and especially the community that will be the main beneficiary or harmed. In this sense, this paper seeks to promote a reflective debate on the introduction of IoTs in the Brazilian scenario, considering the perspective elements and discernment between the opportunities that may come, as well as the weaknesses of their use. Investigating through scientific and literary production what its scope and diffusion have been like.

This work, in turn, is justified since IoTs are technologies that have been projected in the world scenario as something that can enable homecare as an important helper in health actions. Having an IoT participating in the health care system can expand care as well as reduce possible health costs. In addition to combining preventive measures in the formation of healthy habits.

3. Methodology

In this work, the adopted method was the integrative literature review. At first, the theme was defined and it was determined which descriptors would be used. In the case of this research the descriptive terms used were: Internet das Coisas e Brasil, Internet of Things and Health and Brazil and Internet of Things and

Healthcare and Brazil.

According to Souza (Souza, Silva, & Carvalho, 2008), the integrative literature review is a research method that provides the synthesis of knowledge and the incorporation of the applicability of results of significant studies in practice. For Botelho et al (Botelho, Cunha, & Macedo, 2014) the integrative review should be chosen when the synthesis and analysis of the scientific knowledge already produced on the investigated theme is to be performed and/or when it is intended to create information that will enable readers to evaluate the relevance of the procedures employed in the elaboration of the review.

Regarding the inclusion and exclusion criteria of the work: all texts that were of Brazilian origin, dealing with the IoT and health theme, and published between 2014 and 2019 were included. The ones not related to health in the Brazil in the scope of the study were excluded.

Databases such as Capes, LILACS, PUBMED, SciELo, PsyINFO e Google Scholar were used during the research.

Although Google Scholar is not a specialized database, it was chosen once it was possible to distinguish how publications on IoTs were being treated at a national level, as many articles in this area were made available in this database. By choosing Google Scholar, it was possible to notice that more articles available and recognize that the theme was widely used rather than what was indicated inPUBMED, LILaCS, SciElo, PsyINFO and Capes, where most of IoTs articles were not related to the health are, being related other sectors. The study was divided into three moments. The first, in which we researched and selected articles that contained the intended theme. In the second moment, the titles and keywords were read and those related to the area of interest were selected. In the third, the abstracts were read to verify the potential inclusion. And fourth, the full reading was performed to verify the inclusion or exclusion of articles in the review and was finalized with its analysis and categorization.

The research in several databases returned between 6 and 399 articles. One exception being Google Scholar who returned 2,230. It is noteworthy that, among all the works, most of them did not deal with topics related directly to IoT and health in Brazil, so that after extensive reading of titles and abstracts, 35 articles were marked. In addition, there was a considerable part that was duplicated in the various databases searched. Regarding Google Scholar, we chose the most relevant and closely linked to the subject of research.

4. Results

The direct results of the objective analysis allowed us to infer at first that the electronic media in its various databases have an large amount of articles related to IoT in Brazil, especially in Capes and Google Scholar, although many are from technical nature (not fitting the theme of this work) and that a considerable portion is repeating itself on the various bases, it is still a relatively large amount. However, the IoT + health + Brazil theme, in both Portuguese and English, returns few articles that really belong to this scope. The large amount of academic Google mostly refers to IoT technologies in non-medical private institutions, often the term health appears loose, having no relation to the proposed theme. So the articles could easily be distinguished from those that escaped the goal.

The flowchart of the article selection and selection process can be clearly seen in figure 1. This denotes the entire path taken to select the material.

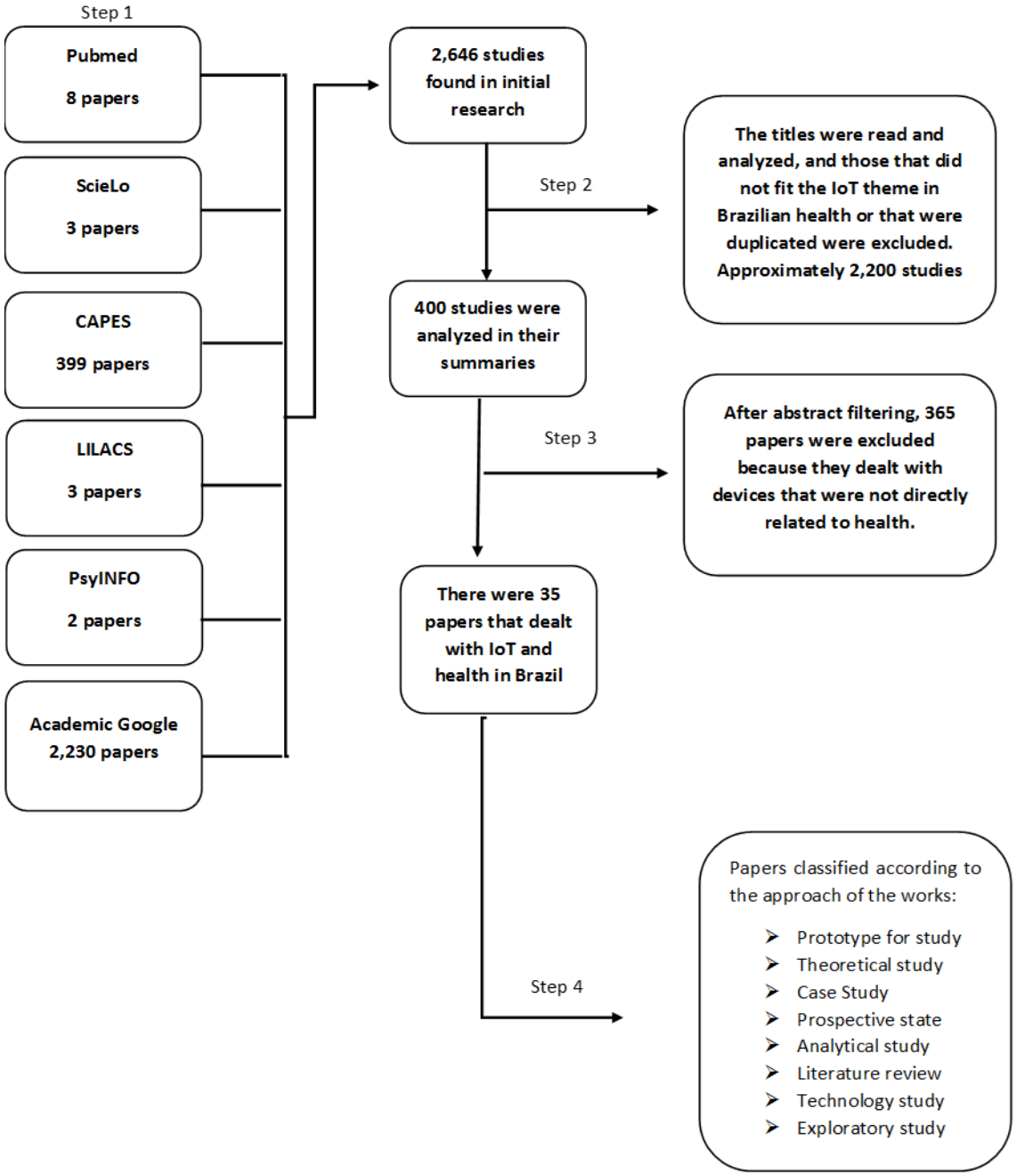

Figure 1: Job Selection Process Board. Prepared by the Authors (2019).

In table 1, we have the articles according to internet search sources. These data show that at the level of international database systems, there are still a small number of researchers sending the studies to be published with the IoT theme in Brazilian health. The database that obtained the most articles used was Google Scholar, which was expected due to the quantity of articles available. In second place was Pubmed, which was peculiar as this database provided only 8 articles and 7 of these were used, perhaps due to the fact that search engines are more effective. Capes presented 399 articles in total, being only 2 adequate for using once they were related to IoT in healthcare area in Brazil.

Table 1. Distribution of publications selected with bases in 2019 reference sources

DATABASE AND SOURCE OF CONSULTATION	TEXTS RELATED TO THEMATIC	Selected publications	
		(n)	(%)
SciELO	3	0	0%
PUBMED	8	7	20%
PsyINFO	2	1	3%
Google Acadêmico	2,230	24	68%
PERÍODICOS CAPES	399	2	6%
LILACS	3	1	3%

Source: Prepared by the authors (2019).

It was also verified the origin of the articles, as the city and state. In the city with the most related articles is Rio de Janeiro, followed by São Paulo and São Leopoldo. When we gather by state, the one that presents the most articles on the IoT theme is the state of São Paulo with 10 articles associate with the subject and, secondly, we have Rio de Janeiro and Rio Grande do Sul tied with 6 each. This information can be seen in table 2.

Table 2. Distribution of articles according to bibliographic source 2019

Research production city	Selected Articles	
	(n)	(%)
Belo Horizonte-MG	1	3%
Bragança Paulista- SP	1	3%
Brasília- DF	2	6%
Campina Grande- PB	1	3%
Campinas-SP	1	3%
Caraúbas- RN	1	3%
Florianopolis- SC	1	3%
Fortaleza- CE	3	8%
Imperatriz- MA	1	3%
Mogi das Cruzes- SP	1	3%
Natal- RN	2	6%
Passo Fundo- RS	1	3%
Porto Alegre- RS	2	6%
Recife- PE	1	3%
Rio de Janeiro- RJ	6	17%
São José do Rio Preto – SP	1	3%
São Leopoldo- RS	3	8%
São Paulo- SP	5	14%
Taguaritinga- SP	1	3%

Total	35	100%

Source: Prepared by the authors (2019).

According to table 3, the most used approach was the study of technologies developed for health, that is, studies aimed at the improvement of technologies such as software and devices and IoTs connections, for application in human care. In second place were the review studies, which give an overview of what is being produced in literary terms in the medical and health fields. In third place were the theoretical studies, which approach the technologies about a possible scope of applicability and diffusion. In fourth place were analytical studies, followed by prototypes for study. Finally, there were exploratory, prospective and particular case studies.

Table 3. Classification of articles according to the most used approach

Approaches used	Number of Publications	Percentage
Literature review	7	20%
Case Studies	1	3%
Analytical studies	5	14%
Prototype for study	4	11%
Theoretical study	6	17%
Prospective Study	2	6%
Technology Study	8	23%
Exploratory study	2	6%
Total	35	100%

Source: Prepared by the authors (2019).

The verified articles presented a multitude of IoTs applications for health that directly interfere with their effectiveness and performance of their daily activities. The use of remote activity sensors and monitoring enables the user to continuously monitor their physical and physiological conditions and situations that could be considered inhospitable. Using IoTs for physiological data allows invasive measurements to be exchanged for more comfortable analyzes, as they can be performed at home. With sensors such as photoplethysmography it is possible to monitor patient conditions, such as pulse oximetry, continuous cardiorespiratory and cardiovascular information, and when compared to the electrocardiogram, it is not a complex hardware implementation and can be incorporated into wristbands (Moraes, et al., 2018). Sensors can also measure systolic blood pressure and associated with other variables determine the risk of hypertension, designing a healthier lifestyle (Santos & Albuquerque, 2019).

The wearable devices are used in order to accompany the patient, providing a more active and healthier life by providing data such as lifestyle, diet, weight, sleep, stress, etc. (Veiga, Rodrigues, Trevizan , Rebonatto, & Marchi, 2017). And it allows immunobiologicals to have their temperature recorded, tracked and monitored so that they are stored in such a way that there is no loss and preserve the quality of the material, as in the case of vaccines that have to be constantly closely monitored (Santos & Felisbino, 2018).

The literature also mentions the use to provide care and independence of the elderly, who due to age may

be affected by diseases and falls. This is used to avoid these situations by applying answers that offer greater security. The insertion of motion-capturing sensors such as the gyroscope and accelerometers make this concept a reality, and Machine Learning (which will be discussed later) prove to be effective in detecting. This proves that people can have their own individual health care system (Mano, Volpato, Funes, & Torres Neto, 2016).

Some studies also use IoTs to change so-called unhealthy attitudes, such as obesity problems that are being considered one of the biggest public health problems not only in Brazil, but worldwide, as developed by the Federal University of Rio Grande do Sul (Sgobbi, Tarouco, & Reategui, 2017). In this work, they use IoTs technologies and virtual world to enable the change of health habits. And even for amputated limbs, IoTs have a practical utility; in the case of wounded soldiers, they lend themselves to aiding in rehabilitation through smart myoelectric prostheses that are compatible with this technology and - by communicating and providing feedback on real time muscle activities - contributes to the strengthening of the patient's patterns, consequently decreasing their recovery time (Silva, Silva, & Brito-Filho, 2018).

In fact, the growing use of IoTs comes from the widespread popularization of wireless and sensor technologies, which, coupled with the demand for new applications is creating a new ubiquitous era of intelligent applications. IoTs are comprised of a set of technologies that provide connectivity anytime, anywhere and with anything. By connecting to each other, objects or things, they interact and cooperate over the wireless connection to ensure ubiquitous communication (Machado, Rosário, Loureiro, Neto, & José, 2014).

IoTs are associated with the term Big Data, which comes from the sheer amount of data produced by these Internet connections, which, among other things, enables healthcare providers to use maps that warn and prevent outbreaks of diseases such as H1N1 by identifying foci of transmission (Magalhães, Martins, & Hartz, 2014). Considering this data, the government can act effectively by controlling and preventing a global pandemic. Even with neglected diseases such as endemic tropical diseases that occur in low-income populations such as Africa and Latin America, data from IoTs and Big Data can be important in preventing (Magalhães, Martins, & Hartz, 2014).

Radio Frequency Identification Systems (RFID), are also well used by IoTs, since through this technology, it is possible not only to monitor the location and information, but also to track the temperature and humidity of environments, refrigerators and freezers. When deployed in a hospital in Rio de Janeiro, increased hospital safety was observed, followed by cost savings and increased efficiency (Alves, Morim, Souza, & Rosário, 2014). An added benefit of such technology is the ease of checking and monitoring all data without human intervention, which is essential is a Hospital Accreditation process as it ensures that data is not biased as to its registration (Alves, Morim, Souza, & Rosário, 2014).

Other authors propose the use of Machine Learning concepts as a way to improve the use of IoT technology, such as Cantanhede e Silva, who believe that it is possible to develop intelligent appliances with the marriage between the two technologies (Mano, Volpato, Funes, & Torres Neto, 2016) (Cantanhede & Silva, 2104). In this direction, Costa et al, argues that the development of Machine Learning based algorithms together with IoTs technologies may reduce the risk to the patient, while optimizing resources in hospitals and determining the future of health and safety of the patient (Costa, Pasluosta, Eskofier, Silva, & Righi, 2018). For these authors the immense availability of data in Cloud Computing will require concepts such

as Machine Learning so that there can be filters and data selection to make the system more optimized and fluid, allowing learning techniques to be used to interpret this data to that research with them can be better viewed and interpreted effectively (Costa, Pasluosta, Eskofier, Silva, & Righi, 2018).

Technological solutions such as IoTs can be applied to improve current healthcare system delivery issues. The application of computational tools for hospital activities has the propensity to make major changes in the operating environment, in order to increase the quality of care and work processes. Remote patient monitoring optimizes and changes the doctor/patient relationship positively, as does the information is best accessed and shared between the doctor and the medical team. Provides even more patient mobility as health status can be monitored both at home and at work without restricting hospital facilities (Fernandes & Lucena, 2017). In addition, it allows:

• Collaborative work between the local and external team of professionals, providing a second opinion about the patient and their diagnosis and treatment.

• An automated process for monitoring vital patient data using sensors.

• Remote and real-time monitoring of patient health conditions.

• Alerts to health professionals in emergency situations.

• Decrease the time taken for detection of abnormalities in vital signs monitored patient due to the use of software agents, which in this context is a computational entity that allows responses activities to emergency situations (Fernandes & Lucena, 2017).

However, for some authors, the focus of IoTs should also be on some very important challenges, such as security, privacy, and trust issues from those who will be impacted by such technologies. As well as usability, personalization, familiarity and comfort issues that are directly related to the expansion and use of such technologies (Roehrs, Costa, Righi, & Oliveira, 2017).

There is, also, a discussion that concerns about Electronic Health Record (EHR) versus Personal Health Record (PHR), in which is debated the patients right to have exclusive access to their data, the option of making it available to their physicians when they want is debated and, therefore, the possibility of integrating the information into the healthcare system that allows it to be accessed convenience in any healthcare organization (Roehrs, Costa, Righi, & Oliveira, 2017).

5. Discussion

With the establishment of Decree No. 9,854 on 06/26/2019 in the Federal Official Gazette, the National Internet of Things (IoT) Plan was established in Brazil, which aims to implement and develop technologies related to this concept, which includes various products connected in homes, hospitals, industry etc. Considering that, more than just a propensity, IoTs have become a reality that is already accepted as present in our current context and that should be encouraged and regulated (BRASIL, 2019). Among other goals, IoTs focus on: improving people's quality of life and promoting service efficiency gains through the implementation of solutions.

The IoTs are the current innovation and it is expected from them to bring solutions for the healthcare sector, including the improvement of unites operational efficiency - with better control of resources – and patients follow-up or distant support (Reis, Pimentel, Machado, & Barbosa, 2018). To have a dimension, the

McKinsey Global Institute (Manyika, et al., 2013) undertook a study in which it identified 12 technologies that would have a possible economic impact of tens of trillions of dollars per year starting in 2025, and among the trends were: mobile internet, internet of things and cloud technology, which are part of the same niche.

In health, IoTs are undoubtedly a worldwide trend and are adapting to the Brazilian scenario that is opening its doors to the entry of such technologies, at least with regard to national policies. The reality is that about 80% of deaths in Brazil are caused by cardiovascular disease and cancer, in addition to violence. Currently, the public and the private sector model is based on individual interventions. However, assistance to these diseases requires a model of continuous and full attention (Vecina Neto & Malik, 2017). To guarantee the quality of life, it is necessary that these information technologies can be strategically used so that they can gain in efficiency and in the universality of health.

The use of IoTs can potentially offer patient care in a variety of ways, from hospital emergency treatment for long-term case management to community-based treatment. In this context, IoT technologies have stood out for allowing the creation of new treatments with precision and greater amount of information, since it has the ability to track people, equipment, supplies, and provide analysis of captured data. Once the patient is connected to sensors, it is possible to measure vital signs and other biometric data and information, which allows problems to be quickly diagnosed and, consequently, superior and more efficient healthcare resources can be offered (Oliveira & Silva, 2017). The biggest opportunities come from the category of chronic diseases, as they are responsible for 71% of deaths worldwide and, according to the World Health Organization, in 2018 it represented approximately 41 million people (World Health Organization, 2018). Many of these diseases refer to heart problems, asthma, diabetes, unhealthy eating, and physical inactivity, which are an open field for digital health to occupy, as applications enable both patients to understand their current state and how to act on it. In addition, alert health professionals about the possibility of acute events (Oliveira & Silva, 2017).

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Regarding to drug traceability, IoTs can fulfill a fundamental level role, enabling the adaptation to the regulation that establishes the National Drug Control System (SNCM) and which proposes to implement a drug identification system. Currently, the proposed identification is through a Datamatrix code, which confers an identity on the factory drug until it is received at pharmacies. With IoTs, data reception be in real time, even more so by pairing with RFID tags that ensure the entire process is tracked with data at any time, ensuring that counterfeiting problems are almost over. The effective guarantee of drug safety is ensured when technologies such as RFID (Radio Frequency Identification), RSSF (Wireless Sensor Network), GPS (Global Positioning System) and QR (Quick Response) ensure tracking, quality monitoring, and almost immediate return when a problem is detected, without even reaching the consuming public (Metzner, Silva, & Cugnasca, 2015).

While there are many healthcare benefits of IoTs, the challenges are not few. Issues like data security and IoT device management concern users. Another question is related to interoperability, which, despite relying on supportive government intentions, represents a challenge path, especially considering the full potential if managers start making data-driven decisions. It is possible, with this technology, to manage patient data and provide with greater confidence a holistic look at it, maximizing benefits and streamlining processes and care that would claim to be more effective (Massola & Pinto, 2018).

Concern about privacy is critical since it involves large volumes of data that can be used in various types of analysis, such as predictive analysis, prescriptive analysis, descriptive analysis and diagnostic analysis, highlighting the potential and usability, that contributes to the decision making, structured on historical evidence, in real time or through foresight. Thus, while on the one hand, they make it possible to bring numerous benefits to the health sector, on the other, ethical issues related to privacy and security imply disadvantages that can be derived from the IoTs associated with the use of big data (Araújo , Lima, Campos, Azevedo, & Barbosa, 2019). According to Araújo et al (Araújo, Lima, Campos, Azevedo, & Barbosa, 2019), is essential that subjects – such as ethics of personal information for business or government control purposes and discrimination in admission examinations – should be debated and reflected once information would, theoretically, be available and could regulate the hiring of people who are willing to develop illnesses among others.

About security, developers themselves still do not have a clear idea of what is really needed. A continuous measurement of vulnerability on software and systems must be done, as well as tests that allows users to

be aware of the importance of keeping their devices up-to-date and with accessible security tools (Magrani, 2018). Bringing it to a broader context, Peppet (2014), says thar IoT objects are susceptible to security breaches and hacking intrusions for three reasons:

1ª Organizations willing to work with IoTs are not specialists in developing high-end software or hardware, but rather on generating relatively common consumer goods in the marketplace. This means that the engineers involved with the projects are inexperienced in designing high level security systems.

2ª The small and compact size of the devices creates a difficulty due to lower processing capacity required for an efficient data security system. In addition, the size is sometimes so small that its battery is not sufficient to handle complex data security systems.

3ª The fact that most IoT objects are not designed to be constantly updated to improve your data security systems.

Other critic about IoTs is related to the anonymization of data, which is not a real fact once it may be deleted to maintain user privacy but can be reidentified by an adversary. This can be done by crossing other user information that is available on the network, which may eventually bring out the real identity of the person. Another risk is tracking, which allows you to locate a person in a given space and time. There is still the risk of profiling, which is the creation of information files about a particular person, in order to make correlations with other data and information. While releasing information there is also a risk of releasing information to unauthorized individuals, called shoulder surfing. And during the change of control of the lifecycle, personal information may still be released from the user, this is a change of user control to a third party, as IoT technologies will have a much more dynamic life cycle in which objects will be discarded, modified and borrowed more flexibly (Peppet, 2014).

Adding to the IoTs, the sheer volume of data produced by it and the change in traditional forms of data analysis, big data is a reality that is taking shape more and more, establishing a new way of dealing with information. And the number of data generated by the Internet of Things will be very useful for epidemiologists, as it will enable to know all the immediate and distant steps that led to the emergence of a given disease or even death. We are currently locked into active research, but in the near future the biggest challenge for science will be to persuade the population to provide data that has already been collected automatically and stored (Chiavegatto Filho, 2015).

The truth is that IoTs are becoming so important that it, along with other technologies, has ushered in what has been called the fourth industrial revolution, which is characterized by a ubiquitous and mobile internet, sensors and devices - which become more accessible and smaller, and the improvement of artificial intelligence (Magrani, 2018). And with the revolution came industry 4.0 which has as its basic foundation that by connecting machines, systems and assets, companies can create intelligent networks throughout the value chain that in turn can control production modules autonomously. In order to produce smart organizations that will have the ability and autonomy to schedule maintenance, anticipate process failures and shape unplanned demands and changes. In practical terms, for healthcare that means we will have assets, taking care of people, recognizing risks and scheduling maintenance with unique and more systematic care plans for the information system (Alves, Carvalho, & Cassias, 2019). There are six industry 4.0 core principles that define intelligent production systems that are likely to influence healthcare systems: 1) Real-time operating capacity; 2) Virtualization; 3) Decentralization; 4) Service orientation; 5)

Modularity, which produces according to demand. These principles applied to industry 4.0 are increasingly being incorporated into the health system, where individuals are monitored for their operation and tracked through health indicators (Alves, Carvalho, & Cassias, 2019).

It can be a system of networks considering that internet is a globalized tool that enables people to communicate via machines. The association of IoTs with RFID technologies, sensors and actuators will lead to many other applications, which are essentially more effective and more efficient. RFID is a technology that comes on top of IoTs, so it opens up a wide field in the market and in globalized health. Some authors believe that with the popularization of IoTs the RFID market will become increasingly promising, generating opportunities and benefits for those who use it (Leite, Ursini, & Martins, 216).

It is only logical that there is still a hard way for ubiquitous computing to become a reality for most of the population, but much has been advanced in technology to make this happen, and with the help of IoTs, new technologies information, tracking systems and wearable computing, it is believed that in a short time the ideal of a society of functional and invisible technology can be achieved. Much remains to be done improving Machine Learning algorithms, improving security standards and efficiency in data privacy, and cheapening wearable devices and technologies that will surely improve the quality of life (Boscarioli, Mello, Siqueira , & Vilain, 2016).

6. Conclusion

The debate around IoTs has been fierce, many are those who defend their use without restriction, and with the decree of 9,854 the truth is that, whether or not Brazil will be entering a new technological age, that of industries 4.0. Through research in international and national databases, it was found that, in terms of international bibliographic production, Brazil is still in the beginning - only 8 articles were returned - if compared to what has been produced abroad. Already in other databases like LiLacs, PsyINFO and ScieLo, the return was equally small. With the exception of Capes and Google Scholar who presented a significant number of articles, the theme has not been gaining ground in specialized magazines around the world. In any case, Google Scholar research has served to pinpoint how much this topic is beginning to get important in national discussions. It can be said that one is still in a technical capacity for the effective promotion of such technologies, although there are a large number of articles in local journals, but they do not have the proper academic expressiveness. In any case, the national literature is very wide and diverse, starting to deal with topics such as security, anonymization of information, improper traceability among other topics of great relevance.

However, when compared to the number of articles in the PUBMED database, the difference is striking, so there are 766 articles dealing with the theme around the world that are indexed in this database, while Brazil has 8 articles on this same subject on that basis.

As for the potentialities, the use IoTs in healthcare system are numerous, highlighting the monitoring of patient physiological conditions, epidemiological survey – in order to study the spread of diseases –, physical rehabilitation – through the sensors – and monitoring the medication from the factory to the patient – taking care to avoid mistakes during the process, such as falsification, tampering.

Overcoming system weaknesses, such as security, could be the impetus IoTs need for exponential growth.

Even if this is not done, it seems that these technologies are already gaining ground, including at the political level. There is also a need for broad debate about who owns the health data, whether the patient or institution, and who will be able to access it.

Therefore, IoTs will transform positively human processes and activities to significantly in a indispensable and intelligent way through devices of various shapes and sizes, at anywhere and anytime.

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Influence of Market Focus Planning Strategies on Competitiveness of Private Universities in Nairobi County, Kenya

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Abstract

In the last three decades, the republic of Kenya has witnessed a tremendous increase in the number of chartered universities and a stiff competition for students. The student enrolment base coupled with the emergence of private university education providers turned the university arena in Kenya into a student enrolment market, leading to intense competition between Public and Private Universities. The researcher realizes that, the existing studies relate competitiveness with performance. Thus, the purpose of this study was to assess the influence of market focus planning strategies on competitiveness of private universities in Nairobi County, Kenya. Resource Based Theory, Competitive Advantage Theory and Generic Framework Theory guided this study. The study applied mixed method approach and thus adopted concurrent triangulation design. Target population comprised 66 Registrar Academics, 66 Registrar Admissions and 33 Directors of Marketing all totalling to 165. Using the Central Limit Theorem, 36 Registrars of Academics, 36 Registrars of Admissions and 18 Directors of Marketing were purposively sampled. Questionnaires were used to collect data from Registrar Academic and Admissions whereas interview guide was used to gather data from Directors of Marketing. Data analysis began by identifying common themes from the respondents' description of their experiences. Qualitative data were analyzed thematically along the objectives and were presented in narrative forms. Quantitative data were analyzed using descriptive statistics and inferentially using Chi-Square through Statistical Packages for Social Science and presented using tables. The study established that many private universities have not fully adopted market focus planning strategies to enhance their competitiveness. The study recommends that private universities design and market their academic programmes affordable to students from all socio-economic backgrounds.

Keywords: Market focus planning strategies, competitiveness of private universities, students' enrolment.

Introduction

Cost focus aims at achieving cost advantage while differentiation focus is about seeking differentiation in a target segment. Cost focus exploits differences in cost behavior in some segments, while differentiation focus exploits the special needs of buyers in certain segments (Porter, 1980). This planning strategy targets a narrow segment of a market not served well by cost leadership planning strategy and tailors its products

to the needs of that specific segment to the exclusion of others (Jauch & Glueck, 2010). According to Pearce and Robinson (2012), focused differentiation is the second of two focus planning strategies. Focus planning strategy gives attention to a narrow market segment or niche market, firms pursuing this planning strategy are either focusing on cost advantage or differentiation of product or service (Porter, 1985).

In the context of education institutions which undertake a marketing approach to attract students, media promotion, scholarship and financial aids offering form the basis of focus planning strategy. In this case, universities which seek to attract students should develop marketing plan indicating how they can provide prospective students with innovative programs and services. A focus planning strategy based on low cost depends on there being a student segment whose needs are less costly to satisfy than the rest of the market. In other words, a focus planning strategy based on differentiation depends on there being a student segment that demands unique academic programme attributes. For example, in a study carried out in Kuala Lumpur, Bourgeo (2000) established that a leaning institution can choose to focus on a select student group, product range, geographical area or service line. According to Bourgeo (2000), market focus is also based on adopting a narrow competitive scope within a learning institution. This implies that in universities, market focus aims at growing market share through operating in a niche market or in markets either not attractive to, or overlooked by, larger competitors.

In Sri Lanka, in a service-learning institution, Kumar (2011) found that hospitals follow generic planning strategy groups and concluded that a focused cost leadership planning strategy is the best route to superior competitiveness. This implies that focus planning strategy is quite different from others in that it aims at a narrow competitive scope within the learning institution. In many countries in Sub-Saharan Africa, a continued survival of universities in the competitive higher education environment will strictly be pegged on how well they capitalize on marketing activities for strategic positioning. In this race, public universities have competitive advantage in the area of financing and sponsorship by the government.

In Morocco, Hazel (2013) also noted that the both variants of the focus planning strategy rest on differences between a focuser's target segment and other segments in the learning institution. The target segments must either have students with unusual needs or else the production and delivery system that best serves the target segment must differ from that of other learning institution segments (Porter & Kramer, 2011). Cost focus exploits differences in cost behavior in some segments, while differentiation focus exploits the special needs of students in certain segments (Porter, 1985). According to Porter and Kramer (2011), the learning institution focuses its marketing effort on serving a defined, focused market segments with a narrow scope by tailoring its marketing mix to these specialized markets, it can better meet the needs of that target market.

Kenya is not different and firms and universities have adopted market focus planning strategies as a way of enhancing their competitiveness. For example, Obado (2015) did a study on competitive planning strategies employed by the sugar BOC Kenya and found out that the sugar manufacturing learning institutions have formalized vision and mission statements. They employed competitive planning strategies of cost leadership, differentiation and focus to different degrees. The fact that the number of private universities in Kenya is significantly high, the number of students enrolled in some universities is significantly low. This implies the need for aggressive marketing communication skills by private universities, a situation that has forced them to critically evaluate their marketing approaches in order to

ensure their survival and viability (Omboi & Mutali, 2014). The products of higher education are considered to be both highly fluid and are characterized by aggressive marketing planning strategies meant to increase their market share, both in terms of student numbers and the caliber of those enrolling, the distinct difference between marketing in higher education and in the manufacturing sector (Omboi & Mutali, 2014).

The focuser's basis for competitive advantage is either lower costs than competitors serving that market segment or an ability to offer niche members something different from competitors. However, studies failed to indicate how, with broad market planning strategies, it is still essential to decide whether university will pursue cost leadership or differentiation once university has selected a focus planning strategy as its main approach. Omboi and Mutali (2014) as did other empirical researchers have not articulated how private universities use cost focus or differentiation focus as keys to making a success of a generic focus planning strategy and add something extra as a result of serving only that market niche.

Statement of the Problem

Market focus planning strategies are critical in enhancing competitiveness of private universities. When effectively adopted, private universities register many undergraduate and postgraduate students who complete their academic programmes in time. As stated in the background, Omboi and Mutali (2014) posit that a continued survival of universities in the competitive higher education environment is strictly pegged on how well the universities capitalize on marketing focus activities for strategic positioning. However, in private universities represented in Nairobi County, the number of students enrolled in universities is still low and some still complain of longer periods to complete their academic programmes. For example, enrolment increased from 82,095 students in 2003 to 443,783 in 2015, an increase of 400 per cent, with private universities accounting for 11.5% (2005-2006) academic year, 17.8% for (2007-2008) academic year, 19.7% (2009-2010) academic year, 27.7% (2011-2012) academic year, 19.8% (2013-2014) academic year and 18.1% (2014-2015) academic year (Republic of Kenya, 2015). Despite these statistics, few studies have interrogated the market focus planning strategies adopted by private universities and how such planning strategies influence competitiveness of private universities, hence the study.

Theoretical Framework

This study was guided by the Michael Porter's generic framework theory that gives techniques for analyzing industries and competitors. This theory can be used to find the optimum position for private universities within higher education institution and often a determinant of institution's profitability can be said to be the attractiveness of an institution/industry in which it operates. The study was also guided by the Competitive Advantage Theory which was also postulated by Porter (1980). According to Porter (1980) Industries, just like in Higher Education Institution and the individual private universities within the universities

constantly involved in a dynamic interplay in an attempt to build a successful; competitive edge over another. The theories relevant to this study are; the generic framework theory, the competitive advantage theory, and the resource-based theory. The choice of the three theories in this study is motivated by the fact

that the porter's generic planning strategies are guided by three pillars; cost leadership, differentiation and market focus planning strategies and thus the need to support them. Private universities concentrate on a narrower buyer segment in order to compete with their rivals on the basis of lower cost of operation; while in the differentiation planning strategy the company concentrates on the market niche by offering the customers a product that best suits their tastes, preferences and expectations.

The Conceptual Framework

In this study, the conceptual framework was based on market focus planning strategies reflected through number of academic programmes, completion period, links with communities and students' status which constituted independent variables whereas competitiveness of private universities whose indicators included; number of students in private universities and those who graduate constituted the dependent variable. The intervening variable for this study included; government policies and staff support as shown in Figure 1;

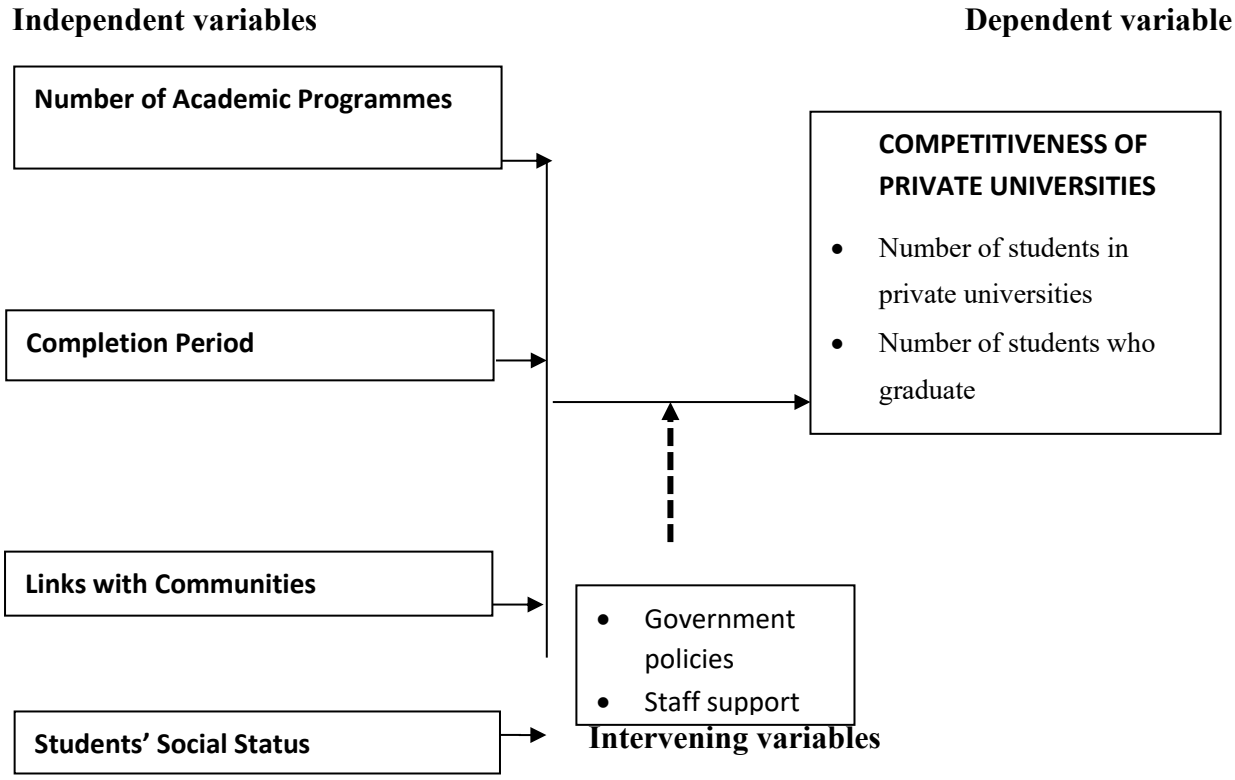

Figure 1: The Conceptual Framework
Source: Researcher (2020)

Research Methodology

The study applied mixed methods approach, that is, quantitative and qualitative methods. The study applied concurrent triangulation research design since this is a single-phase design in which the researcher applied quantitative and qualitative methods at the same time and with equal weight. Target population for this study was 165 respondents. This consisted of 66 Registrar Academics, 66 Registrar Admissions and 33

Directors of Marketing. The sample for the study was eighteen universities, that is, 54.5% of 33 that was slightly but within the threshold. The choice of eighteen universities was motivated by the fact that they are firmly established in Nairobi County. Using the Central Limit Theorem, all the Registrars in charge of Administration and Registrars in charge of Academic Affairs, their Assistants and Director marketing in all Private Universities were selected purposefully.

Purposive sampling was used to select 18 private universities in Nairobi County to act as research sites due to their establishment in terms of period of operation and their magnitude in terms of courses offered. Eighteen Directors of Marketing, 36 Registrar Academics and 36 Registrar Admissions were selected using purposive sampling. This procedure enabled the researcher to realize a sample of 18 Directors of Marketing, 36 Registrar Academics 36 Registrar Admissions. Qualitative data was analyzed thematically along the objectives and presented in narrative forms whereas the quantitative data was analyzed using descriptive statistics such as frequencies and percentages and inferentially using Chi-Square Test Analysis with the help of SPSS Version 23 and presented using tables.

Results and Discussions

In this section, the data analysis, presentation and interpretation are reported. The following main question guided the study:

i. What is the influence of market focus planning strategies on competitiveness in private universities in Nairobi County, Kenya?

Response Rates

In this study, 36 questionnaires for Registrar Academics and 36 questionnaires for Registrar Admissions were administered. In return, 32-Registrar Academics' and 32-Registrar Admissions' questionnaires were filled and returned. The researcher also conducted interviews amongst 16 Director of Marketing. This yielded response rates shown in Table 1;

Table 1: Response Rates

Respondents	Sampled Respondents	Those Who Participated	Achieved Return Rate (%)
Directors of Marketing	18	16	88.9
Registrar Academics	36	32	88.9
Registrar Admissions	36	32	88.9
Total	**90**	**80**	**88.9**

Source: Field Data (2020)

From Table 1, Director of Marketing, Registrar Academics and Registrar Admissions registered a response rate of 88.9%. This confirmed the findings of Creswell (2009) that a response rate above 75.0% is adequate and of suitable levels to allow for generalization of the outcomes to the target population.

Influence of Market Focus Planning Strategies on Competitiveness of Private Universities

The study sought to establish how market focus planning strategies adopted by registered private universities to influence their competitiveness. Descriptive data were collected from Registrar Academics and Registrar Admissions and results are shown in Table 2:

Table 2: Views of Registrar Academics and Registrar Admissions on the Influence of Market Focus on Competitiveness of Private Universities

Test Items	RESP.	SA %	A %	U %	D %	SD %
The programmes offered in private universities make them enroll more students and complete courses in time	**RAC**	59.5	15.5	4.5	11.5	9.0
	RAA	66.3	9.7	3.9	12.3	7.8
Private universities develop links with communities in order to tap students and thus increase their enrollment	**RAC**	56.5	23.5	2.5	9.5	8.0
	RAA	63.9	11.5	1.3	13.7	9.6
Developing academic programmes which caters for students from all social classes has increased enrollment and enabled students to complete their courses in time	**RAC**	51.5	8.5	7.0	22.5	10.5
	RAA	58.3	7.6	4.4	21.8	7.9
Private universities which admit students regardless of their families' income levels enroll many students	**RAC**	68.5	15.5	3.5	8.5	4.0
	RAA	72.6	10.5	2.4	7.9	6.6
Private universities which offer different programmes which meet students' preferences enroll many students	**RAC**	78.5	14.5	2.5	3.0	1.5
	RAA	77.2	13.3	1.5	6.3	1.7
Campaigning for concerted efforts on research and innovation and providing funds for the same has enabled private universities to have competitive edge	**RAC**	68.5	13.5	3.5	3.5	11.0
	RAA	70.5	15.3	4.5	6.7	3.0
Private universities accept invitations from students in social gatherings in their places of residence, harambees and burial ceremonies of students to enrol students	**RAC**	59.9	16.7	4.5	3.7	15.2
	RAA	70.4	17.2	2.2	6.1	4.1
Linkages between students' sponsors and the private universities through mentorship programmes and feedback on performance	**RAC**	66.7	16.4	3.5	3.4	10.0
	RAA	68.3	11.9	2.8	5.1	11.9

have acted as a means of increasing students in the universities						
Private universities have adopted sponsorship of students for exchange programmes through religious missions, crusades and sporting activities to increase enrollment	**RAC**	58.9	17.5	4.9	4.2	14.5
	RAA	67.1	20.1	3.7	5.4	3.7

Key: RESP-Respondents; RAC-Registrar Academics; RAA-Registrar Admissions

Table 2 reveals that 19(59.5%RAC) and 21(66.3%RAA) of the Registrar Academics and Registrar Admissions strongly agreed with the view that the programmes offered in private universities make them enroll more students and complete their courses in time, 5(15.5%) of the Registrar Academics agreed as did 3(9.7%) of the Registrar Admissions. However, only a paltry 1(4.5%) of the Registrar Academics as well as 1(3.9%) of Registrar Admissions were undecided, 4(11.5%) of Registrar Academics as did 4(12.3%) of the Registrar Admissions disagreed whereas 3(9.0%) of Registrar Academics and 2(7.8%) of the Registrar Admissions strongly disagreed. 18(56.5%RAC) and 20(63.9%RAA) strongly agreed with the view that private universities develop links with communities in order to tap students and thus increase their enrollment. 8(23.5%) of the Registrar Academics as did 4(11.5%) of the Registrar Admissions agreed. 1(2.5%) of Registrar Academics and 1(1.3%) of the Registrar Admissions were undecided, 3(9.5%) of Registrar Academics and 4(13.7%) of the Registrar Admissions disagreed whereas 3(8.0%) of the Registrar Academics as did 3(9.6%) of the Registrar Admissions strongly disagreed.

From Table 2, 16(51.5%RAC) and 19(58.3%RAA) strongly agreed with the view that developing academic programmes which caters for students from all social classes has increased enrollment and enabled students to complete their courses in time. 13(8.5%) of the Registrar Academics as did 2(7.6%) of the Registrar Admissions agreed. 2(7.0%) of Registrar Academics and 8(4.4%) of the Registrar Admissions were undecided, 7(22.5%) of Registrar Academics and 7(21.8%) of the Registrar Admissions disagreed whereas 3(10.5%) of the Registrar Academics as did 3(7.9%) of the Registrar Admissions strongly disagreed. These findings are consistent with the assertions of Nangila (2014) that market focus aims at growing market share through operating in a niche market or in markets either not attractive to, or overlooked by, larger competitors. These findings attest to the fact that a continued survival of universities in the competitive higher education environment will strictly be pegged on how well they capitalize on marketing activities for strategic positioning.

Table 2 shows that 22(68.5%RAC) and 23(72.6%RAA) strongly agreed with the view that private universities which admit students regardless of their families' income levels enroll many students. Meanwhile a small proportion of 5(15.5%) of the Registrar Academics and 3(10.5%) of the Registrar Admissions agreed. 1(3.5%) of the Registrar Academics and 1(2.4%) of Registrar Admissions were undecided, 3(8.5%) of Registrar Academics and 3(7.9%) of the Registrar Admissions disagreed whereas 1(4.0%) of the Registrar Academics as did 2(6.6%) of the Registrar Admissions strongly disagreed. 25(78.5%RAC) and 25(77.2%RAA) strongly agreed with the view that private universities which offer different programmes which meet students' preferences enroll many students. Meanwhile a small proportion of 5(14.5%) of the Registrar Academics and 4(13.3%) of the Registrar Admissions agreed.

1(2.5%) of the Registrar Academics and 1(1.5%) of Registrar Admissions were undecided, 1(3.0%) of Registrar Academics and 2(6.3%) of the Registrar Admissions disagreed whereas 1(1.5%) of the Registrar Academics as did 1(1.7%) of the Registrar Admissions strongly disagreed. These findings corroborate the assertions of Omboi and Mutali (2014) that higher education products are considered to be both highly fluid and are characterized by aggressive marketing planning strategies meant to increase their market share, both in terms of student numbers and the caliber of those enrolling, the distinct difference between marketing in HE and in the manufacturing sector. Hence, these findings affirm the fact that market focus planning strategy aims to achieve competitive advantage by either offering lower costs than competitors or offering members something different from competitors.

Majority, 22(68.5%RAC) and 23(70.5%RAA) strongly agreed with the view that campaigning for concerted efforts on research and innovation and providing funds for the same has enabled private universities to have competitive edge. 5(13.5%) of the Registrar Academics and 5(15.3%) of the Registrar Admissions agreed, 1(3.5%) of the Registrar Academics and 2(4.5%) of Registrar Admissions were undecided, 1(3.5%) of Registrar Academics and 2(6.7%) of the Registrar Admissions disagreed whereas 4(11.0%) of the Registrar Academics as did 1(3.0%) of the Registrar Admissions strongly disagreed. These findings lend credence to the assertions of Weingarten and Deller (2010) that a suite of benefits that flow from increased differentiation includes higher-quality teaching and research programs, more student choice, a globally competitive system and increased financial sustainability.

These findings further corroborate the findings of a study conducted in the Netherlands in which Luliya et al (2013) established that, to maintain this planning strategy the institution of higher learning should have: strong research and development skills, strong academic programme engineering skills, strong creativity skills, good cooperation with distribution channels, strong marketing skills, and incentives based largely on subjective measures, be able to communicate the importance of the differentiating academic programme characteristics, stress continuous improvement and innovation and attract highly skilled, creative people. Thus, these findings affirm the fact that differentiation planning strategy aims to build up competitive advantage by offering unique academic programmes which are characterized by valuable features, such as quality, innovation and student service. In other words, the essential success factor of differentiation in terms of planning strategy implementation is to develop and maintain innovativeness, creativeness, and organizational learning within an institution of higher learning. 19(59.9%RAC) and 23(70.4%RAA) strongly agreed with the view that private universities accept invitations from students in social gatherings in their places of residence, harambees and burial ceremonies of students to enrol students. 6(16.7%) of the Registrar Academics and 6(17.2%) of the Registrar Admissions agreed, 2(4.5%) of the Registrar Academics and 1(2.2%) of Registrar Admissions were undecided, 1(3.7%) of Registrar Academics and 2(6.1%) of the Registrar Admissions disagreed whereas 5(15.2%) of the Registrar Academics as did 2(4.1%) of the Registrar Admissions strongly disagreed. These findings are consistent with the assertions of Ramsaran-Fowdar (2007) that unusual features, responsive student service, perceived prestige and status are critical in enhancing enrollment of more students. This implies that rather than cost reduction, an institution of higher learning using the differentiation needs to concentrate on investing in and developing such things that are distinguishable and students will perceive and are meant to leave a permanent imprint on students' memory such as social events.

Majority, 21(66.7%RAC) and 21(68.3%RAA) strongly agreed with the view that linkages between students' sponsors and the private universities through mentorship programmes and feedback on performance have acted as a means of increasing students in the universities. A small proportion of 5(16.4%) of the Registrar Academics and 4(11.9%) of the Registrar Admissions agreed, 1(3.5%) of the Registrar Academics and 1(2.8%) of Registrar Admissions were undecided, at the same time 1(3.4%) of Registrar Academics and 2(5.1%) of the Registrar Admissions disagreed whereas 1(10.0%) of the Registrar Academics as did 4(11.9%) of the Registrar Admissions strongly disagreed. This is a good pointer to the fact that students want to know if the institution undertake strategic partnerships with related higher education which is valuable in cases of using outside research facilities or for their attachment and related training.

Majority of the respondents 19(58.9%RAC) and 22(67.1%RAA) strongly agreed with the view that private universities have adopted sponsorship of students for exchange programmes through religious missions, crusades and sporting activities to increase enrollment. 6(17.5%) of the Registrar Academics and 7(20.1%) of the Registrar Admissions agreed, 2(4.9%) of the Registrar Academics and 1(3.7%) of Registrar Admissions were undecided, at the same time, 2(4.2%) of Registrar Academics and 2(5.4%) of the Registrar Admissions disagreed whereas 5(14.5%) of the Registrar Academics as did 1(3.7%) of the Registrar Admissions strongly disagreed. These findings are consistent with the assertions of Jongbloed, Jürgen and Salerno (2007) that the legitimacy of higher education to society is increasingly evaluated by the level and quality of the private universities' commitment to its community of stakeholders and is inherently of greater depth than any simple maintenance of contacts. In other words, organizations should find ways and the means of involving the stakeholders so as to best perceive how the latter value the services provided and how best to improve them. Thus, these findings point to the fact that differentiation tends to reduce rivalry, increasing the possibility of building competitive advantages, whereas conformity improves the social support of stakeholders and therefore the legitimacy of the institution of higher learning. Hence, participation of students in off-campus activities is another key attraction for prospective students. To further ascertain the relationship between market focus and competitiveness of private universities, data were collected on the number of academic programmes and the number of students in private universities and results are shown in Table 3:

Table 3: Results of Number of Academic Programmes and the Number of Students in Private Universities

Number of Academic Programmes	Number of Students in Private Universities
55	13000
65	23000
77	28000
89	50000

Source: Field Data (2020)

Table 3 indicates that registered private universities which offer several academic programmes have a greater number of postgraduate and undergraduate students. These findings are also consistent with the findings of Omboi and Mutali (2014) that the number of higher education products are considered to be

both highly fluid and are characterized by aggressive marketing planning strategies meant to increase their market share, both in terms of student numbers and the caliber of those enrolling, the distinct difference between marketing in HE and in the manufacturing sector.

Inferential Findings on the Influence of Market Focus Planning Strategies on Competitiveness of Private Universities

These results in Table 3 were subjected to Chi-Square (χ^2) Test Analysis and results were as indicated in Table 4:

Table 4: Chi-Square (χ^2) Analysis of the Relationship Between the Number of Academic Programmes and the Number of Students in Private Universities

	Value	df	Asymp. Sig. (2-sided)	Monte Carlo Sig. (2-sided)			Monte Carlo Sig. (1-sided)		
				Sig.	95% Confidence Interval		Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound		Lower Bound	Upper Bound
Pearson Chi-Square	12.000[a]	9	.213	1.000[b]	1.000	1.000			
Likelihood Ratio	11.090	9	.270	1.000[b]	1.000	1.000			
Fisher's Exact Test	10.610			1.000[b]	1.000	1.000			
Linear-by-Linear Association	2.780[c]	1	.095	.041[b]	.037	.045	.041[b]	.037	.045
N of Valid Cases	4								

Source: SPSS Generated (2020)

From the Chi-Square (χ^2) Statistics in Table 4, the processed data, generated a significance level of 0.041^b which shows that the data is ideal for making a conclusion on the population's parameter as the value of significance (p-value of 0.041^b) is less than 5%, that is, p-value=0.041^b<0.05. It also indicates that the results were statistically significant and that there is significant relationship between the number of academic programmes and the number of students in private universities. These findings thus affirm the fact that the number of higher education programmes offered by private universities are meant to increase their market share both in terms of student numbers and the caliber of those enrolling.

Thematic Analysis of Qualitative Findings on the Influence of Cost Leadership Planning Strategies on Competitiveness of Private Universities

During the interviews, Director of Marketing responded in favor of the view that the programmes offered in private universities make them enroll more students and complete their courses in time. Director of Marketing, DM1, noted,

> "*In our university, we offer quite a number of academic programmes which cater for the interests of every student from different social backgrounds. This has witnessed enrollment of students in every programme and thus improving our university's competitive edge".*

The interviewees also noted that, besides the number of academic programmes, private universities develop links with communities in order to tap students and thus increase their enrollment. Just like quantitative findings, these views lend credence to the views expressed by Nangila (2014) that market focus aims at growing market share through operating in a niche market or in markets either not attractive to, or overlooked by, larger competitors. This implies that continued survival of private universities in the competitive higher education environment is strictly pegged on how well they capitalize on marketing activities for strategic positioning. On students' preferences, Directors of Marketing also noted that private universities which offer different programmes which meet students' preferences enroll many students. This further implies that higher education products are considered to be both highly fluid and are characterized by aggressive marketing planning strategies meant to increase their market share, both in terms of student numbers and the caliber of those enrolling. On research and innovation, the Directors of Marketing in private universities also indicated that campaigning for concerted efforts on research and innovation and providing funds for the same has enabled private universities to have competitive edge. When probed further, Director Marketing, DM2, noted,

> *"Our university has embarked on serious research and innovation programmes which involves affiliation with research bodies and ethical review committees to enhance our student research activities and undertakings. Our university views research as the backbone of every academic programme. Through this initiative, we have witnessed an increased number of postgraduate students in different academic disciplines".*

These views further corroborate the views expressed by Weingarten and Deller (2010) that a suite of benefits that flow from increased differentiation includes higher-quality teaching and research programs, more student choice, a globally competitive system and increased financial sustainability. The Directors of marketing in private universities also responded in favor of the view that their private universities have always accepted invitations from students in social gatherings in their places of residence, harambees and burial ceremonies of students. Directors of marketing noted that, through this initiative, their universities have been able to enroll more students. Thus, private universities which differentiation needs to concentrate on investing in and developing such things that are distinguishable and students will perceive and are meant to leave a permanent imprint on students' memory such as social events. On university linkages, Director of Marketing, DM2, noted,

> *"Our university has embarked on creating linkages between students' sponsors, parents and guardians in order to sensitize their neighborhoods of our existence. This has involved undertaking*

mentorship programmes and feedback on performance which has acted as a means of increasing students in our university. Activities such as sports, religious crusades and community charity programmes have also been fronted ways of attracting potential students to our university".

These views further corroborate the views expressed by Jongbloed et al (2007) that the legitimacy of higher education to society is increasingly evaluated by the level and quality of the private universities' commitment to its community of stakeholders and is inherently of greater depth than any simple maintenance of contacts. This indicates that community of stakeholders are increasingly playing an active role in the validation process of the products service coming out the higher education institutions, in this case students and research findings, and which does consequently influence on their operations. This points to the fact that differentiation planning strategies tend to reduce rivalry, increasing the possibility of building competitive advantages.

SUMMARY AND CONCLUSIONS OF RESEARCH FINDINGS

From the study findings, it is also evident that market focus planning strategies influence competitiveness of private universities. That is, many private universities have enrolled and continue to enrol more undergraduate and postgraduate students due to the number of academic programmes they offer. These programmes are tailor-made to cater for the interests of every student from different social backgrounds. Hence, these findings point to the fact that market focus planning strategies aim at growing market share through operating in a niche market or in markets either not attractive to, or overlooked by, larger competitors.

RECOMMENDATIONS

Drawing from the study findings, the study recommends that universities should ensure that they offer many, but quality, academic programmes in order to attract many postgraduate and undergraduate students. Private universities should further increase and improve the number of linkages with communities from where students hail from. The Ministry of Education through Commission for University Education should formulate policies which ensure that universities offer quality and affordable academic programmes for students from different socio-economic backgrounds in order to admit the 40% of KCSE candidates who miss placement after public and private universities.

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Women With Breast Cancer Care At The Public Hospital Of Macapá - Amapá: Epidemiological And Clinical Aspects

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Abstract

Breast cancer is a disease of widespread epidemiology worldwide and is considered a serious public health problem. Although it is well established that early diagnosis and appropriate treatment interfere with mortality rates and cancer prevalence, few data are available on the descriptive epidemiology of breast cancer in Brazil and in the state of Amapá. The general objective of this dissertation work was to study the epidemiological and clinical aspects of breast cancer patients treated at the Dr. Alberto Lima Clinical Hospital (HCAL), from January 2012 to December 2017 in the city of Macapá, Amapá. Breast cancer cases were reviewed, with analysis of 194 medical records, and the following variables were studied: Annual frequency of breast tumor, age, education level, origin, location of breast lesion, histological type of cancer, age at first childbirth, Menarche and Menopause, breastfeeding time, alcohol intake, smoking, family history of breast cancer in first-degree relatives, clinical staging of the disease, immunohistochemical panel, type of surgical treatment, Chemotherapy, Radiotherapy, Hormone Therapy and Target Therapy " It was noted that the year 2017 had the highest number of diagnosed cases, the age group between 41-50 years was the most affected, women with low education (Elementary Level) and coming from the capital of Amapá. In these women, the most frequent characteristics were: Age at first birth between 13-20 years, Menarche between 10-13 years, Menopause 41-50 years with significant number of patients in Menácme (out of menopause), Breastfeeding time between 02 -22 and 23-42 months, both intervals with the same number of records; Most of them did not drink alcohol, were not smokers, and had no family history of first-degree relatives of breast cancer. In the studied cases, the most common localization of the breast lesion was the Lateral Upper Quadrant, the most diagnosed histological type was Invasive Ductal Carcinoma, with clinical stage IIA, Luminal A molecular subtype, Radiotherapy and Hormomyotherapy were performed most of the time, but Target Therapy was not prevalent.

KEYWORDS: Cancer; Breast; Epidemiological aspects; Clinical features; Malignant Breast Neoplasia.

INTRODUCTION

The etiology of breast cancer is still unknown, but it is known that, like other cancers, it is multifactorial[1]. The implementation of a breast cancer control policy in the single health system must be able to expand and qualify the screening, guaranteeing the care of cases and reducing mortality [34]. It is recommended that

screening should start at age 40, including annual mammography and clinical examination, self-examination is optional and is also importante [41].

Conservative treatment coupled with new techniques, revolutionary drugs, more accurate and accessible tests, better trained doctors and more

conscious will make breast cancer better controlled and less lethal [34]. Patients can be submitted to conservative surgery as the first option, if mastectomy is indicated, immediate reconstruction should always be offered, within the possibilities of each medical servisse [41].

The identification of risk factors and characteristics of women with breast cancer, including epidemiology, can facilitate the tracking of subclinical lesions, in addition to helping to form viable proposals to decrease the incidence of breast cancer in the population [37]. The absence of this information makes it difficult to evaluate programs aimed at breast cancer and also makes it impossible for financial and human resources to be allocated according to the needs peculiar to the North and Brazilian Amazon. Therefore, the present study will seek to describe the demographic and clinical characteristics of women who were treated for breast cancer between 2012 and 2017 in the State of Amapá, Brazil.

MATERIAL AND METHODS

The access to the information necessary to carry out the research was done through authorization / acceptance from the institution signed by the clinical director and by the Data Usage Commitment Term (TCUD), signed by the researcher. The study was assessed and approved by the Human Research Ethics Committee of the Federal University of Amapá (UNIFAP) under opinion No. 3,063,020.

This is a retrospective, cross-sectional, descriptive, quantitative study with patients with malignant tumor, from the Mastology sector / Unit of High Complexity Assistance in Oncology-UNACON of Hospital de Clínicas Dr. Alberto Lima, where there was a review of breast cancer cases, with an analysis of 194 medical records, from a total of 254 cases diagnosed from January 2012 to December 2017 and use of information contained in 171 medical records. The collected data were recorded in a form designed specifically for the research.

As eligibility criteria we had:

- Inclusion criteria: Women diagnosed with breast cancer, attended at HCAL, from January 2012 to December 2017 were included.

- Exclusion criteria: Medical records containing insufficient information and male individuals were excluded.

The following variables were studied: annual frequency of the breast tumor, age, education level, origin, location of the breast lesion, histological type of the neoplasia, age at first delivery, menarche and menopause, breastfeeding time, alcohol intake, smoking, family history of breast cancer in first-degree relatives, clinical stage of the disease, immunohistochemical panel, type of surgical treatment, chemotherapy, radiotherapy, hormone therapy and "target" therapy.

A comparative statistical analysis of the data obtained was performed using the BioEstat software, version 5.3, with the application of the Chi-Square test, comparing the number of observations between the

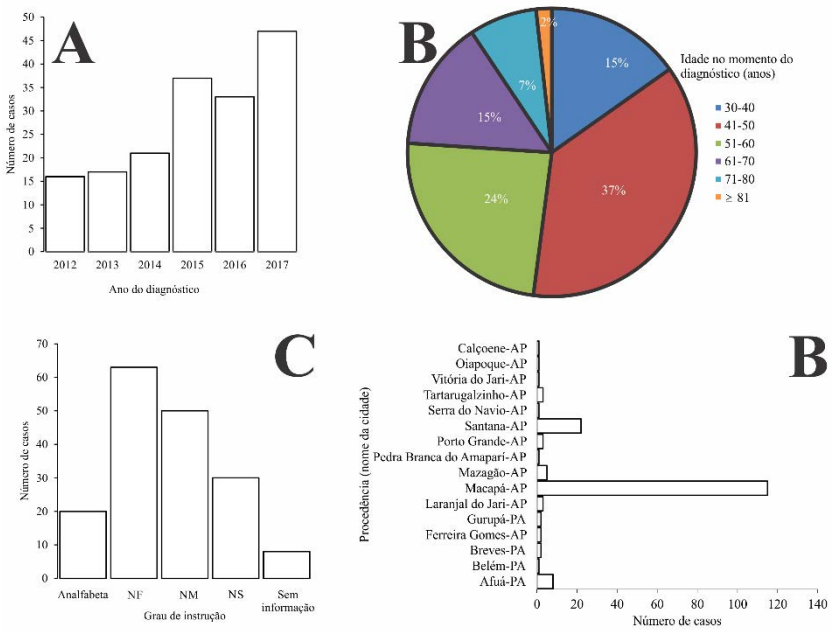
classes of each researched variable. The significance level of 5% was considered in all comparative analyzes.

RESULTS

Demographic epidemiology of breast cancer patients

Information was collected on 171 breast cancer cases from January 2012 to December 2017. Figure 1 shows the comparisons of demographic parameters of the breast cancer cases identified in the study period. It was observed that within the historical series the number of cases increased significantly from 2012 and reached its maximum value in 2017 ($p < 0.05$). The prevalent age group in the sample studied was between 41 and 51 years old, with a decrease for older and younger age groups. Women affected by breast cancer had mainly a level of education with only elementary education and gradually decreased the higher the degree of education of the patient. The vast majority of diagnosed women came from the state capital, Macapá.

Figure 1. Demographic epidemiology of breast cancer cases treated at Hospital de Clínicas Dr. Alberto Lima, from January 2012 to December 2017, in Macapá-AP, showing the occurrence of cases regarding the (A) year of diagnosis , (B) age of diagnosis, (C) education level and (D)origin.



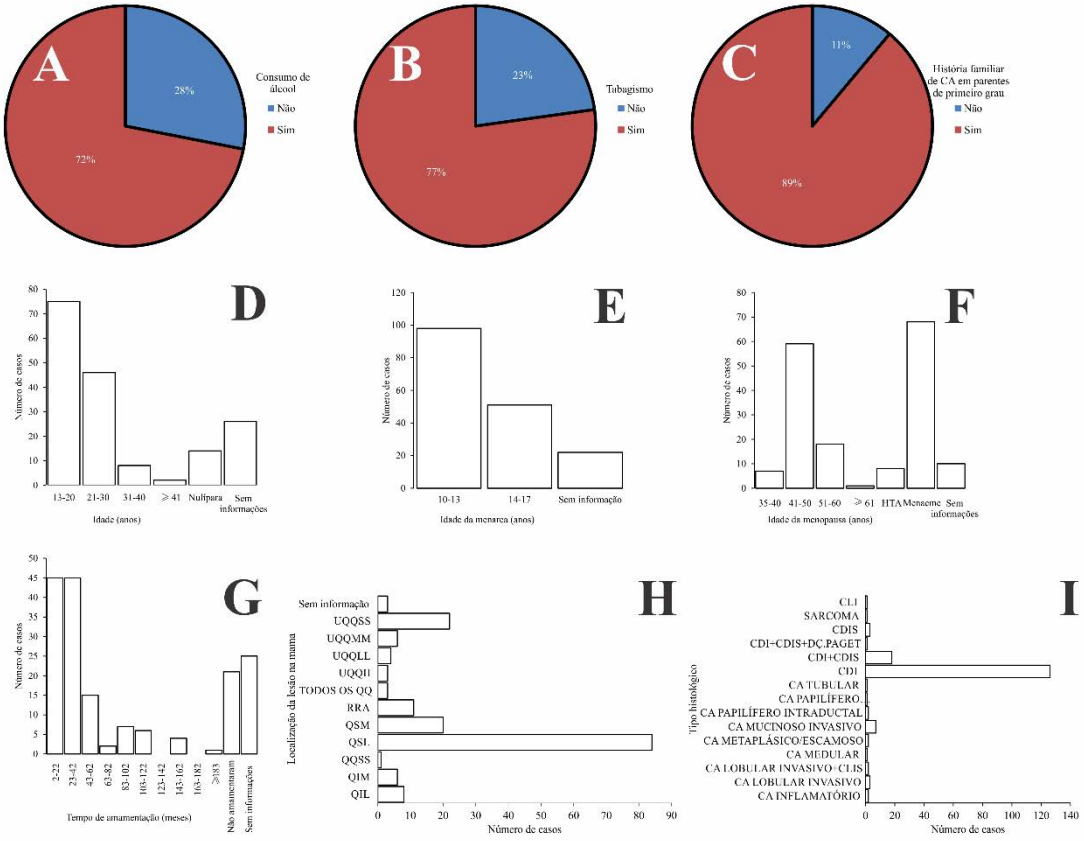
Clinical epidemiology of breast cancer patients

Figure 2 shows the distribution of cases regarding the patient's clinical history or the disease. The vast majority of patients had alcohol consumption habits, cigarettes and had first-degree relatives who had already had cancer. Most women had their first delivery between 13 and 20 years old, menarche between 10 and 13 years old. A bimodal distribution was found regarding the duration of the menstrual cycle. One fashion indicated a prevalence of cases whose women had menarche between 41 and 50 years old and another fashion indicated a number of cases

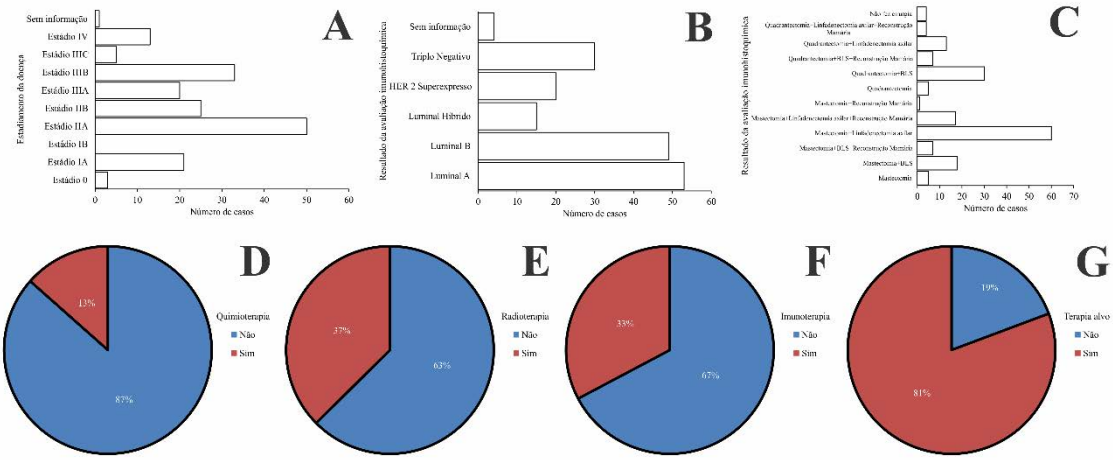
equivalent in women who were still menstruating. The short period of breastfeeding and the absence of breastfeeding were characteristics with a number of equivalent cases. The location of the lesion was greater

in the Upper Lateral Quadrant than in the others and the most prevalent histological type was Invasive Ductal Carcinoma.

Figure 2. Clinical epidemiology of breast cancer cases treated at Hospital de Clínicas Dr. Alberto Lima, from January 2012 to December 2017, in Macapá-AP.



Stages of disease II and III were prevalent in comparison to the others, as well as the luminal immunohistochemical result (A and B). The preferred treatment chosen for the studied cases was Mastectomy associated with Axillary Lymphadenectomy followed by Quadrantectomy associated with BLS (Sentinel Lymph Node Biopsy). Most patients underwent Chemotherapy, Radiotherapy, Immunotherapy, however the minority had Targeted Therapy.



DISCUSSION

Cases of malignant breast cancer have, over the years, shown alarming growth, as concluded by Souza et al. (2017), this aspect was confirmed by the present study, where there was a progression in the number of diagnoses confirmed annually. Highlight for the year of 2016, which presented a decrease and in the following year, a greater number of cases (47) was registered among women with breast cancer.

This increase is probably due to the emergence and dissemination of campaigns with the main objective of making an early diagnosis of the disease, encouraging the practice of breast self-examination and facilitating access to diagnostic methods. It is worth remembering that in 2012 the State of Amapá hired mastologists (04), through a public tender increasing the likelihood of registering new cases. This follows the INCA's annual estimates for breast CA, which are also increasing.

Farina et al. (2017), observed that the age group from 41 to 50 years old was the most affected by malignant breast tumors. Result identical to the research in question, where 63 patients were counted. However, most of the consulted medical literature shows a predominance of ages between 51 and 60 years. This finding is possibly due to the hormonal imbalance that arises in the climacteric, added to environmental, biological and individual factors.

In this research, most women had a low level of education, where the Fundamental Level (63) stood out. Information that can be ratified in the study by Ribeiro (2018) carried out in the State of Pará, with the level of education in the population studied being far from ideal. Sousa et. Al. (2016) observed similar results, in his publication also in the northern State of Tocantins, in this case it was the level of education of incomplete elementary school that predominated. Barboza et al. (2017) were also able to prove this information, in their work carried out in the State of Rio Grande do Norte (Northeast region), which presents socio-demographic characteristics similar to those of the states in the North region.

The literature describes that, the lower the level of education, the lower the chances of diagnosis in early stages of the neoplasia, a limiting factor for carrying out preventive measures. Thus, there is no doubt that the results obtained prove that the low cultural and educational degree, predispose the misinformation about prevention, early diagnosis and risk factors for breast cancer, further damaging the diagnosis.

As for the origin, it was observed that the capital of the State of Amapá (Macapá) had the largest number (115) of patients with the disease, similar to what is described by Ribeiro (2018), Barboza et al. (2017), Pereira (2016) and Pinto & Oliveira (2003). It may be that the cause is greater availability and better access to diagnostic methods, in addition to the population concentrating on Macapá-AP, favoring most case reports. It must be remembered that, for some years, there has been a migratory flow of cancer patients to the Cancer Hospital of Barretos-SP (Hospital de Amor de Barretos-HAB) and / or its unit in Porto Velho-RO, cause underreporting of new cases of breast cancer, among others. In 2019, the HAB inaugurated in Amapá a unit for the prevention of cervical and breast cancers, where the itinerant service is carried out by municipalities in the interior of the state with a mobile unit called “Carreta da Mulher”, providing the population with screening tests, this could invariably increase the number of diagnosed cases among rural women.

Pinto and Oliveira (2003) stated that the Upper Lateral Quadrant (QSL) of the breast was the most affected site. Conclusion that could be made by the present study, which contains 84 records, the correct

topographic documentation of the lesion being extremely important, because the QSL is the one that most leads to the involvement of axillary lymph nodes. Even so, it was not possible to collect this information from 03 medical records.

Invasive Ductal Carcinoma, which is one of the tumor histological types with the worst prognosis, was significantly (126) the most diagnosed, this data is in agreement with the conclusions of the researched studies, such as Barboza et al. (2017), Farina et al. (2017), Sousa et al. (2016), Pereira (2016), Moura et al. (2015), Gonçalves et al. (2012) and Leme (2005).

Regarding age at the first delivery, there was agreement with the research by Souza et al. (2017) and Moura Silva (2015), as well as the vast majority of the literature consulted, where ages under 30 years were more prevalent, considering that the Northern Region of Brazil has a high birth rate, including among adolescent mothers. However, the number of nulliparous women must be carefully observed.

The age of menarche between 10-13 years (98) predominated, coinciding with the results published by Souza et al. (2017), Farina et al. (2017) and Moura Silva (2015). Possibly such statement must happen due to the change in eating habits, with increased consumption of animal fat and foods rich in factors related to the genesis of breast cancer. In our region, these data deserve a special discussion, since amapá habitats eat foods with a high content of animal fat and salt, but vegetables, some of which have protective factors against cancer, are hardly part of the regional menu, in which fish meat is widely consumed.

The most frequent age of menopause was between 41-50 years (59), as stated by Moura Silva (2015) in his article, where menopause occurred before the age of 55 in 100% of patients. But, Among the cases studied in the current research, 68 women were not menopausal (Menácme), 8 were submitted to Total Abdominal Hysterectomy (HTN) surgery and 10 patients had no record of this information.

As for breastfeeding time, in the present study it was found that the result obtained was similar to those by Souza et al. (2017) and Farina et al. (2017), but it was also observed that 21 women did not breastfeed and in 25 medical records there was no such information. Contradicting the protective action of breastfeeding for breast cancer in the rest of the medical literature available for consultation.

With regard to alcohol intake, the present research work was in agreement with the theses of Farina et al. (2017), Barboza et al. (2017), Sousa et. Al. (2016) and Leme (2005), as 123 women said they did not use alcohol. However, alcohol consumption is considered a risk factor, since it can increase total levels and estrogenic bioavailability, progressive tissue damage by the formation of acetaldehyde that acts on breast carcinogenesis through an inflammatory response mechanism, that is, the greater the consumption , the greater the chance of developing the malignancy.

As for smoking, 132 patients denied being a smoker, according to the provisions of the studies by Ribeiro (2018), Barboza et al. (2017) and Leme (2005), however Souza et al. (2017) showed a significant result where 29% of women reported being smokers. Factor that is considered to be contradictory to the risk of breast cancer in humans.

The family history of breast cancer in first-degree relatives was not observed among the majority (152) of the medical records handled, coinciding with the results of Souza et al. (2017), Sousa et. Al. (2016), Lauter et al. (2014) and Leme (2005), but diverging from the conclusion of Barboza et al. (2017) which points out 42% (495) of patients with a family history of cancer. According to INCA (2018), this increases the risk of developing breast cancer by two to three times, as this is an important risk factor for breast

cancer, due to the mutations of the BRCA 1 and BRCA 2 genes, which are passed on from one generation to another.

Regarding clinical staging, it was noticed that the majority (50) of the women studied were in stage IIA, similar to what was observed in the research by Barboza et al. (2017), Farina et al. (2017), Pereira (2016), Moura et al. (2015), Lauter et al. (2014) and Gonçalves et al. (2012). However, there was disagreement with the conclusions of Sousa et. Al. (2016) and Leme (2005).

In Amapá, cases of breast cancer with advanced clinical staging were highlighted, causing patients to undergo more difficult, time-consuming and radical treatments. The early diagnosis of this disease is not yet part of our reality.

As for Immunohistochemistry, the molecular subtype Luminal A was the most found (53), being in accordance with most of the available literature, however the work of Pereira (2016) describes the Negative Triple as being the most recurrent.

Mastectomy with axillary lymphadenectomy was the most common surgical treatment (60), in the study in question, in accordance with the publications by Souza et al. (2017), Pereira (2016), Gonçalves et al. (2012) and Leme (2005). However, it is at odds with the article by Leite (2011), where most of the surgeries were of the conservative type. The increasing use of this surgical modality, where there is no complete excision of the breast, has reduced the negative effect on body self-image and self-esteem of women affected by the disease.

Conservative surgery is the standard treatment for breast cancer in stages I and II, but it requires some minimum conditions for it to occur, such as the transoperative evaluation of the compromised surgical margins by the tumor, a procedure performed by a pathologist and that for many years it was not offered in the public health network of Amapá. Pre-surgical marking of lesions breast cancer, which is a procedure performed by a radiologist, is another limiting factor because it is not yet offered in the Unified Health System (SUS) in Amapa. Perhaps these reasons, among others, may justify the greater number of radical surgeries that occurred during the period of the present study. Not to mention that surgery is impaired, in cases where breast reconstruction could be performed with silicone prostheses, because this material is considered “high cost” and the State Government does not usually stock it, as it would be necessary to purchase through a long bidding process and this could harm the patients, who would be waiting for a long period of time to be operated and thus have their breast reconstructed.

148 women underwent chemotherapy treatment in the present study, the majority in the cases studied and agreeing with Ribeiro (2018), Barboza et al. (2017), Pereira (2016) and Leme (2005). Chemotherapy is an advanced, high-cost pharmacotherapeutic method, capable of inhibiting tumor progression by various mechanisms. Widely used as a complementary resource to the treatment of breast cancer.

However, large variations in time to start treatment or between drug infusion cycles are related to adverse, potentially damaging effects on the organism that can lead to discontinuity or a longer interval between doses, being very harmful, causing failure and affecting substantially the general efficacy of the treatment, hindering the healing process and may even change the prognosis of these patients. In Amapá, in certain periods, there was a “lack of high-cost drugs”, which may hinder the cure of the disease for some women.

As for radiotherapy, it was indicated for 107 breast cancer patients in this study, which is in agreement with the researched literature. It is a local treatment modality in which controlled radiation is emitted on cancer cells to eliminate them or slow their growth, however not all patients have a clinical indication for radiotherapy, which also depends on the tumor stage.

The omission of radiotherapy treatment is related to the decrease in survival due to the disease. Amapá is the only state where this therapy is not offered to users of the health system, causing a migratory flow of patients, who in the case of the public network travel with the help of Treatment Outside the Home (TFD), but there is bureaucracy and delay, discouraging factors for patients.

Most (115) of the patients used hormone therapy, the same situation mentioned in the studies by Ribeiro (2018), Barboza et al. (2017), Souza et al. (2017) and Milk et al. (2011). Positivity for hormone receptors in breast tissue is generally linked to a good response to treatment and a better prognosis, since hormone therapy is a type of systemic treatment, reaching the breast and also other organs, and can be neoadjuvant (before surgical treatment) or complementary (adjuvant), contributing to reduce the risk of recurrences. In general, it acts to contain the activity of Estrogen and Progesterone as growth promoters and tumor spread in the breast, by reducing serum levels of hormones or inhibiting their activity in breast cancer cell receptors.

As for Target Therapy, Most women (138) did not use it, in line with the information in the medical literature consulted, with emphasis on the publication of Brasil (2017), where the overexpression of human epidermal growth factor type 2 receptors (HER-2) is seen in around 20% to 30% of breast cancer cases. In this overexpression, extra transmembrane proteins function as growth factor receptors, inducing dimerization and the consequent determination for accelerated cell division and multiplication.

Tumors are considered HER-2 positive when they present grade 3+ results on immunohistochemistry, confirmed by fluorescence in situ hybridization (FISH) demonstrating amplification of the HER-2 gene. Tumors may also occur that do not show overexpression of the HER-2 gene, but which do have amplification.

The status of HER2 indicates the likelihood of response to certain chemotherapeutic agents, contributes to determining the patient's prognosis and identifies women who can respond to treatment with Trastuzumab, so the procedures used to determine the status of HER-2 must be reliable and judicious.

CONCLUSION

The year 2017 had the highest number of diagnosed cases, the age group between 41-50 years was the most affected, women with a low level of education (Fundamental Level) and coming from the capital of Amapá. In these women, the most frequent characteristics were: Age at first delivery between 13-20 years, Menarche between 10-13 years, Menopause from 41-50 years with significant number of patients in Menácme (outside of Menopause), breastfeeding time between 02 -22 and 23-42 months, both intervals with the same number of records; most did not ingestion of alcoholic beverages, was not a smoker and had no family history of first-degree relatives of breast cancer.

In the studied cases, the most common location of the breast lesion was the Upper Lateral Quadrant, the most diagnosed histological type was Invasive Ductal Carcinoma, with clinical stage IIA, Luminal A molecular subtype, the most common surgical treatment was Mastectomy with axillary lymphadenectomy, Chemotherapy, Radiotherapy and hormone therapy were performed most of the time, but Target Therapy was not prevalent.

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Creative economy, authenticity and peripheral memories: the favela souvenirs in Rio de Janeiro

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Abstract

The aim is to examine the economic and cultural roles of the favela souvenirs for Rio de Janeiro's slums, with the focus on the work of a male artist from Santa Teresa (an old neighbourhood, on the top tod a hill in the central region of the city, with great tourist appeal and strong contrast between mansions and one of the poorest and most violent communities of Rio). The main argument indicates that favela souvenirs generate income and jobs not only for craft workers, but indirectly for tourist guides, food services and other creative sectors connected to the favela tourism. When these souvenirs are original and truth-telling, they may stimulate a better perception of the favelas in tourists and consolidate them as tourist destinations, despite the aggravation of violence in many slums in Rio de Janeiro. Favela souvenirs also carry the memories of the city's periphery, which is sometimes seen as secondary in Rio de Janeiro's long-established tourist images and "generic souvenirs". They offer greater visibility to the cultural production of marginalized social groups, which fuels potentially transformative views about the favelas and bring about the discussion on the lives of those who live in these areas. In the case of the work of the considered artist, it is possible to say that his paintings have elements of the "objective authenticity" of souvenirs, which contrast with a preconceived idea of an "imaginary favela" in his treatment of Santa Teresa's poorest communities. However, there are some aspects of standardization in his pictorial production and simulation in the process of elaboration of the artist's work during tourists' visits to his studio.

Keywords: Favela; Favela Souvenirs; Rio de Janeiro; Authenticity; Memory.

1. Introduction

Rio de Janeiro has sought to position itself, at national and international dimensions, as a "creative city", a space in which social and artistic activities, creative sectors and the government articulate to promote a cultural effervescence that attracts talents, strengthens the potential of companies and institutions and stimulates social diversity (Jesus & Kamlot, 2016). Creative economy was understood by many municipal governments and companies in the city as a set of activities, goods and services based on creativity, talent or individual ability, which can bring new possibilities of development with the productive mobilization of local cultural and creative specificities and urban regeneration projects (Reis, 2011).

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Tourism is one of the most important creative industries in Rio de Janeiro, but, for many years, the city's tourist image was connected to its natural landscapes – such as the Sugar Loaf and the beaches – or some specific tourist attractions, such as the Christ the Redeemer statue. Now it is possible to see that, against the stereotypical perspective of Rio de Janeiro as a "pornotropical" city (McClintock, 1995), the favelas (slums) become gradually important as tourist destinations, which, according to some specialists, can bring a more precise perspective of the living experience in the city (Moraes, 2010). Many critics say the "tourist favela" does not resemble the real lives of many residents who suffer from the state abandonment and the disputes among police forces, drug dealers and militias (Grilo & Neri, 2013). Despite the differences among specialists on what kind of favela is really incorporated as a tourist destination, these communities in Rio de Janeiro are very active culturally and produce creative expressions in many sectors, such as music – carioca funk is a good example –, dance and crafts.

In a creative city, the valorization of collective memories should not be understood in the context of a nostalgic return to the past, but rather a contemporary need to improve life in the urban space. It motivates actions of decisive political importance when re-appropriating, restoring and rehabilitating the present and aiming at a future of more just social relations (Tomaz, 2010). At this perspective, souvenirs have an important role, because they can possibly bring social and cultural meanings for a group of local people to preserve their past, generate income from their cultural expressions, preserve the local memory alive and extend the knowledge and recognition of their culture worldwide (Cavalcanti & Fonseca, 2008). These souvenirs are tangible artifacts that satisfy the intangible images of the experience remembered by the tourist. For the tourist, the purchase of a souvenir serves as a tangible way of capturing an intangible experience (Swanson, 2004); in this case, the tourist's visit to the favela or even Rio de Janeiro.

The commercialization of souvenirs is important in the promotion of the favelas as tourist destinations. Souvenirs and other memory objects are not only gifts, signs or remainders, but they also create moments of interaction among artisans, artists and tourists, with face-to-face interactions and conversations (Freire-Medeiros, 2013). They may have deeper effects at the communities in which they are produced and sold.

The aim of the article is to examine the economic and cultural roles of the favela souvenirs for Rio de Janeiro's slums, with the focus on the work of a male artist from Santa Teresa (an old neighbourhood, on the top tod a hill in the central region of the city, with great tourist appeal and strong contrast between mansions and one of the poorest and most violent communities of Rio). The main argument indicates that favela souvenirs generate income and jobs not only for craft workers, but indirectly for tourist guides, food services and other creative sectors connected to the favela tourism. When these souvenirs are original and truth-telling, they may stimulate a better perception of the favelas in tourists and consolidate them as tourist destinations, despite the aggravation of violence in many slums in Rio de Janeiro. In the case of the work of the considered artist, it is possible to say that his paintings have elements of the "objective authenticity" of souvenirs (Wang, 2009), which contrast with a preconceived idea of an "imaginary favela" in his treatment of Santa Teresa's poorest communities. However, there are some aspects of standardization in his pictorial production and simulation in the process of elaboration of the artist's work during tourists' visits to his studio.

Even though we agree with Wang (2009) that the object-related authenticity of the souvenir and the

activity-related authenticity may not necessarily be related, the search for the tourists' authentic selves may be supported by authentic souvenirs. The authentic experiences connected to authentic souvenirs may replace storytelling for truth-telling and bring entertainment, learning and a more real aesthetic fruition. Favela souvenirs also carry the memories of the city's periphery, which is sometimes seen as secondary in Rio de Janeiro's long-established tourist images and "generic souvenirs", characterized by a stereotyped perception of Rio de Janeiro connected to its traditional tourist destinations and experiences. Favela souvenirs offer greater visibility to the cultural production of marginalized social groups, which fuels potentially transformative views about the favelas and bring about the discussion on the lives of those who live in these areas.

2. Theoretical framework

2.1. Souvenirs and creative economy

The creative economy presents a broad sectorial aspect by bringing together to the new media and technologies elements of the solidarity economy, which are related to craft and traditional knowledge. As a development strategy, creative economy recognizes the importance of human capital to foster the integration of sociocultural and economic objectives and brings opportunities for creative entrepreneurship, the formalization of small companies and the generation of income and employment. The intangibility of creativity can add value by incorporating inimitable cultural characteristics to products and services and creating synergies between the local lifestyle and the environment in which it takes place (Reis, 2008).

Creative sectors such as craft have not only an economically productive perspective, but also a political perspective of social inclusion and resistance to oppression. As these sectors are living cultural heritages, they promote the relationship between local residents of many communities with their families and social groups – which stimulate conviviality, dialogue and learning that integrate different generations – and the consumers of their products, such as tourists that buy favela souvenirs. The commercialization of these products makes contact and encounter possible and brings the experience of dialogue (Ribeiro, 2014).

It is possible to say that creative sectors are not merely understood as forms of wealth accumulation or gains in competitiveness, which characterizes Western capitalism in the deterritorialization of symbolic goods. Actually, they seek to value the socioeconomic, political and cultural roles of local creative production for the population of the poorest communities, in a perspective that surpasses a utilitarian or functionalist understanding and moves toward the incorporation of a broader and more robust view of development, understood as a set of individual and collective freedoms (Sen, 2000). Instead of aligning itself with a reductionist conception of the supposed commodification under given and immutable conditions of the capitalist society, creative production in areas such as favelas transcends the immediate field of market economy and incorporates the potential for reflections on the cultural aspect of underdevelopment and dependence, following the critical view proposed by Furtado (1984). Creative economy is thus not limited to reproducing a linear and evolutionary conception of economic development of industrial capitalism. It introduces a new perception of human development in a context of valuing individual and collective potentials in the production of symbolic and intangible goods as forms of social inclusion and the recognition of the wealth of multiple cultural expressions, in a resistance to homogenizing

attempts to de-merit local cultural practices by mass culture (Furtado, 1984).

In the light of this conception of development, culture is not merely provided with economic value by contributing to national and international flows of goods and services, but is constituted as a set of intangible and tangible goods that allow the transmission of ideas and values and a more egalitarian exchange of human experiences (DaMatta, 1991). Creative local products such as souvenirs can provide consumers with distinct experiences that not only entertain but develop the collective imagery and the historical and affective memories through the permanent and incessant construction of feelings of belonging and identity that anchor the memory of the society. Personal and collective memories may arise or be reactivated by these products, which, by building or bringing back specific moments, can produce emotional and affective relationships and preserve elements of peripheral cultures, often conceived as subaltern by the mainstream creative industries. The culture of marginalized groups survives in the material assets that their members produce and the experiences associated with them, related to the history, traditions and ways of life of the communities and shared with visitors and tourists (Lopes, 2014).

2.2. The authenticity of tourism and souvenirs

For travellers, the souvenirs brought the possibility of perennial memories of their trips. Many definitions of a "souvenir" highlight that these objects may turn the intangible into tangible elements and materialize the memory (Perrotta, 2015). Their physical presence helps locate and freeze in time a transitory experience. They may be pictorial products, such as postcards and posters; miniatures of monuments and local icons; products with the place brand; natural objects or products made of these objects, such as shells, stones and seeds; and local products, such as craft and typical local drinks and foods (Gordon, 1986). However, it is important to say that, in a niche of tourists, there is also a lot of prejudice regarding souvenirs, precisely because of their supposed sameness and low quality, especially when related to mass tourism, and inauthenticity. The definition of authenticity of the souvenirs may include singularity, aesthetics and function of the craft, as well as the integrity of the local culture, the link with history and the genuineness of the product. More experienced tourists are not usually interested in trivial products, such as those that carry the message of the tourist destination or some meaning that refers to the place of origin. These people are concerned with living authentic experiences and, during these times, they acquire a specific product, which is not often marketed in a souvenir shop or fair, nor is it produced for this purpose (Horodyski et al., 2014).

Nevertheless, it is very common to identify the researchers' disappointment with the low creativity of the so-called "handmade products" sold as souvenirs in their studied communities. MacCannell (1976) – who introduced the concept of authenticity to sociological studies of tourist motivations and experiences – believes that these products are parts of a "staged authenticity", which is appreciated by the tourist as "original", but tourist practices serve the interests of the imaginary of the modern man, revealing a network of culturally defined social relations. This "constructive authenticity" is conceived as the result of a social construction, not an objectively measurable quality of what is being visited. In this sense, authenticity is seen as relative, negotiable, contextually determined and ideological and projects stereotyped images and expectations onto toured objects, such as souvenirs (Wang, 1999). According to Boorstin (1992), tourism is essentially inauthentic, and tourist performances are produced and based on the taste of the tourist

demand, so the tourist has no reason not to enjoy them.

The process of "McDisneyisation" of contemporary tourism (Ritzer & Liska, 1997) – which makes the experiences more predictable, calculated, controlled and, above all, efficient – also happens with the souvenirs, while the real "authentic" may be conceived as difficult, uncomfortable, and unpredictable. That is why many tourists accept "inauthenticity" for its predictability and their own comfort. Not only the same repertoire of products (mugs, keyrings, T-shirts, caps) appear everywhere, but sometimes with the same decorative pattern. Nevertheless, they are easier to be purchased and bring good memories from the visited places. The perspective developed by Stephen (1990) indicates that the persistence in debating the authenticity of tourist objects such as souvenirs may encourage the belief that in some place there may exist a "genuine life". The recognition of the dialectic of authenticity that underlies the construction, exchange and movement of tourist attractions and souvenirs characterizes the postmodern world. Tourists do not live in submerged myths, but they participate in their creation. Postmodern researchers do not see inauthenticity as a problem, because there is no absolute boundary between what is real or fake.

Critics question the usefulness and validity of the discussion about the authenticity of tourism – which has repercussions to the discussion about the authenticity of souvenirs, as may be seen below – and show that the tourist motivations or experiences cannot be limited to the conventional concepts of authenticity. However, authenticity cannot be ignored when issues related to ethnic, history or culture tourism are discussed, once they involve the representation of difference and its past. Instead of persisting in the debate on object-related authenticity in tourism between objective and constructive authenticity, Wang (1999) tries to bring more clarification to the meanings of authenticity in tourist experiences, which has effects on the debate on the authenticity of souvenirs. The author argues that "existential authenticity" is an alternative source in tourism, regardless of whether the toured objects are authentic. This opens the possibility of a greater variety of tourist experiences, because the notion of "existential authenticity" is conceived as an activity-related situation, which may open the possibility of developing experiences of intrapersonal authenticity – related to bodily feelings as the inner source of pleasure, as well as self-making – and interpersonal authenticity, which is connected to the strengthening of family ties and the possibility of making new friends in tourist activities with the company of others. According to Wang, the authenticity of experiences separated from the authenticity of toured objects – including souvenirs – is crucial for introducing existential authenticity as an alternative source of authentic experiences. While certain toured objects, such as nature souvenirs, are irrelevant to authenticity in MacCannell's sense, nature tourism is one of the major ways of experiencing a real self, which involves an existential authenticity rather than the authenticity of objects. In this perspective, existential authenticity – as an activity-related issue – may have nothing to do with the authenticity of toured objects, including souvenirs. In this activity-related authenticity, tourists are not concerned about the authenticity of toured objects at all, but rather they are in search of their authentic selves with the aid of activities or toured objects.

2.3. The authenticity of favela souvenirs in Rio de Janeiro and their role in creative economy

The commercialization of local souvenirs has an economic and cultural relevance for the communities and stimulates specific places as tourist destinations, such as some favelas in Rio de Janeiro. The favelas have always been an issue of great concern of local authorities, but also the curiosity – and

visitation – of chroniclers, who saw something mysterious and exotic in them. Tourists also became gradually interested in favelas as a destination, because many are not satisfied with the superficial knowledge of the place they visit. They want to search for more authentic experiences. This search is bigger and more complex than the search for native places and spaces where official tourism has not yet entered, but the meaning of life through the experience of alterity, diversity, novelty or instability. The "favela tourism" may be taken as an example of the search for diversity. In Rio de Janeiro, this type of tourism was institutionalized in the 1990s following a global tendency of tourism options focused on poverty. According to Freire-Medeiros and Menezes (2016), the tourist poverty in Rio de Janeiro finds its symbolic reference in an "imaginary favela", set in the mountains, between the forest and the sea, from where it is possible to see the richest neighbourhoods of the city. This imaginary territory starts to compose the tourist package which offers specificity to Rio de Janeiro, complimenting or competing with traditional itineraries.

Although some specialists say that "favela tourism" is a type of exploitation of poverty, this perception is not recurrent among favelas' residents. They usually do not feel comfortable when the tours are operated by famous agencies in safari jeeps, but local initiatives, with local guides and conducted on foot, developed by people from the favelas, are viewed positively. These tours offer reliable information, generate personal experiences for the tourist, employ local people, support small business and deconstruct violence stereotypes and stigmas associated to favelas and generated by media. The interaction of tourists with the community is stimulated by making them more aware of local problems and daily routines, such as the difficulties of walking in the narrow alleyways and climbing steep stairs without pavement and sanitation. This indirectly generates support for social projects. Many communities invest the profit brought by tourism in local social projects and promote the residents' self-esteem (Rompu, 2017).

The tourists seek to transform the experience outside their home into something different from their daily lives. This experience may involve the "search for authenticity", which is actually a construction. Although this search has always existed, discussions on the topic have been more recurrent after the phenomenon of mass tourism, and even more so in the imagery and digital era, when "reality" has been constructed by images, symbols and posts. The more authenticity is sought, the more it is invented. Thematization and scenarization, original to American parks, had already occurred in restaurants, hotels, shops, malls and museums and now they came to exist in cities – and also in the favelas – that turned to tourism as part of the construction of their images for consumption (Fagerlande, 2015, 2017; Luna, 2010).

Freire-Medeiros & Menezes (2016) argue that the version of the favela embodied in most souvenirs fits into a larger set of interventions that targeted the landscape of these communities and the conduct of their inhabitants to fit them into a broader narrative of Rio de Janeiro as an "entertainment machine". According to the authors, "favela tourism" was used by local authorities as a practice to support the city's broader reconfiguration project. They also argue that the favela iconography present in the souvenirs treats the communities in a generic way, with no details and specificities that differentiate one from the other. In the interviews conducted by the authors, they identified that many artists thought it would be more advantageous to produce a "generic souvenir" to please tourists – since they did not seem to care much about what was specific to each favela, but what would be typical of the favelas in general – and sell their products in other places (Freire-Medeiros & Menezes, 2016). Nevertheless, it is important to say that Freire-Medeiros & Menezes – as well as most authors who work with favela souvenirs in Rio de Janeiro –

focus on objects produced in Rocinha, the biggest slum in the city. However, they do not explore the production of favela souvenirs in other Rio de Janeiro's poorest communities which might be more original and authentic than the ones in Rocinha. Some authors brought initial ethnographic efforts in the study of favela souvenirs in other communities such as Santa Marta's slum, but they did not bring a deeper research on the object-related authenticity of favela souvenirs in the city.

In the universe of souvenirs sold in the favelas, it is possible to perceive more authentic productions that, even when they dialogue with national and international cultural movements, do not lose fundamental elements of the specificities of communities. Such souvenirs have not only the role of productive inclusion and increase of local self-esteem, but they also serve as repositories of a peripheral memory that resists attempts to erase and eliminate them. In the fields of marketing and business management, Pine & Gilmore (1998) argue that the "experience economy" has a strategic potential to add value to brands by generating memorable experiences in addition to their deliveries of products or services. In this economy, consumers increasingly seek authentic experiences, when storytelling – the narrative that advertising usually uses to tell the story of a brand or product, seeking proximity to its user – has been overtaken by truth-telling. The experience should bring entertainment, learning, stress relief and aesthetic fruition. For creative economy, authenticity is also fundamental – in this case, the development of souvenirs – to meet the human, economic, social and sustainable development premises.

3. Methodology

In the first part of our research, we developed how Rio de Janeiro's favela souvenirs incorporated the idea of "staged authenticity". In the second part, we investigated the Santa Teresa's male artist work with a qualitative content analysis. The selected souvenirs are categorized into four categories: the aesthetics elements of the artist's production; the connection of the favela representation in the souvenir with the reality of the portraited community; the characteristics of the local where these paintings are produced and the tourists' interactions with the artist. Our aim was to examine if and how the authentic experiences connected to authentic souvenirs helped stimulate truth-telling and bring entertainment, learning and a more real aesthetic fruition to tourists. We aimed to verify if the artist's favela souvenirs also carried the specific memories of Santa Teresa's poorest communities, different from those connected to "generic souvenirs", and offered greater visibility to the cultural production of marginalized social groups, which fuels potentially transformative views about the favelas.

4. Results

In Freire-Medeiros & Menezes (2016) work about the souvenir trade in Rocinha, there is a picture of a favela artist, with the caption "Rocinha's resident *stages* the painting of a canvas to attract the attention of tourists who pass through Street 1" (emphasis added). The favela artist has a brush in his hand and seems – or simulates – putting the finishing touches on a canvas, practically finished, that represents the favela on the side of a hill, with the starry sky. The naïf strand painting draws attention, because it represents the favela with colourful houses, covered with a clay tile of the colonial type, while Rocinha today is a cluster of small buildings and brick houses with no plastering, which have cemented slab roof. Another important

aspect is the large dimensions of the painting, unlike all the others displayed for sale, which are generally very small.

At the craft fairs aimed at tourists in the neighbourhoods of Copacabana and Ipanema (some of the most expensive locations in the city), it was not possible to find any artist painting in these sites, but several exhibiting paintings from favelas with different languages were found. Some were more abstract or figurative, naïf or realistic, with or without landscapes in the background. Some artists show their own characteristics, while some mix the elements others do. Anyway, the works are repetitive, within the portfolio of each artist. For each "model" presented, some variations are offered, mainly in format.

The canvases of the Santa Teresa's male artist considered in this research, from an aesthetic point of view, are less naive, colourful and cheerful when compared to canvases sold in other favelas and craft fairs. Regarding the aesthetics elements of his production, the drawings have more depth, less precise and delineated contours and apparent and dramatic strokes due to the contrast of warm with many dark colours. Some canvases even exacerbate real aesthetic characteristics, such as the profusion of electric wires in Rio de Janeiro's hills. However, when the connection of the favela representation in the souvenir with the reality of the portraited community is considered, some of his canvases repeat elements of the imaginary representation of favelas, such as the small houses with tile roofs. The representation of an "imaginary favela" is reinforced by the artist's own speech when he justifies – and romanticizes – the choice of his work theme:

> They don't really have any kind of architecture. The guy makes a house one on top of the other, and they don't fall. Then, one paints one house green, the other yellow, the other red, and it turns into a beautiful scene. I really like painting favelas; I like the chaos, the confusion, the disorder. There is a poetry in the painting that I like.

Regarding the characteristics of the local where these paintings are produced and the tourists' interactions with the artist, our main aim was to verify whether the artist could be found painting in the gallery or he was only "staging". The artist's gallery could be easily found in Santa Teresa. In the place, his work is exposed, as well as other artists' paintings. However, he also transformed the gallery into his studio and develops his activities between painting and talking to customers. We went twice to the Santa Teresa gallery and found the artist wearing an apron excessively dirty with paint – almost as if it were an abstract painting – in front of a painting that was practically finished, giving a brushstroke and sometimes chatting with visitors. The possible staging of the painting – which reminds us of Helen of Troy's tapestry (the one that never ended) – is reinforced by some speeches by the artist himself:

> I work calmly. I don't feel rushed to finish a painting. I have clients that receive their work five months later! I don't paint because I already received the money and must deliver it quickly. On the contrary, I work on the painting in my time, I put in my love, my feelings. When the clients receive it, they are happy because I paint with love.

In the internet, the gallery is closely linked to tourism websites, networks such as Instagram and

platforms such as Airbnb, especially in searches related to tourist attractions in the Santa Teresa neighbourhood. In most articles and posts, there are pictures of him painting a canvas of a favela, which is practically done.

5. Discussion and analysis

Tourists generally want local products, whether they are relatively craft and artisanal, such as wine, olive oil, cheese and chocolate; or industrial, such as Havaianas sandals in Brazil. When small communities are considered, however, there is a clear expectation for handmade products. This is the case of favelas, although they are within the metropolis. Nevertheless, in general, what the communities of Rio de Janeiro offer as "handmade" souvenirs is quite standardized and repetitive. Miniature favelas made from recycled paper and paintings on canvas are common, but always very similar to each other. It is not necessary to go to the favela to take a favela souvenir home. As these communities became a symbol of Rio de Janeiro, their iconographic representation – more related to the collective imagination than to contemporary reality – is in all types of handmade or industrial artifacts, at different souvenir outlets, inside or outside the communities. In these places, it is also possible to find small canvases, supposedly by artists from the communities.

In the work of the Santa Teresa's artist considered in this research, it is possible to identify the idea of a "tourist favela", an aesthetic construction which has become a product to be sold and grown rapidly in Brazil in the last decades (Luna, 2010). It resembles the argument developed by Boorstin (1992), which indicates that life is full of inauthentic experiences – "pseudo-events" – that transform cultural manifestations into the repetition of facts, including tourism. The taste for inauthenticity appears in comparison with everyday life, which seems to be as forged as the attractions that entertain it.

When the connection of the favela representation in the souvenir with the reality of the portraited community, the characteristics of the local where these paintings are produced and the tourists' interactions with the artist are taken into account in the analysis of the work of the artist considered in this research, it is possible to identify elements of what MacCannell (1976) calls "staged authenticity": although tourists may travel in the search of reality and the authenticity of the visited places – having this search as the main motivation to find the true essence of the local culture –, this authenticity can even be a performance. In tourism, the façade would be the place presented to visitors and, behind the scenes, the place where what will be offered and shown on the façade is prepared. The tourists usually circulate through façades, which are spaces built especially for them. The same can be said about most favela souvenirs, including the ones produced by the artist considered in this research.

However, when the aesthetics elements of his production are considered, his work has differences from some typical favela souvenirs, which may stimulate a more precise perception of the favelas and contrast with a preconceived idea of an "imaginary favela" in his treatment of Santa Teresa's poorest communities. His work has elements of the "objective authenticity" of souvenirs (Wang, 2009), which carry the memories of the population who lives in the favela and scape from the stereotyped perception of Rio de Janeiro's traditional tourist destinations. The cultural production of marginalized social groups may also stimulate potentially transformative views and bring about the discussion on the lives of those who live in

these areas.

6. Conclusion

In times of post-Fordist consumption, the old packaged and standardized tourism is replaced by segmented, flexible and commercialized tourism, having as one of its characteristics the importance given to "fun, pleasure and imitation". The spectacle and exhibition helped to produce the generalization of the "tourist gaze". Satisfaction comes from the expectation and the pursuit of pleasure (Urry, 1990). Tourism is a product of socio-cultural development: the invention of unique places and practices, which is common in elitist tourism, is now copied and no longer unique (Boyer, 2003). This is the case of the favelas in Rio de Janeiro.

The article shows that the commercialization of souvenirs – which are more than gifts, signs or remainders – may create moments of interaction between artisans and tourists, as Freire-Medeiros (2013) argues. It may also generate income and jobs not only for craft workers, but indirectly for tourist guides, food services and other creative sectors connected to the favela tourism. The work of the artist considered in this research brings elements of "objective authenticity", but he does not escape from some forms of standardization in his pictorial production and the tourists' visits to his studio. The authentic experiences connected to authentic souvenirs may replace storytelling for truth-telling and bring entertainment, learning and a more real aesthetic fruition, but it is not completely achieved by the work of the considered artist and other artisans. More authentic favela souvenirs could tell more about the memories of the Rio de Janeiro's periphery, which is sometimes forgotten in tourist images and "generic souvenirs" of traditional tourist destinations and experiences in the city.

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Seed cassava cuttings production: alternative use of growing substrates

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ABSTRACT

This experiment was realized to improve the rapid propagation technique in different substrates applied to cassava crops in order to multiply traditional genotypes based on selected characteristics. The first stage the study was carried out in September 2016 in open air beds covered with transparent plastic. Four traditional cassava genotypes and one cassava cultivar (Fepagro RS13) were tested. Measurements of air and soil temperatures were carried out throughout the experiment until more than half of the planted manures were sprouted. Measurements stopped when most plantlets had sprouted. The second stage of the experiment was carried out in November 2016 (cutting in different substrates) when plants presented four fully expanded leaves. Shoots were cut and transplanted to individual containers with four different substrates (water, sand, soil and commercial substrate). After transplanting, seedlings were stored in greenhouse, under controlled temperature and irrigation. Leaves, stem and root dry and fresh masses,

and the size of the three longest roots per plant, were evaluated 40 days after the start of the experiment. Cultivars Fepagro RS13 and SJ13 stood out among the assessed varieties, because they presented good potential for rapid multiplication. Commercial substrates can be an alternative for rapid propagation.
***Keywords**: Manihot esculenta* Crantz; stem cutting; multiplication; substrate.

1. INTRODUCTION

Manihot esculenta Crantz is relevant for the world economy (Schons *et al*., 2009), since its tuberous roots have high carbohydrate and protein contents, which turn it into an option for animal feed (Machado *et al*., 2016). The species is widely cultivated in African and Latin American tropics as the main source of energy for millions of people (Gárcia-Segovia *et al*., 2016). According to Ribeiro *et al*. (2012). This plant adapts to different environments; however, its exposure to several biotic and abiotic stresses ~~that~~ can negatively influence its growth, development and yield.

The rapid propagation method developed by the International Center for Tropical Agriculture (CIAT) in Colombia is inexpensive and simple. The method can increase cassava multiplication rates up to 100 times (Silva *et al*., 2002). Seedlings presenting better physiological and sanitary quality show multiplication increase in the short-term, since stem cutting have two to three buds, whereas the traditional cultivation have approximately seven buds. Different from traditional multiplication in the field, which generates at most four stems, sprouting buds subjected to rapid multiplication re-sprout, depending on the environmental propagation conditions.

The rooting substrate is a determining factor for seedling development, since it is the first nutrient source; therefore, some change in its composition can influence plant formation. Substrate works as structural support for plants, besides providing water and nutrients (Fermino *et al*., 2010). Substrate type, irrigation, proper fertilization and production management provide the conditions to generate high quality plants in the field (Costa *et al*., 2012). Seedlings presenting appropriate quality standards show favorable growth and competition conditions for environmental factors such as water, light and nutrients (Caron *et al*., 2010).

The aim of this study was to analyze the growth and development processes of four cassava accessions and Fepagro cultivars rescued in rural properties and through fast propagation technique adaptation using different substrates.

2. MATERIALS AND METHODS

The research started by rescuing cassava accessions in rural properties in Alto Jacuí Region, after the implementation of a Germoplasm bank. Two experiments (stage 1 and stage 2) were installed after the branches were collected in the Unicruz University germoplasm bank.

Stage 1 – The stage one was conducted in open masonry beds covered with a transparent plastic structure (protection tunnel against weather changes and insect visitations). Experimentation in masonry beds (tunnel) started on September 21, 2016. Eighty (80) stem cutting from 4 cassava accession tables (FV13, SJ 08, SJ10, XV04) and one cultivar (Fepagro RS13) were planted. The five treatments were composed of the four accessions and ~~one~~ cassava cultivar, planted in two beds, considered as two

replications and each replication consisted of 40 stems cutting. Segments containing only two buds were cut with manual saws, weighed and planted approximately 3 cm down the ground, spaced 20 cm from each other. The number of shoots and their relations with the weight of the stem cutting were evaluated at the end of the experiment.

Minimum and maximum daily air temperatures inside the tunnel were read with digital thermometer. Soil temperature was measured at 09:00 am, 12:00 pm and 03:00 pm, with digital thermometer installed 5cm down the ground, when 51% of planted cassavas had sprouted. The second stage of the research started after shoots reached height higher than 15 cm in order to perform the rooting phase, which corresponded to stage 2.

Stage 2 –The stage two was carried out on November 10, 2016 - 50 days after stage 1 was implemented. The experiment was conducted in greenhouse and followed a completely randomized design, based on 4 x 5 factorial arrangement. Factor "A" referred to four different treatments: 1) Substrate commercial Plantmax ®, 2) soil, 3) sand 4) water (control), and Factor "B" accession: 1) FV13, 2) SJ 08, 3) Fepagro RS13, 4) SJ10 and 5) XV04.

The sample counted on four cassava accessions and one cultivar, thus totaling 20 treatments, with 10 replications, each one composed of 1 (sprout) cutting. Shoots were cut with blade sterilized in alcohol. Forty (40) shoots from each accession were used in the experiments. These shoots were immediately placed in water to avoid losing sprouting turgescence. Subsequently, they were placed in seedling packages (dimension 15 x 20 x 0.10 cm) with 1 kg of substrate for rooting. Different substrates were used in the experiment. Samples were stored in greenhouse at 25ºC under controlled irrigation.

Weekly evaluations were performed throughout this period by analyzing cuttings' survival rates and the total number of leaves. It was done in order to seek knowledge about the most appropriate substrates for shoot development. The final evaluation was carried out 40 days after the second stage was installed. It was done by assessing leaves, stem and root fresh and dry masses, as well as the size of the three longest roots per plant.

Data normality in all experiments was assessed through Komogorov-Smirnov test and variance homogeneity was calculated through Bartlett test. Data were subjected to Analysis of Variance, and the mean values of the characteristics evaluated in the cassava accessions were grouped by means of Scott Knott test, at 5% error probability, when "F" was significant.

3. RESULTS AND DISCUSSION

Stage 1

The accessions FV 13 and SJ 08 recorded the largest number of shoots, (1.1 and 1.0 shoots per plant, respectively). They were followed by Fepagro RS13 (0.71 shoots). The smallest number of shoots obtained for accessions SJ10 and XV04 (Table 1). With regard to stem cutting mass, FV13, XV04, Fepagro RS13 and SJ10 recorded the highest values (Table 1). Data in the present research evidence that stem cutting mass influences the number of shoots; therefore, accessions recording the highest masses were the ones presenting the best shoot emissions, which can be related to the greatest stem cutting reserve. Besides

the inherent characteristics of each genotype, the difference in the number of roots may be related to the vigor of the planted seed cassava cuttings associated with its origin and the capacity of root formation.

Table 1: Number of shoots and stem cutting mass (g) of different cassava accessions for seedling formation.

Accession/Cultivar	Features	
	Number of shoots**	Stem cutting mass (g)
FV13	1.12 a	17.00*a
SJ 08	1.00 a	17.00 a
Fepagro RS13	0.71 b	18.37 a
SJ10	0.42 c	16.75 a
XV04	0.29 c	9.87 b
CV (%)	16.00	17.82

* means not followed by the same lowercase letter in the columns differed from each other in the Scott Knott test at 5% probability level.

Differences were verified between the genetic materials used in relation to the weight of the stem cutting (Table 1), which may influence the development of the seedlings and it could compromise the production. It is noteworthy that there are no studies in the literature related to the production of cassava seedlings from stem cutting. Different results recorded for different cassava cultivars were also observed in other studies with other cultivars. Rós Golla *et al*. (2010) found differences to the number of leaves and root diameter of different cassava varieties. Silva *et al*. (2011) concluded that, overall, cultivars with larger stem diameters (25 to 30 mm) present the best performance.

The Figure 1 depicts the mean air and soil temperature during the experimental period. One-hundred forty-four (144) soil temperature and air temperature records were registered throughout the assessed period (from September 21, 2016 to October 10, 2016). Average soil temperature and average air temperature were 26.18 ºC and 23.60 ºC, respectively. According to Alves (2006), environmental factors such as temperature and photoperiod affect cassava growth and development. Air temperature affects sprout budding, formation, size and the useful life of plant leaves. Plant growth benefits from mean annual temperature variation from 25 ºC to 29 ºC and the plants have the ability to tolerate temperature variation from 16 ºC to 38 ºC.

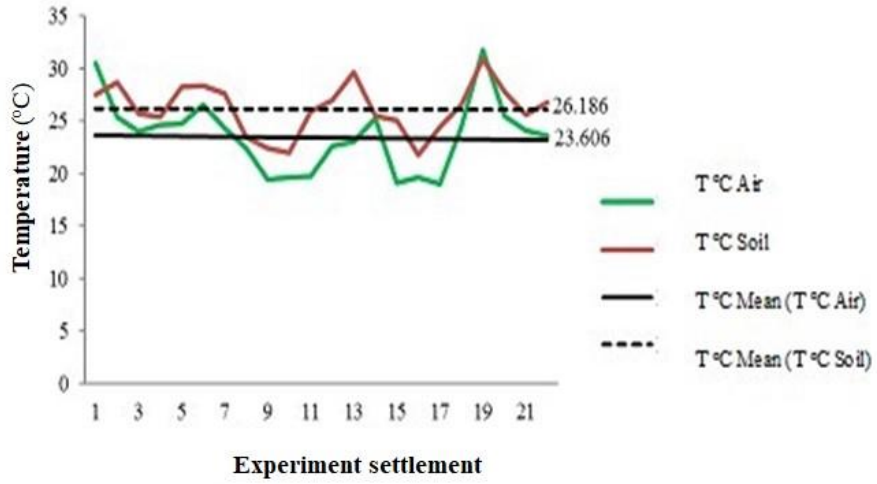

Figure 1: Air and soil temperature from 09/21/2016 to 10/12/2016 in the study site.

Results as shown in Figure 1 the average soil temperature was 26.1 °C during the experiment, and it is worth to note that our results comply with results recorded by El-Shakawy, (2004). According to these author', sprouting buds in stem cutting benefit from soil temperature from 28 to 30 °C. However, sprouting is interrupted at temperatures above 37 °C and below 17 °C.

Stage 2

For the plant height variable, no interaction between accession/cultivar and substrates was obtained. When the individual factors were analyzed, for plant height, accessions SJ08 and cultivar Fepagro RS13 showed the greatest values for plant heights. Regarding cultivations, water was superior to the other treatments, showing a height of 11.32 cm (Table 2). Water can be a good alternative for rooting of cassava seedlings.

Table 2. Plant height (cm) in different system of cultivate with cassava accessions.

Plant height (cm)			
Accession/Cultivar		Cultivation	
SJ08	10.40 a*	Water	11.32 a
FepagroRS13	9.60 a	Sand	8.16 b
FV13	8.35 b	Substrate	8.00 b
XV04	7.95 b	Soil	7.84 b
SJ10	7.85 b		
CV (%)		16.21	

* means not followed by the same lowercase letter in the columns differed from each other in the Scott Knott test at 5% probability level.

In relation to cultivar x substrate, accessions FV13, SJ08 and cultivar Fepagro RS13 had the highest survival rate in water. In all the other substrates, all accessions had excellent performance, with no significant differences among them (Table 3). The variable number of leaves showed interaction between accessions/cultivar and substrates. For cultivar Fepagro RS13, the largest number of leaves was observed in the commercial substrate, sand and water crops, which were superior to the soil. For the FV13 accession, the best result was obtained in the sand, followed by commercial substrate and soil, all of them superior to water. For accession SJ10, the soil and commercial substrate were superior to water and sand. For SJ08 accession, the best results were obtained for cultivation in water and commercial substrate, which were superior to sand and soil, and for accession XV04, the water was superior followed by substrate. The lowest results were found in sand and soil (Table 3).

Table 3: Survival (%), number of leaves, plant height, length of the three largest ~~h~~accession roots / cassava cultivar in different culture media.

Survival (%)				
		Cultivation		
Accession/Cultivar	Water	Sand	Soil	Substrate
Fepagro RS13	100 aA*	100 aA	100 aA	100 aA
FV13	100 aA	100 aA	100 aA	100 aA
SJ10	60 cB	100 aA	100 aA	100 aA
SJ08	100 aA	100 aA	90 aA	100 aA
XV04	80 bB	100 aA	90 aB	100 aA
CV (%)		17.33		
Number of leaves				
		Cultivation		
Accession/Cultivar	Water	Sand	Soil	Substrate
Fepagro RS13	7.00 cA	7.20 bA	6.00 bB	7.20 bA
FV13	6.00 dC	7.80 aA	6.80 aB	7.00 bB
SJ10	6.00 dB	6.00 cB	7.00 aA	7.20 bA
SJ08	8.00 aA	7.00 bB	6.80 aB	7.80 aA
XV04	7.60 bA	6.00 cC	6.00 bC	7.00 bB
CV (%)		4.24		
Plant height (cm)				
		Cultivation		
Accession/Cultivar	Water	Sand	Soil	Substrate
Fepagro RS13	11.30 aA	13.20 aA	13.00 aA	12.00 aA
FV13	9.00 aB	9.90 bB	11.80 aA	13.50 aA
SJ10	5.00 cC	9.00 bB	11.60 aB	14.70 aA
SJ08	12.50 aA	12.80 aA	13.60 aA	14.90 aA

XV04	7.10 bB	8.90 bB	9.40 aB	12.90 aA
CV (%)		17.05		

Mean length of the three longest roots (cm)

	Cultivation			
Accession/Cultivar	Water	Sand	Soil	Substrate
Fepagro RS13	3.70 bB	14.30 aA	12.50 aA	17.10 Aa
FV13	2.80 bC	9.30 bB	10.40 aB	14.90 aA
SJ10	2.60 bB	10.30 bA	13.10 aA	14.50 aA
SJ08	5.90 aC	10.90 bB	10.00 aB	16.00 aA
XV04	3.40 bC	9.40 bA	7.20 bB	12.40 aA
CV (%)		19.04		

* Means followed by the same lowercase letter in the columns and uppercase in the row do not differ from each other by the Scott-Knott test at 5%.

The comparison between number of leaves in each substrate evidenced that accession SJ08 recorded the best results in water, which was followed by XV04, Fepagro RS13 - the worst results were recorded for accessions FV13 and SJ10. The largest number of leaves was recorded for accession FV13 in sand, which was followed by cultivar Fepagro RS13 and accession SJ08 - the lowest values obtained for SJ10 and XV04. FV13, SJ10 and SJ08 had better results than Fepagro RS13 and XV04 in soil. Accession SJ08 showed larger number of leaves than other varieties in commercial substrate (Table 3).

The highest plant-height values obtained in commercial substrate. All culture media behaved similarly for cultivar Fepagro RS13 and accession SJ08, did not significantly differ from each other. Commercial substrate and soil were the best substrates for accession FV13, which were followed by sand and water. The commercial substrate was better for accession XV04 than the other ones (Table 3).

For the variable mean length of the three longest roots, the commercial substrate was the best treatment. The data are similar to those obtained for plant height. Comercial substrate, soil and sand were superior to water in cultivar Fepagro RS13 and in the SJ10 accession. For FV13 and SJ08, commercial substrate and soil were superior to sand and the lowest values were obtained for water. For accession XV04, commercial substrate and sand were the best treatments followed by soil. However, the lowest values were obtained in water.

Viana *et al*. (2001) conducted a study under field conditions and they found that the stem cutting size effect on the number of shoots per plant is linear. High stem cutting mass can be associated with longer stem cutting length; therefore, heavier stem cutting stem cutting tend to produce a larger number of shoots corroborating with Rós-Golla *et al*. (2010) that observed different plant height in the same cassava cultivar; overall, greater diameters generate larger plants.

For fresh mass of cassava roots, it was observed that the commercial substrate showed the highest values (Table 4). Regarding root dry mass, the highest values for all accessions were also obtained in

commercial substrate cultivation, and the lowest values were found in water. Based on the results of this study, it can be inferred that in the methodology proposed by Silva *et al.* (2002), who developed the method of rapid propagation, the authors describe that this method allows an increase of up to 100 times in multiplication rate of cassava using water for the rooting process and that after rooting, the seedling should be placed in the commercial substrate. The results obtained in this work allows to observed that it is evident that the process of passage through water is unnecessary since the seedling can be passed directly to the commercial substrate, already that it shows a high cost in in time and labor.

Table 4: Fresh and dry mass (g) of cassava accessions / cultivars in different culture media.

Accession/Cultivar	Root fresh mass (g) Cultivation			
	Water	Sand	Soil	Substrate
Fepagro RS13	1.00 aC	3.50 aB	3.10 aB	5.10 aA
FV13	1.50 aD	4.10 aB	3.20 aC	6.70 aA
SJ10	0.90 aC	3.40 aB	3.50 aB	6.30 aA
SJ08	2.00 aC	4.30 aB	3.30 aB	7.90 aA
XV04	1.60 aA	1.60 bA	1.30 bA	2.40 bA
CV (%)		23.69		
Accesso/Cultivar	Root dry mass (g) Cultivation			
	Water	Sand	Soil	Substrate
Fepagro RS13	0.00 aB	0.40 aA	0.50 aA	0.60 bA
FV13	0.00 aB	0.60 aA	0.60 aA	0.90 aA
SJ10	0.00 aC	0.40 aB	0.60 aA	0.90 aA
SJ08	0.00 aC	0.50 aB	0.40 aB	1.30 aA
XV04	0.00 aA	0.00 bA	0.20 aA	0.10 cA
CV (%)		22.69		

* means not followed by the same lowercase letters in the columns and by the same uppercase letters on the lines differed from each other in the Scott Knott test at 5% probability level.

The Table 5 shows no accession/cultivar and substrate and, accession/cultivar substrate interactions in leaf fresh and dry masses - accession XV04 presented the lowest leaf fresh and dry mass. Growth was higher in commercial substrate, sand and soil than in water. The total fresh mass of all accessions and cultivar Fepagro RS13 were higher than that recorded for accession XV04; its cultivation in commercial substrate stood out, since it recorded better results than all other (Table 6). Fepagro RS13, FV13, SJ08 recorded higher total dry mass than SJ10 and XV04; the commercial substrate was better than sand and soil in these cultures. SJ10 and XV04did not significantly differ from each other.

Table 5: Fresh and dry mass (g) of cassava accessions / cultivars in different culture media.

Leaf fresh mass (g)			
Cultivar		Cultivation	
Fepagro RS13	2.57* a	Substrate	2.86 a
FV13	2.40 a	Sand	2.50 a
SJ10	2.40 a	Soil	2.64 a
SJ08	2.85 a	Water	1.60 b
XV04	1.77 b		
CV (%)		24.22	
Leaf dry mass (g)			
Cultivar		Cultivation	
Fepagro RS13	0.77 a	Substrate	0.80 a
FV13	0.75 a	Sand	0.70 a
SJ10	0.57 b	Soil	0.72 a
SJ08	0.82 a	Water	0.44 b
XV04	0.40 b		
CV (%)		24.75	

* means not followed by the same letter differed from each other in the Scott Knott test at 5% probability level.

Table 6: Fresh and total dry mass (g) of cassava accessions / cultivars in different culture media.

Total fresh mass (g)			
Cultivar		Cultivation	
Fepagro RS13	7.30 a	Substrate	10.26 a
FV13	7.40 a	Sand	7.04 b
SJ10	7.10 a	Soil	6.86 b
SJ08	8.60 a	Water	3.62 c
XV04	4.32 b		
CV (%)		25.61	
Total dry mass (g)			
Cultivar		Cultivation	
Fepagro RS13	1.62 a	Substrate	1.98 a
FV13	1.55 a	Sand	1.56 b
SJ10	1.40 b	Soil	1.58 b
SJ08	1.82 a	Water	0.80 c
XV04	1.00 b		
CV (%)		23.04	

* means not followed by the same letter differed from each other in the Scott Knott test at 5% probability level.

Stem fresh mass of accessions FV13, SJ10 and SJ08, and cultivar Fejagro RS13 was higher than the values obtained for accession XV04 grown in commercial substrate, which were followed by results observed in sand and (Table 7). There was no stem dry mass difference between stratum accessions, all results were better than values observed in water.

Table 7: Fresh and dry mass (g) of cassava accession / cultivar stem in different culture media.

Stem fresh mass (g)			
Cultivar		Cultivation	
Fepagro RS13	1.50 a	Substrate	1.72 a
FV13	1.22 a	Sand	1.22 b
SJ10	1.22 a	Soil	1.40 b
SJ08	1.47 a	Water	0.70 c
XV04	0.87 b		
CV (%)		24.60	
		Stem dry mass (g)	
Cultivar		Cultivation	
Fepagro RS13	0.22^{ns}	Substrate	0.26 a
FV13	0.05	Sand	0.18 a
SJ10	0.22	Soil	0.22 a
SJ08	0.27	Water	0.06 b
XV04	0.12		
CV (%)		24.11	

* means not followed by the same letter differed from each other in the Scott Knott test at 5% probability level.

The highest root/shoot ratio values obtained for SJ08 and XV04, which were followed by SJ10, FV13 and Fepagro RS13. Water and soil were the best culture media, but they were followed by sand and substrate (Table 8). There was no statistical difference in leaf area between accessions, since substrate, sand and soil were better than water in the crops.

Table 7: Root / shoot ratio and leaf area of cassava accessions / cultivars in different culture media.

Root / shoot ratio/(g)			
Cultivar		Cultivation	
FepagroEPAGRO RS13	2.60 b	Substrate	1.75 b
FV13	2.35 b	Sand	2.18 b
SJ10	2.00 b	Soil	3.02 a
SJ08	2.87 a	Water	3.62 a
XV04	3.35 a		
CV (%)		25.57	
		Leaf area cm^2	
Cultivar		Cultivation	

Fepagro RS13	139.42 a	Substrate	142.93 a
FV13	133.08 a	Sand	124.47 a
SJ10	139.75 a	Soil	140.47 a
SJ08	125.58 a	Water	96.00 b
XV04	92.00 a		
CV (%)		28.70	

* means not followed by the same letter differed from each other in the Scott Knott test at 5% probability level.

Seed cassava cuttings remained in greenhouse under intermittent misting, which had positive influence on their development. This outcome corroborated the results recorded by Fachinello *et al*. (1994), who state that intermittent nebulization provides lower moisture reduction due to water-film formation on the leaves and to temperature decrease. Seed cassava cuttings were stored under the aforementioned conditions, which proved to favor seedling development.

S and density (Kämpf, 2000) favors cuttings' support, which is an important characteristic of substrates used for rooting, the same author recommends that extremely porous substrates for the propagation of cuttings presenting low water retention ability. Oliveira *et al*. (2001) recommend avoiding excessive moisture in substrates favoring the emergence of fungal diseases that affect cuttings' rooting. Accordingly, it can be inferred that cuttings laid in sand are more stable; the high drainage ability of this substrate provides better conditions for mini-ixora rooting (Ixora coccinea 'Compacta') under the herein assessed experimental conditions. Similar results were recorded for cassava, because sand recorded good results for some of the assessed variables.

According to Garay *et al*. (2014), there is no ideal substrate, the choice for a good material depends on crop features and on purchasing costs; therefore, it is necessary testing different substrates or substrate mixtures for each species.

4. CONCLUSIONS

The present results validate the potential of rapid cassava multiplication strategy in comparison to the conventional multiplication technique. Cultivar Fepagro RS13 and accession SJ13 stood out among other varieties, because they have good potential for rapid multiplication; therefore, they can be used by farmers who aim at producing stem cutting

The commercial substrate can be an alternative for rapid cassava propagation.

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Social-cultural and educational practices: is the university prepared for the social question of aging?

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Abstract

We are living a period of demographic increase in the elderly population in Brazil and worldwide. Among the main causes are the decrease in infant and elderly mortality due to medical scientific achievements. This makes society and families increasingly live in their family and institutional spaces with older people.

Situations such as the large concentration of people in urban centers, the liquid, individualistic, hedonistic and presentist society reflect as characteristics for the life of the elderly population, which wants to take advantage of the opportunities that life can provide, living in spaces public with different generations. In this sense, we understand that population aging has become a pressing social issue, which institutions such as the University, for example, have an obligation to account, especially in the sense of reflection, research in the area and opportunities for training / qualification for both the elderly as for the professionals who will work with this audience.

Keywords: Aging; Education; Socio Cultural Practices;

1. Introduction

We are living a period of intense demographic increase of the elderly population in Brazil and in the world, being able to affirm that we are experiencing a process of super aging. Among the main causes are the decrease in infant mortality and mortality of the elderly themselves due to medical scientific achievements, which generates a considerable increase in life expectancy.

This is therefore "One of the greatest cultural achievements of a people in their humanization process" (BRASIL, 2019, pp. 1), which reflects the improvement of living conditions. Data are projected in relation to the doubling aging in the coming years of this population, reaching almost two million elderly people. In 2017, we already had 30.2 million elderly people in Brazil and it is projected to reach around 28.3 million by 2020, and in this scenario there is a special highlight to the feminization of old age.

This makes society and families increasingly live in their family and institutional spaces with older people. Situations such as the large concentration of people in urban centers, the liquid, individualistic, hedonistic and presentist society reflect as characteristics for the life of the elderly population, which wants to enjoy the opportunities that life can provide, living the life in public spaces and private, with different generations.

In this sense, we understand that population aging has become a pressing social issue, which institutions such as the University, for example, have an obligation to account, especially in the sense of reflection, research in the area and opportunities for training / qualification for both the elderly as for the professionals who will work with this audience. Therefore, the objective of this research is to discuss the socio-cultural and educational practices in the context of contemporary aging, and to reflect through the intergenerational actions developed at the University of Cruz Alta/RS, Brazil.

2. Methodology

The research is characterized as a reflection sustained through bibliographic review, linked in the discipline of Citizenship and Social Insertion for the Elderly from the Postgraduate Program in Sociocultural Practices and Social Development of the University of Cruz Alta - UNICRUZ and the Interdisciplinary Group of Human Aging Studies - GIEEH.

For the theoretical basis of this article were used the authors: Camarano (2014), Bauman (1999), Lipovetsky (2004), Cachioni and Todaro (2016), among others.

3. Results and discussions

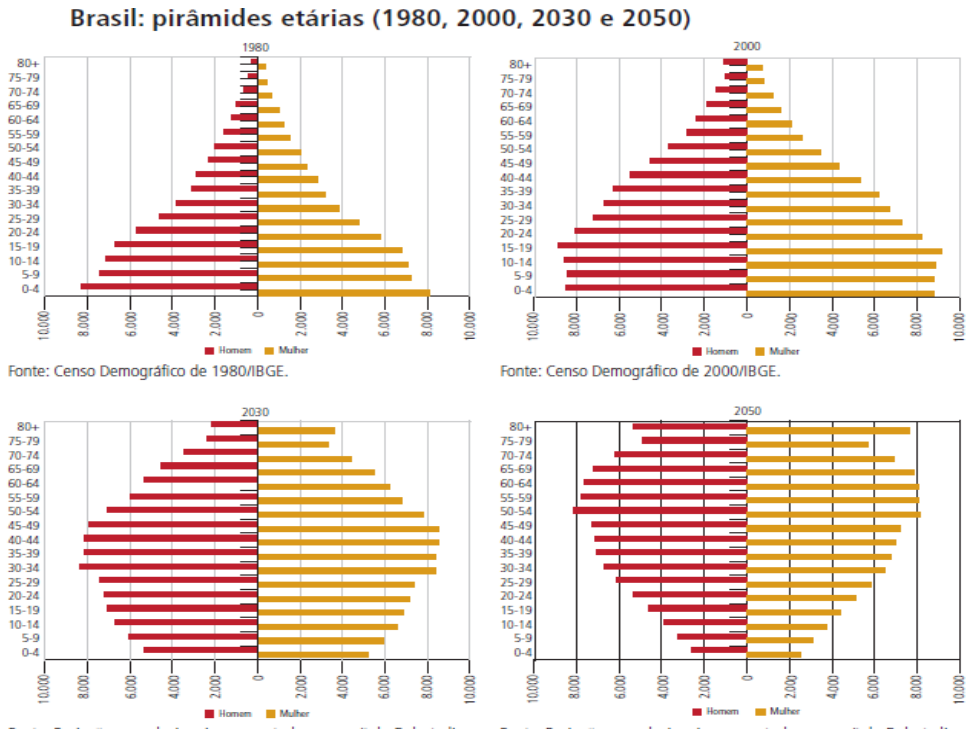
3.1 Challenges of Contemporary Aging

As we saw earlier, the accelerated aging process of the Brazilian population is a reality. As explained by Camarano (2014, pp. 15):

" […] Life expectancy at birth, an indicator of the average duration of life, increased by 27 years and can be considered one of the greatest social achievements of the second half of the 20th century. Today, a Brazilian lives an average of 75.2 years, and it is recognized that there is still a lot of room for new gains in this indicator. These two processes occurred in a short period of time and, simultaneously, in almost all developing countries".

In order to prove these demographic issues, Camarano (2014) presents a compilation of age pyramids from 1980 and 2000 and a prediction of the age pyramid from 2030 and 2050, based on the demographic predictions of the human aging process in Brazil.

Figure 1- Brazil: age pyramids (1980, 2000, 2030, 2050)



Source: CAMARANO, 2014.

With that, it is highlighted that the contemporary population growth occurred basically for three events: demographic transition, migratory processes and the phenomenon of presentism.

In the period from 1940 to 2010 there was a population increase motivated by expressive migratory movements in Brazil, also, this period there was a decrease in fertility and an increase in life expectancy, impacting on the significant expansion of the elderly population in the urban environment, characterizing contemporaneity as a she was over-aged (CAMARANO, 2014).

In this sense, Bauman's liquid modernity (2001) starts from the principle of the transition from heavy and solid modernity to light and fluid modernity. "[...] Fluids, so to speak, do not fix space or arrest time. While solids, they have clear spatial dimensions, but they neutralize the impact and, therefore, diminish the significance of time (BAUMAN, 2001, pp.08). The author also points out "[...] Fluids are not very attached

in any way and are constantly ready to change it (BAUMAN, 2001, pp.08).

With the transition from modernity described by Bauman (2001) and the contemporary demographic transition, the characteristics of society are modified through globalization and presentism. The phenomenon of presentism refers to living in today, that is, living in the present, and not the 'after' (future). Lipovetsky (2004, pp. 59) points out that "[...] This is the phenomenon that changed us: it is with the revolution of everyday life, with the deep convulsions in the aspirations and in the ways of life stimulated by the last half century, that the consecration of the present ".

With these assumptions, it can be considered that contemporary society is constantly changing and at an accelerated pace, mainly with demographic growth, expansion of urbanization and increased longevity. The fact is that we need to face and adapt to this population rhythm through proposals/implementation of public policies for this Brazilian reality.

3.2 Sociocultural and educational practices of aging: A social problem

With the increase in longevity and the contemporary population dynamics, basic assumptions about this stage of the human cycle stand out, such as ensuring active and healthy aging with quality of life.

Thus, this concern is highlighted in Brazilian policies aimed at the elderly in various contexts and segments of society: Liberty, Respect and Dignity; Education, Culture, Sports and Leisure; Cheers; Social Security and Assistance; Home; Transport. In the education segment, the Ministry of Education released the following report:

EDUCATION POLICY FOR THE ELDERLY

Ministry of education

In Brazil, the proportion of people aged 60 or over in the total population in 2009 is 11.3%, but in the population with up to 7 years of schooling, this proportion is approximately 30%, which represents a low level of education in this group in relation to the other age groups. This proportion of elderly people increased by about 30% in the population with 0 to 3 years of schooling between 2001 and 2009 and approximately 50% in the population with 4 to 7 years of schooling. The increase in the proportion of people in these lower schooling categories occurred because in that period there was an increase in the level of education in the younger age groups, which meant that they started to represent a higher proportion in these categories. In addition, the proportion of elderly people among the most educated has increased mainly in the Southeast region, due to the increase in life expectancy.

Source: Ministério da Educação, 2012.

The National Policy for the Elderly, under law No. 8,842, of January 4, 1994 provides in the area of education:

a) to adapt curricula, methodologies and didactic material to educational programs for the elderly;

b) insert in the minimum curricula, at the different levels of formal education, content aimed at the aging process, in order to eliminate prejudices and produce knowledge on the subject;

c) include Gerontology and Geriatrics as curricular subjects in higher education courses;

d) develop educational programs, especially in the media, in order to inform the population about the aging process;

e) develop programs that adopt distance learning modalities, appropriate to the conditions of the elderly;

f) support the creation of an open university for the elderly, as a means of universalizing access to different forms of knowledge; (BRASIL, 1994, pp.01)

The Statute of the Elderly states in Art. 22 that: “[...] In the minimum curricula of the various levels of formal education, content aimed at the aging process will be inserted, [...] in order to eliminate prejudice and produce knowledge about the matter ”(BRASIL, 2003, pp. 01).

In view of this, Senate Bill nº. 501/2015 (Authored by Senator Omar Aziz- PSD / AM, Brazil), establishes that the theme of aging must be based on the curriculum of basic education, involving the essential care of aging and respect for the elderly, being taught by trained and qualified professionals, in gerontology, thus changing the Law of Directives and Bases of National Education (SENADO FEDERAL, 2015).

However, this population dynamics increasingly reflects the coexistence of young and old. In the labor market, Camarano (2004, pp.11) points out that "[...] It is common in Brazil for the retiree to continue in the labor market". Thus, with this (re) insertion of the elderly in the labor market, a period of new and / or old discoveries begins that motivates this elderly person to learn, to qualify, either with a technical course or continuing with his studies (teaching elementary and high school), as well as with a higher education.

Thus, through qualification programs, undergraduate and / or graduate courses at universities, we experience intergenerational coexistence (different generations). “All people live with people of the same and different ages [...]. But for each one the same time is different time [...] (MOTTA, 2010, pp.230 apud MANNHEIM 1928, pp.124)

Thus, Cachioni and Todaro (2016, pp. 176) emphasize that "[...] In Brazil, permanent education, in the context of aging, is found in the learning spaces for formal and non-formal education". Still, the authors state that youth and adult education - EJA is a formal modality in the educational context and may be “[...] aimed at illiterate people or those with little schooling, it serves the elderly, but it cannot be considered as a program educational program exclusively for this segment ”(CACHIONI; TODARO, 2016, pp. 176).

In view of this, Cachioni and Todaro (2016, pp. 181) highlight the concept of non-formal education as "[...] a set of activities or programs organized outside the regular education system". Non-formal education is related to educational activities linked to higher education institutions (private) for the elderly population, being called Open Universities for the Elderly (UnATIs) (CACHIONI; TODARO, 2016).

And that the main objective of UnATIs "[...] is not to certify or professionalize elderly students, but rather to open to them the world of knowledge and the possibility of learning throughout their lives" (CACHIONI ; TODARO, 2016, pp. 181).

Regarding education to the elderly, whether formal or informal, we contemplate that it is a fundamental right and that this social / educational inclusion of this elderly population guarantees equality and dignity in contemporary society.

3.3 Intergenerational possibilities and perspectives at the University of Cruz Alta - UNICRUZ

The University of Cruz Alta is a community HEI with the mission of “[...] producing and socializing knowledge qualified by a solid scientific, technological and humanistic base, capable of contributing to the formation of critical, ethical, solidary and committed citizens. sustainable development ”(UNICRUZ, 2018,

pp. 23).

With this in mind and the emerging assumptions about contemporary aging, the Interdisciplinary Group on Human Aging Studies (GIEEH) was created in 2002, with the aim of researching and reflecting on various themes associated with human aging. Currently, the group has more than 40 researchers, including doctors, masters and academics from UNICRUZ's Undergraduate and Graduate Studies. The GIEEH presents three lines of research: Culture, health and lifestyles, Health status and Physical-Functional changes in Aging and Public policies, social practices and elderly populations.

It should be noted that UNICRUZ has acted in a participatory and effective way, since 1999, with the implementation of the Municipal Council for the Elderly in the municipality of Cruz Alta-RS (Brazil), contributing to issues related to aging and public policies. There is also the insertion of GIEEH professors / researchers in the State and National Council for the Elderly, participating in conferences and debates on the theme.

An example of this refers to the Rio Grande do Sul (Brazil) Forum of the HEIs that takes place each year, with an HEI being chosen to host the annual event. Thus, this event is aimed at discussions of actions aimed at human aging and its challenges. Highlighting the following themes and editions:

At the II Rio Grande do Sul Forum of the HEIs in 2002, it was discussed "The professional training of students in matters of aging". The third edition of the event (2004) discussed the "Statute for the Elderly and the IES of RS: challenges and commitments". In the fourth edition (2006), it was highlighted "The elderly in IES / RS: realities and perspectives". Thus, this event contributes through debates and reflections on the aging process and the HEIs commitment to the elderly population.

In this sense, in 2008 the UNATI / UNICRUZ project was created, which "[...] offers activities through workshops such as water aerobics, walking, nutritional and nursing guidelines, dance, plastic arts and digital inclusion" (GARCES, 2013, pp.20). Thus, Garces et al. (2016, pp.49) emphasize:

"[…]The Unati project, from the University of Cruz Alta, aims to serve independent elderly people who participate in other projects and programs of the institution, as well as organized groups in the city of Cruz Alta, such as the elderly who attend the Elderly Reference Center of Cruz Alta City Hall and the Sesc elderly group. It seeks to provide opportunities for the elderly to participate in activities linked to the University, allowing elderly people access to a differentiated space. Therefore, it proposes to the elderly citizen the incentive to find other forms of social (re) insertion and valorization of their life experience" (GARCES et al., 2016, pp. 49).

The UNATI / UNICRUZ provides a set of interdisciplinary actions aimed at promoting and preventing health in order to improve the quality of life of the elderly population. Also, activities are developed in some health units and in a Long Term Care Institution for the elderly (LTCF) in the municipality of Cruz Alta-RS.

Concerned with this rapid demographic growth, UNICRUZ establishes specific areas of human aging in the curricula of undergraduate courses and graduate courses (PPG). In the PPG in Sociocultural Practices and Social Development it is offered as an optional curricular subject: "Citizenship and Social Insertion for Elderly Populations". The objectives of this curricular subject are: To understand the aging process as part of the life cycle and as a social issue interwoven in contemporary society; Identify practices for the social insertion of this population in actions that prioritize their recognition, dignity and protagonism as a subject

that builds their citizenship from the area of performance of each master's student; Enable the construction of interdisciplinary projects that show social practices focused on citizenship with respect to Human Rights and citizenship.

In addition, on October 10, 2019, in room 101 and in the corridor of Building 7 of UNICRUZ, there was the “First exhibition on old age: With maturity you become younger”, with a total of 46 event participants, coming from the curricular subject of Citizenship and Social Insertion for Elderly Populations and supported by GIEEH.

Thus, the activities carried out at the 1st Mostra on Old Age were:

• Exhibition of photos of the elderly (personal photos sent by UNICRUZ undergraduate and graduate students and teachers); photos of research and extension projects linked to the issues of aging (Cinoterapia-Therapy with the dog, Universidade Aberta da Terceira Idade - UNATI / UNICRUZ).

• Exhibition of paintings and artistic canvases from UNATI / UNICRUZ- Momentos de Artes.

• Exhibition in Varrais: Artistic drawings, culinary recipes, homeopathic recipes, poetry, phrases and excerpts from literary works.

• Exhibition of manual arts (knitting, crochet)

• Video exhibition created specifically for this event.

Some photos of the event:

Figure 1. event organizers and collaborators 2019.

Figure 2. Event collaborators.

Source: authors' personal files.

Finally, it is noteworthy that holding academic events directed to the demographic reality (aging) collaborates with the (re) knowledge of public policies existing to the elderly and mainly contributes to the effective exercise of citizenship.

4. Conclusion

The rapid demographic growth in Brazil and in the world, brought in contrast significant changes related to the characteristics of the population, such as the phenomenon of presentism, over-aging and liquid society. Thus, with the demographic transition and liquid / fluid society, aging becomes a pressing social issue, in which the population increasingly lives in public and private spaces with different generations, mainly in universities.

The (re) insertion of the elderly in the labor market reflects in their educational segment, whether formal or informal, through EJA, educational programs, such as UnATIs are fundamental for the social / educational inclusion of this elderly population, guaranteeing equality and dignity before the society.

Thus, it is concluded that aging is a mandatory theme to be discussed and implemented in the disciplines of undergraduate and graduate courses in universities, in which reflecting and researching the process of aging under different perspectives makes it possible to ensure more fully the principles respect, protection, dignity and well-being of the elderly guaranteed in the Federal Constitution of Brazil of 1988 (force in currently), Statute of the Elderly and National Policy for the Elderly.

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The Use of Learning Analytics Interactive Dashboards in Serious Games: A Review of the Literature

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Abstract

The learning analytics in serious games, corresponds to a subject in increasing demand in the educational field. In this context, there is a need to study how data visualizations found in the literature are adopted in learning analytics in serious games. This paper presents a Systematic Literature Review (SLR) on how the evolution of studies associated with the use of learning analytics interactive dashboards in serious games is processed, seeking to investigate the characteristics of using dashboards for viewing educational data. A bibliometric analysis was carried out in which 75 relevant studies were selected from the Scopus, Web of Science, and IEEExplore databases. From the data analysis, it was observed that in the current literature there is a reduced number of studies containing the main actors in the learning process, as follows: teachers/instructors, students/participants, game developers/designers, and managers/researchers. In the vast majority of investigated studies, data visualization algorithms are used, where the main focus takes into account only actors, such as teachers/instructors and students/participants.

Keywords: Learning analytics; serious games; data visualization; interactive dashboards

1. Introduction

With the breakthrough in digital technologies, the educational field has been seeking to update itself with regard to active teaching methodologies such as serious games (Chaudy & Connolly, 2019). Serious games prove to be very effective in the teaching-learning process and in retaining users, in addition to providing a wide variety of possibilities that can be difficult to obtain in a traditional classroom (Chaudy & Connolly, 2019).

Serious games make the learning process more fun, challenging and rewarding, making it possible for the user to be involved in the game and not notice that they are immersed in a teaching-learning system (Ali, Shatabda, & Ahmed, 2018). In addition, serious games allow users to adopt their own pace of study (Chaudy & Connolly, 2019). However, high performance in a serious game does not necessarily imply effective learning. In a game, satisfactory performance is related to reaching a milestone and obtaining a high score, whereas learning refers to reflection, repetition and self-assessment of the mistakes made

(Massa & Kuhn, 2019).

In that context, the evaluation of the user within a serious game is fundamental to the teaching-learning process. The most common method for evaluating serious games is by performing a test before and after the user participates in the game, and from the results obtained, perform a statistical comparison (Alonso-Fernandez *et al*., 2017). That pre- and post-test method is expensive, time-consuming and provides limited information about the user in the learning process (Alonso-Fernandez *et al*., 2017). For those reasons, learning analytics has seen a more effective method of teaching-learning assessment. Learning analytics can be used as part of an evaluation approach, in order to verify whether games are achieving good learning results, providing data on user interaction with the game in real time (Callaghan *et al*., 2018).

Learning analytics refers to the collection, analysis and visualization of a large amount of data related to educational processes (Slimani *et al*., 2018), thus determining which information needs to be extracted from a serious game for the analysis process (Callaghan *et al*., 2018). The extraction of that data can occur through web logs, tracking mechanisms, eyepieces, location and movement detectors (Massa & Kuhn, 2019). After extraction, those data must be processed through data mining and, finally, information visualization techniques must be used to assist in the interpretation of the data and identification of possible patterns.

The data visualization is a fundamental characteristic within a serious game, as it is through the representation of the data that the educational efficiency is verified, providing means to evaluate the knowledge obtained by the user (Alonso-Fernandez *et al*., 2017).

Normally, the data visualization is done through a dashboard. The visualization must occur in a significant way, so that the dashboard is not overloaded with information and only has information that has a certain purpose, aiming at a satisfactory user experience (I. J. Perez-Colado *et al*., 2018a). Dashboard views are characterized by presenting the activities performed by users over time (Martínez-Ortiz, *et al*., 2019).

In that context, the following research question is elaborated: how is the evolution of studies associated with the use of learning analytics interactive dashboards in serious games processed? To answer that research question, it is defined the main goal of the Systematic Literature Review (SRL), to understand the evolution of studies related to the use of learning analytics interactive dashboards in serious games, scientific productions in different areas of knowledge, evaluation metrics adopted, and the identification of possible gaps and opportunities for future research on the topic.

In order to achieve that goal, the work is structured as follows. The next two Sections explore the subjects “Learning Analytics” and “Learning Analytics in Serious Games” by different authors. Soon after, the methodological procedures are presented. In order to assist in the understanding of the object of study, this work presents the results of an SRL in electronic databases on the associated variables, identified in theoretical and empirical studies. Finally, the paper discusses the theoretical and practical implications of the results.

2. Learning Analytics

Learning analytics is a data analysis method, designed to assist in the understanding of students' tendencies towards activities and the significant aspects of those activities in their teaching-learning process (Kim & Moon, 2018), making it possible to identify students at risk of failure and learning difficulties.

In order to reduce the risk of failure and the difficulty of students in certain areas of teaching, games were seen as a powerful tool for learning and for evaluating (Chaudy & Connolly, 2018), since games provide an interactive and fun environment. At the same time, through the collection of educational data, it is possible to obtain relevant information on user game interaction (Slimani *et al*., 2018). Another aspect of great relevance is the evaluation, which, part of it can be carried out through learning analytics, to evaluate if the games are achieving satisfactory learning results and to provide information in real time about possible game deficiencies (Hauge, Berta, *et al*., 2014).

The information obtained through learning analytics corresponds not only to a report, but also to the descriptions of potentials, standards, and validation actions of statistical significance. In that way, it is possible to understand the dynamic performance of users, risk patterns in the teaching process and work factors to be adjusted in the search for improvements in the learning process (Massa & Kuhn, 2019). Because of those benefits, learning analytics is not only used in the educational field for game analysis, but also in organizations such as business analysis, web analysis, social network analysis and academic analysis (Massa & Kuhn, 2019).

3. Learning Analytics in Serious Games

In the serious game the main objective is to use digital game technology in teaching and learning and not necessarily in entertainment (Chaudy *et al*. 2014).

Serious game is effective in increasing interest in learning and allowing training and evaluation of user performance (Slimani *et al*., 2018). A priori, all serious games are part of an evaluation mechanism, in order to verify the player's performance and progress, thus generating a large set of data that allow the monitoring of user actions (Hauge, Berta, *et al*., 2014).

That data can be collected in two ways: the first is through pre- and post-test, in order to check the users' previous knowledge and compare with the knowledge acquired after the contact with the serious game (Massa & Kuhn, 2019) ; the second refers to the collection of information performed during the game, which can occur through web logs, tracking mechanisms, sensors such as eye trackers, location tracking, and motion detectors. In addition, the combination of serious games with learning analytics results in improvements in the monitoring and evaluation of game-based learning (Hauge, Berta, *et al*., 2014). In general, the data collected provides insights into the learning experience, the learnings related to the virtual environment, as well as the actual performance during the game (Hauge, Berta, *et al*., 2014).

In the context of serious games, learning analytics is an area of emerging knowledge that provides detailed reports on the use of a game; gameplay data and information visualization, based on data mining processes (Chaudy & Connolly, 2019). The combination of learning analytics techniques and serious games results in learning analytics in serious games (Serrano-Laguna *et al*., 2014).

According to Petrov *et al*. (2019), interactions between serious games and learning analytics occur for two main reasons: learning analytics used with the aim of improving a serious game; and, using serious games

to improve the quality of learning analysis. One of the goals of learning analytics is to improve learning through the processing and visualization of educational data (Cariaga & Feria, 2016). This visualization usually occurs through dashboards with tables or graphic forms (Cariaga & Feria, 2016). Ideally, the data sets obtained through the learning analytics should be viewed through interactive and adaptive dashboards, varying according to the needs of the game's users (Alonso-Fernandez *et al*., 2017). Those data sets can generate information for several purposes, such as: student assessment; personalized and adaptable gameplays and improvement in the serious game (I. J. Perez-Colado *et al*., 2018b). Therefore, learning analytics must be an interactive and adaptive process for the various parties involved, such as: teachers/instructors, students/participants, game developers/designers, and managers/researchers (Alonso-Fernandez *et al.,* 2017).

4. Methods

In this study, the Systematic Literature Review (SLR) was adopted and as a methodological procedure, a bibliometric analysis with a quantitative basis was carried out, in order to fulfill the research objectives. Freire (2013), mentions that the SLR procedure must be exploratory, in order to search and analyze publications already made on the subject. The author describes seven steps to be followed to search and analyze a SLR according to the Cochrane Handbook and NHS/York manual, they are: question formulation; location and selection in databases; critical evaluation of studies; data collection; analysis and presentation of data; data interpretation; and improving and updating the review.

4.1 Search Strategies

In the planning stage, the research question was defined, as well as the databases used to research the state of the art and the inclusion and exclusion criteria for articles for SRL. For this study, the international databases SCOPUS Elsevier, Web of Science, and IEEExplore were selected. The search descriptors used in the databases were "learning analytics" AND "serious games". In this research, the terms searched in English and Portuguese were taken into account. Table 1 shows the search variables used in the databases and the number of articles resulting from the search.

Table 1 - Search descriptors used in the databases

Databases	Search Descriptors	Articles
SCOPUS Elsevier	(TITLE-ABS-KEY ("learning analytics")) AND ("serious games") AND (LIMIT-TO (DOCTYPE, "ar"))	65
Web of Science	webscience: TS = (("learning analytics") AND ("serious games")) Refined by: DOCUMENT TYPES: (ARTICLE)	17
IEEExplore	("learning analytics") AND ("serious games")	33

The inclusion and exclusion criteria for articles are shown in Table 2.

Table 2 – Inclusion and exclusion criteria

Inclusion Criteria	• Article related to learning analytics, after reading the abstract
	• Article related to serious games, after reading the abstract
Exclusion Criteria	• Duplicate article
	• Unavailable article
	• Incomplete article
	• Article not related to learning analytics, after reading the abstract

4.2 Selection of Studies and Methodology Quality

In order to assist the process of inclusion and exclusion of articles, the Start tool (State of the Art through Systematic Review) was adopted for the export of articles, as well as for the analysis and selection of studies (Lapes, 2017). After reading the abstracts of the 115 articles, the selection criteria for the inclusion of articles were performed, described in Table 2. In that stage, 104 articles were accepted and 11 were rejected articles.

Then, the extraction step was performed, using the article exclusion criteria. At this stage, it was identified which articles were duplicated, incomplete or unavailable. Subsequently, we sought to identify the following information from the articles: Classification of the type of study, general characteristics of the study, data visualization techniques adopted and main results achieved. In that stage, a total of 75 accepted articles were obtained, 18 rejected and 11 articles were identified as duplicates.

For the systematic review of the literature, a bibliometric analysis was adopted, which is a research method and data analysis that allows measuring and evaluating results of bibliographic research on a research question (Freire, 2013). That method is used in this study in order to detect patterns of writing, publications and literature. In addition, an attempt is made to analyze the size, growth and bibliographic distributions in the field of knowledge researched (Freire, 2013). Finally, a descriptive analysis is performed to identify the results of the groupings of the analyzed data (Freire, 2013).

5. Results

For the SLR, a bibliometric analysis was performed in order to analyze the bibliographic data found in the literature and verify the evolution of studies associated with the use of learning analytics interative dashboards in serious games.

5.1 Study Classification

Studies related to learning analytics in serious games can be classified into five main types: studies with an emphasis on educational technologies; proposals for evaluation methodologies; studies with an emphasis on computational technologies; literature review studies on learning analytics; and, studies with an

emphasis on data visualization.

This Section presents the characteristics of the main articles for each type of study, in order to contextualize the main topics covered.

5.1.1 Studies with an Emphasis on Educational Technologies

Regarding studies with an emphasis on educational technologies, serious games in the area of inclusive education and socio-educational problems such as bullying and cyberbullying stand out.

In inclusive education, serious games can be used as training for activities considered common for a person without special needs. Cano *et al*. (2018), analyzes the process of creating and developing a serious game designed to train people with intellectual disabilities when traveling around the city on subway trips. The tests of serious game were carried out through the experience of adults with mild intellectual diseases (Cano *et al*., 2018). In order to analyze the needs of users with intellectual disabilities, an investigation was carried out on cognitive, psychological and motor skills, which were later translated into user requirements. Those requirements have game mechanics adapted to improve understanding and increase the probability of the user to perform the tasks correctly within the game (Cano*, et al*., 2018).

In order to analyze the effectiveness of the serious game of subway travel for people with disabilities, a learning analytics module was added, where relevant information was collected on how users are playing, allowing to infer how the learning process of each user is occurring. For that purpose, educational data are collected using analytical learning techniques during game sessions. And, to view the game results, existing standards were used in the Experience API library (xAPI) (Cano *et al*., 2018), which allows the generation of virtual dashboards with information on the students' general performance (Calvo-Morata *et al*., 2018).

A serious game that is concerned with cyberbullying is the game entitled Connected. The game puts users in the role of a student who is cyberbullyed by schoolmates. The game follows the classic adventure style, where it structures the main means of interaction in dialog options, allowing the game's story to be changed in a dynamic way resulting in possible different forms of completion (Calvo-Morata *et al*., 2018).

From the point of view of the teachers who tested the Connected game, it is important that the educational tools are under control, so that they are aware of the current situation in the classroom. In that way, it is possible for professionals to visualize the student's progress and assess whether the tools are serving their purpose. In that case, it is necessary to perform data collection and analysis (Calvo-Morata *et al*., 2018).

5.1.2 Proposals for Evaluation Methodologies

Within the context of learning analytics in serious games, it is possible to notice a great concern regarding the use of an appropriate evaluation methodology. Regarding evaluations in serious games, it is necessary to verify patterns of behavior in the data records, in order to identify and measure the implicit learning and the development of knowledge that has not yet been identified.

To record the data Rowe *et al*. (2017) made use of the tool called Impulse, which records game events, as well as the location of objects in the game space and the feeding of that information into the database. To that end, five main categories were defined: (a) location/vector and movement of player particles; (b) moment and location of the impulses; (c) number and location of other particles; (d) general characteristics of the game; and (e) result of the game.

The authors (Rowe *et al*., 2017) applied the techniques mentioned in two serious games for teaching physics. The study resulted in several measures of implicit learning and significant improvements in external assessments.

Gibson & de Freitas (2016), described how evaluation data can be used to fully understand the student experience. According to the authors, one way to obtain data is during the game session, where the individual's experience can be modeled and mapped in an effective way providing feedback throughout the game experience.

Another relevant factor regarding the student's experience is the user's retention throughout their gaming experience. Taking that factor into account, it is possible to visualize the benefits of using performance data throughout the game's life cycle. Thus, the data in question can be used in the planning and implementation of interventions during the user study (Gibson & de Freitas, 2016), making the level of difficulty to be adapted for each type of user, thus creating a better type of assessment for each student profile.

Assessment is essential for students to receive feedback on their progress, and for educators to assess the effectiveness of their teaching. However, educators do not always trust the result of serious play. In order to address that problem Chaudy *et al*. (2014) developed a general evaluation mechanism used as a link between developers and educators, entitled EngAGe. At EngAGe, the teacher/instructor creates the assessment by providing guidelines and allows the assessment to be updated at any time after the game is distributed. The evaluation step is carried out in an independent module, which does not require a programming language. The system proposed by the authors presents a panel that provides a visual report summarizing all the data collected from the various phases of the games (Chaudy *et al*., 2014).

5.1.3 Studies with an Emphasis on Computational Technologies

Computational technologies aim to bring innovative tools that assist in the construction of serious games and in the collection, standardization and analysis of educational data. In that context, the Experience API library (xAPI) stands out. The xAPI library is an interaction model to track user data, in order to carry out learning analysis in serious games (Serrano-Laguna *et al*., 2017).

The xAPI library defines each event tracked in a learning activity as a "statement". The main attributes in an instruction are actors, verbs (action) and objects. The xAPI instructions are sent to a database so that it is possible to check sequences of interactions performed by users. Finally, the data are presented on dashboards for students and educators (Serrano-Laguna *et al*., 2017).

The collection and analysis of data proves to be an extremely relevant tool among computational technologies, presenting behaviors of great significance for the learning process. In the study carried out in the Learning Management System, a learning platform was developed to collect data not only on the use of the system, but also related to the way students learn and progress training activities (Villagrá-Arnedo *et al*., 2016). In order to verify the hypothesis that complementing behavioral data with other more relevant data (related to the learning results) can lead to a better analysis of the learning process, making it possible to predict the student's final performance in advance. The study showed satisfactory results and classified users with the probability of belonging to one of the three classes: high, medium and low performance (Villagrá-Arnedo *et al*., 2016).

Studies in computational technologies also stand out, for addressing the development and application of

assessment tools in serious games, such as the EngAGe tool, which is an integrated assessment tool for teachers and developers designed to separate the serious game from the system evaluation (Chaudy & Connolly, 2019). Developers use the tool to integrate assessment with teaching using games. In addition, teachers have the possibility to modify the assessment and view the learning analysis through a data control dashboard (Chaudy & Connolly, 2019).

In order to test EngAGe, a qualitative assessment was carried out with the developers, where 7 experienced developers and 29 students were selected (Chaudy & Connolly, 2019). Qualitative evaluation was also carried out by 31 educators, and it was observed that with access to EngAGe, it is more likely that educators trust the evaluation of the game, since EngAGe can be used by educators effectively to modify educational games, evaluate, and view gameplay data (Chaudy & Connolly, 2018). According to the authors, in that way EngAGe allows an increase in confidence in educational games as an assessment tool (Chaudy & Connolly, 2018).

5.1.4 Literature Review Studies on Learning Analytics

In the classification of studies of literature review, what stands out most are the works that present a relationship between serious games and learning analytics.

Massa & Kühn (2018) present the following research questions in their study: (a) what kind of solutions are perceived in studies on learning analytics in serious games?; (b) are there studies on learning analytics for commercial serious games that have not been developed by educators?; (c) were studies published that offer analytical methodologies for implementing learning in serious games?; and (d) are there studies that offer tools for implementing learning analytics in serious games?

As results of the study, the authors obtained the following answers: (a) there are two main lines of research, those that offer theoretical solutions on the subject, and those that already offer practical solutions, already implemented or in the process of future implementation. The authors noted that 33% of publications maintained a theoretical approach, while the other 67% proposed a more practical than theoretical focus; (b) only one article found has partly commercial applications; (c) the authors identified some proposed methodologies for the implementation of learning analytics; (d) the authors found few complete software that allow the incorporation of learning analytics in a serious game, in addition, the articles that were found focus directly on the student's assessment within the serious game (Massa & Kuhn, 2019).

5.1.5 Studies with an Emphasis on Data Visualization

In the vast majority of the investigated studies, the data visualization in relation to learning analytics, showed a greater focus on information associated with users/students and instructors/teachers, being used mainly to assist in the analysis of learning.

In the view of Alonso-Fernandez *et al*. (2017) in the analysis and visualization stages, there are two main objectives to be achieved: (a) standards of analysis and visualization sets should provide insights, thus making it possible to personalize with zero cost; and (b) advanced users must be allowed to add specific information by creating custom dashboards and views.

In addition, the sets of analysis and visualization standards must be adapted to the needs and interests of the different stakeholders involved in the learning process, namely: teachers/instructors,

students/participants, developers/ designers, managers/researchers (Alonso -Fernandez *et al*., 2017).

For teachers, the main characteristics related to data visualizations are: user classification by number of errors, questions with a higher error rate; number of players in each game session; total number of correct and incorrect alternatives selected in the multiple choice questions for each player; score and progress achieved by players at different levels; players' progress over time; and for each activity, rule, game suggestions, the number of times that were visited and ignored by the players (Alonso-Fernandez *et al*., 2017).

According to the authors, it is interesting for students to view answered questions, errors, proportion of correct answers, final score, timestamps, and session duration (Alonso-Fernandez *et al*., 2017).

For developers or designers, views with the following characteristics are considered relevant: views by students in the class, sessions, questions answered, total errors, proportion of correct answers and timestamps; distribution and questions answered of the scores obtained in the game; number of accesses performed by the players; duration of sessions; number of times that each verb has been used over time (Alonso-Fernandez *et al*., 2017).

And, for managers and researchers, relevant visualizations (Alonso-Fernandez *et al*., 2017) must contain: peak times of game use and intergroup comparisons.

Alonso-Fernandez *et al*. (2017) developed the visualization dashboards with a tool called Kibana, as it is a platform that provides flexible navigation with an interface based on analysis and visualizations. Once created, those dashboards can dynamically change to display updated results as they become available.

Melero *et al*. (2015) explores visualizations to support student self-assessment and teacher assessment. The proposed design is a gamification composed of a location-based learning activity, containing geolocated questions.

The "QuesTInSitu: The Game" proposed by Melero *et al*. (2015) provides the data for the visualizations, which represent relevant aspects of the group activity. According to the authors, the interactions occurred by 23 groups of students with the application in their mobile design, including data such as: time used to answer questions and to reach the geographical area of the questions, number of attempts to solve each question and scores obtained per question. With that information, several visualizations of learning analysis were possible for the evaluation of teachers and self-evaluation of students (Melero *et al*., 2015). The assessment was divided into sessions, which are: general information, time used, trails, frequency, and score (Melero *et al*., 2015). For teachers, they are important information to maintain the objectivity of the application, however, they can present a large volume of information to be analyzed (Melero *et al.,* 2015).

Another approach is the visualization through dashboards oriented to the teacher, where there is an administrator dashboard containing an interactive menu that allows the user to select the desired dashboard, while the students' performance information is displayed in a main table (I.J. Perez-Colado *et al*., 2018). According to the authors, the type of visualization adopted can also be filtered or not by student. Those dashboards are composed of five sections that are presented in the form of bar graphs, slices and region, they are: general information and configuration; scores; responses; progress and duration; and location-based games (I. J. Perez-Colado *et al*., 2018).

5.2 Analysis of Studies

In the bibliometric analysis, important aspects related to the 75 selected studies referring to "learning analytics" and "serious games" were considered (Appendix A). In this analysis, mappings were made relating the classification of the type of study, publications per year, techniques adopted, as well as the use of interactive dashboards.

Regarding the classification of types of study, as noted in Appendix A, a classification was made according to the type of approach of each article, within the context of learning analytics and serious games. As shown in Figure 1, it was observed that the largest number of the articles are related to studies with an emphasis on educational technologies (36%) and computational technologies (31%). These results reflect the growing number of studies in the development and application of serious games, in order to create innovative tools that are effective during the learning and evaluation process.

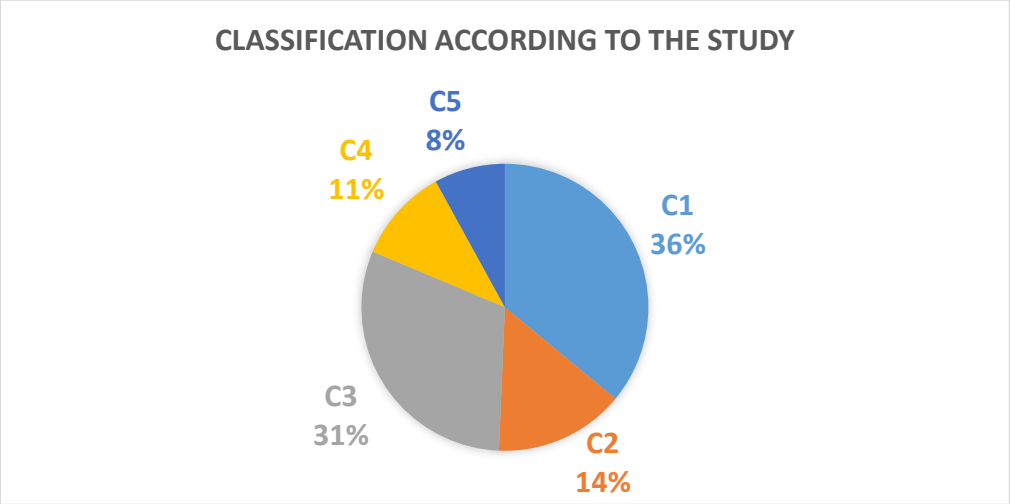

Figure 1 – Studies classification.

C1: Studies with an emphasis on educational technologies; C2: Proposals for evaluation methodologies; C3: Studies with an emphasis on computational technologies; C4: Literature review studies; C5: Studies with an emphasis on data visualization.

Regarding the number of publications, Figure 2 shows the evolution of studies on learning analytics in serious games between the years 2014 to 2019. It is notable the significant increase in publications on the subject from the year 2016, having just a small drop in 2015 and doubling the number of publications from 9 in 2017, to 18 publications in 2018 and reaching 24 publications in 2019.

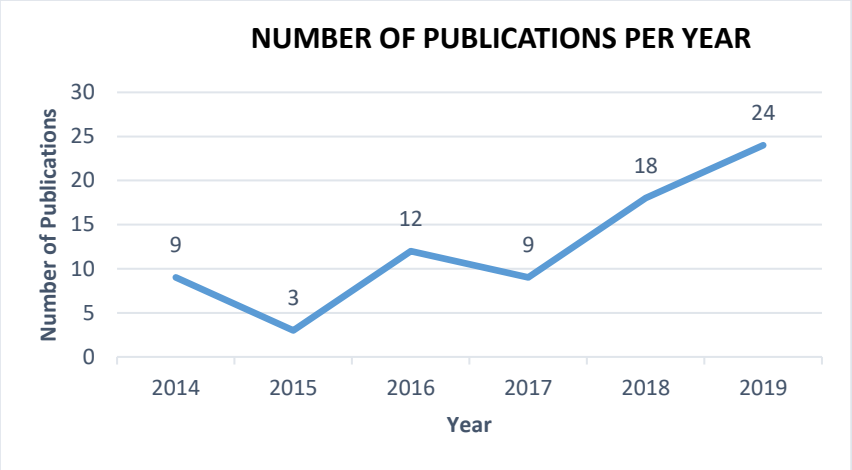

Figure 2 – Evolution in the number of publications.

Another important information is the number of citations per article (Appendix A). In this context, on of the highlights is the study by Serrano-Laguna *et al*. (2014) which proposed a two-step approach for the application of learning analytics, where in the first step occurs the identification of generic features and, the second step, the definition of reports that can be applied in any type of game. In addition, Serrano-Laguna *et al*. (2017), which presents game-specific evaluation rules based on combinations of generic tracking. In that particular study, a new interaction model is presented to track learning in serious games and their implementation using the Experience API library (xAPI) (Serrano-Laguna *et al*., 2017).

In this context, it is possible to notice a great relevance and concern of the work of learning analytics in serious games in tracking educational data, in order to create reports. The way of viewing those data reports is also of great relevance for users, teachers/instructors and researchers. In Figure 3, it is observed that 65.3% of the investigated articles (n = 75), do not apply any data visualization technique (N/A) and only 10.7% of the articles use interactive and adaptive dashboards (V3), 2.7% present the data through hierarchical maps (V2) and 21.3% present the data reports through static dashboards (V1), for individual results and/or groups of users.

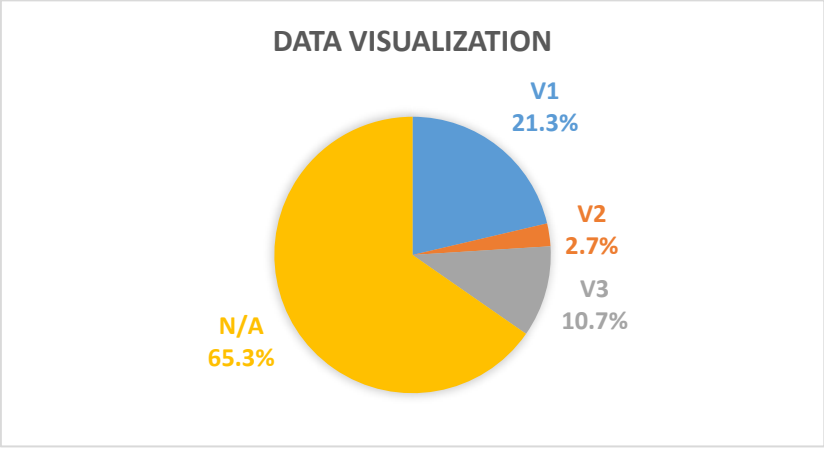

Figure 3 - Data visualization techniques adopted.

V1: Visualization through static dashboards with individual results and/or group of users; V2: Visualization through hierarchical maps; V3: Visualization through interactive dashboards with individual results and/or group of users; N/A: Not applicable.

In order to keep track of the progress and actions of users, data visualization is relevant for educators and students. Visual analyzes that aggregate the learning analysis data during the game session, based on control dashboards allow an overview of the participating student groups (Calvo-Morata *et al*., 2019).
The use of an interactive dashboard, which allows to obtain filtering by student, chosen paths, progress, actions in the game, answers, scores, times for completion, among others, is of great relevance, so that educators can also view detailed information on learning during a session of a serious game (Calvo-Morata *et al.,* 2019). It can be observed (Figure 4) the evolution in the studies of learning analytics interactive dashboards in serious games in 2016 and a significant growth until 2019. Figure 4 shows that the visualizations through static dashboards, also remain in increasing, despite a drop in its use between the years 2015 and 2016.

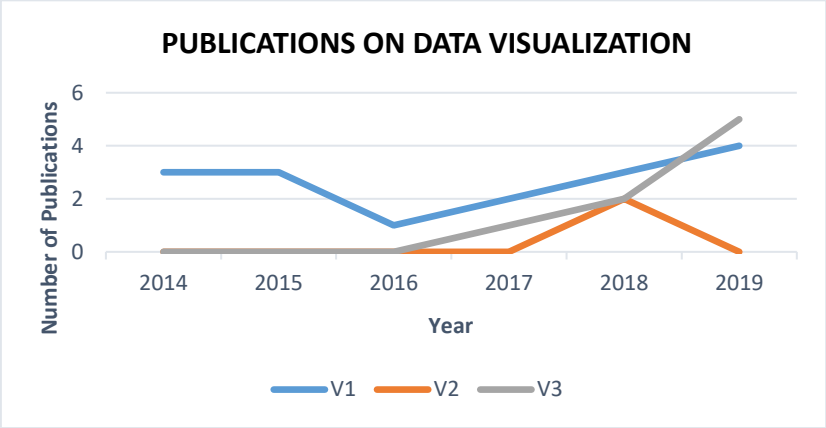

Figure 4 – Publications on data visualization.
V1: Visualization through static dashboards with individual results and/or group of users; V2: Visualization through hierarchical maps; V3: Visualization through interactive dashboards with individual results and/or group of users.

In particular, studies with an emphasis on data visualization (category C5 in Appendix A), articles that are concerned with visualization by the teacher/instructors and the student/participant stand out, as shown in Figure 5. It was found only one article that presents the visualization for all the actors participating in the learning process, namely: teachers/instructors, students/participants, game developers/designers and managers/researchers. And, two studies that present the visualization aimed only at the teacher/instructor.

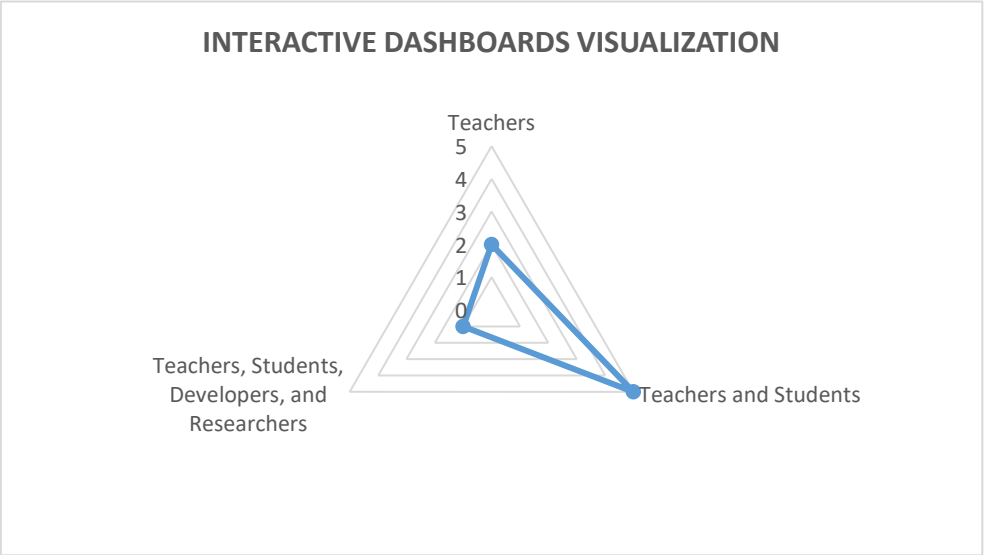

Figure 5 – Interactive dashboards for educational visualization.

6. Final Considerations

The study aimed to present and analyze the evolution of studies associated with the use of interactive learning analytics panels in serious games through an SLR, resulting in 75 selected studies which made it possible to deepen the researched subject.

By means of bibliometric analysis and descriptive analysis, it was possible to observe relevant data for the investigation, such as the growth in the use of interactive dashboards in the presentation of data in serious games and the use of interaction models to track educational data.

The information visualization must take into account each person involved in the teaching and learning process. On top of that, it is necessary that the serious game provides the values and information of the game immediately and with a minimum configuration (Alonso-Fernandez et al., 2017), so that actors such as teachers can visualize the results quickly and easily. It is also necessary to make it possible for advanced users to customize and adapt their analyzes to specific requirements (Alonso-Fernandez et al., 2017), in order to visualize what they deem most necessary about their performance.

Regarding the number of publications per year, the growth trend of the learning analytics in serious games subject in the last years is notable. The number of citations shows a great concern with the tracking of educational data. The types of studies investigated have an increasing demand in studies related to educational technologies. Finally, with regards to data visualization, it is possible to conclude that studies related to the use of interactive dashboards in serious games have been growing, but the main focus remains on teachers/instructors and students/participants. Thus, there is a need for greater versatility in learning analytics frameworks in order to take into account other actors that are part of the teaching-learning process such as game developers/designers and managers/researchers.

7. Acknowledgement

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Appendix A

Classification and Authors	Research question/Purpose	Visualization techniques	Results summary	Citations
(C1) Serrano-Laguna *et al.*, 2014	They propose two main steps for the application of learning analytics: identification of generic report tracking and construction of game-specific evaluation rules based on generic combinations.	N/A	The game was evaluated by a group of 37 students from a web programming team. 94% of students successfully completed the game and 81% of students achieved satisfactory scores.	30
(C1) Freire *et al.*, 2014	Investigates issues involved in integrating serious games within the Massive Open Online Course (MOOCs).	N/A	The test content was integrated and the adopted model was analyzed, but an experimental validation was not carried out.	15
(C1) Alonso-Fernández, Caballero Roldán, *et al.*, 2019	They propose a combination of game learning analysis and data mining techniques to predict knowledge change based on student interactions.	N/A	The prediction model was highly accurate, and the authors suggest that serious games should be used not only to teach, but also to measure knowledge acquisition after the game.	14
(C1) Rodríguez-Cerezo *et al.*, 2014	It describes the system entitled Evaluators, which allows instructors to generate games related to exercises that address concepts of computer languages.	N/A	By reproducing the generated games, students were able to learn the fundamentals of the semantic evaluation process in attribute grammars.	12
(C1) Liu *et al.*, 2017	Investigates students' behavior patterns when interacting with an adaptive learning environment.	V1	They concluded that the lack of alignment between components in an adaptive system can impact how students access the system and how visualizations can reveal interesting results.	7
(C1) Hubalovsky, Hubalovska & Musilek, 2019	Describes learning exercises containing implemented adaptive elements.	N/A	The authors concluded that adaptive learning resources can be implemented in primary education.	5
(C1) Ruipérez-Valiente *et al.*, 2017	Presentation of a learning analysis tool for Open edX, entitled Analyze.	V1	The research obtained very positive results for a usability scale (78.44 /100) regarding the usefulness of the visualizations (3.68/5) and the effectiveness ratio (92/100) of the actions.	5
(C1) Nguyen, Gardner & Sheridan, 2018	It proposes a structure for serious games specialized for people with intellectual disabilities.	N/A	Provides necessary guidance for potential application developers for people with intellectual disabilities.	4
(C1) Cano *et al.*, 2018	It addresses the use of a serious game to train students with intellectual disabilities on trips on the subway.	V1	The game is evaluated through activities, being considered then a supplementary tool to train skills on the subway.	4
(C1) I. J. Perez-Colado *et al.*, 2017	It presents the creation of uAdventure, a serious game editor, which allows the creation of games without the need of programming.	N/A	The authors noted that uAdventure improves the lifecycle of serious games, reducing creation and maintenance costs.	4
(C1) Hauge *et al.*, 2015	Explores the potential in the use of games and learning analytics in support of teaching and learning experience.	V1	The results showed that 94% of students completed the game successfully.	4
(C1) Park *et al.*, 2016	Features a serious game for children with Attention Deficit/Hyperactivity Disorder (ADHD).	N/A	The platform is expected to help children with ADHD improve their level of attention, control hyperactive behavior and develop their social skills.	4
(C1) Terras *et al.*, 2018	Synthesizes the literature on the use of serious games for people with intellectual disabilities.	N/A	The authors concluded that the contextual influences on gameplay are complex and dynamic.	3

Classification and Authors	Research question/Purpose	Visualization techniques	Results summary	Citations
(C1) Calvo-Morata *et al.*, 2018	Describes the serious game intitled Connected by presenting a validation process with students through game analysis.	V1	The game makes users aware of cyberbullying and makes players empathize with victims.	3
(C1) Alonso-Fernández, Cano *et al.*, 2019	It presents the experience of raising awareness of cyberbullying through a serious game.	V1	It tests some hypotheses defined by the educators and simplifies the implementation and evaluation of the game through learning analytics.	2
(C1) Seufert *et al.*, 2019	It investigates how learning analytics can be applied in the pedagogical area and conceptualizes a generic structure for the design of learning analysis environments.	N/A	A pilot project was applied to validate and review the generic model and for each case study (n = 4) the planning was carried out with specialists.	1
(C1) Loh & Li, 2016	Investigates how to reduce training costs with serious games.	N/A	Data-driven training can help learning organizations to reduce costs by decreasing unnecessary training.	1
(C1) Ninaus *et al.*, 2014	Uses infrared spectroscopy to examine whether neurophysiological measures can help to identify if a user is learning during a game.	N/A	Identification of increased brain activation in frontoparietal areas, while users actively learn rules or applied knowledge during the game.	1
(C1) V. M. Perez-Colado *et al.*, 2018	Describes fundamental specifications for location-based games.	V2	The authors concluded that the xAPI library is a simple, effective, standards-based and extensible way to handle the exchange of learning analytics data between location-based games.	1
(C1) Codish, Rabin & Ravid, 2019	Presentation of a methodology for detecting patterns of user behavior in unstructured processes.	N/A	The authors concluded that the proposed methodology has the ability to discover specific user usage patterns and to create a cluster based on the identified patterns.	0
(C1) Capatina *et al.*, 2018	Presentation of an environment to track the learning analysis on the performance ranking of serious game teams.	N/A	The authors concluded that one can develop skills for real business competition.	0
(C1) Forsyth, Graesser & Millis, 2019	Investigation of shallow versus deep learning predictors in a serious game known as Operation ARA.	N/A	The results revealed distinct patterns of predictors of deep versus superficial learning for students in the game's training environments.	0
(C1) Birt, Clare & Cowling, 2019	It explores the pedagogical possibilities in a case study based on mixed reality multimodal learning analysis, enabled for smartphones for health education, focused on learning the anatomy of the heart.	V1	The results of the pilot study showed engagement and enthusiasm of the proposed method among experts, but also demonstrated problems that must be overcome in the pedagogical method before implementation.	0
(C1) Liu *et al.*, 2019	It explores the extraction of data captured by an educational digital game, designed for high school, in order to identify students' behavioral patterns when using the game.	V1	The results showed positive relationships between student performance and the use of tools in terms of frequency and duration of use of the tool.	0
(C1) Francis *et al.*, 2019	It presents a critical thinking about the analysis of learning.	N/A	The authors presented the impact of student learning analysis, showing that it is limited and confined to research studies.	0
(C1) Calvo-Morata *et al.*, 2019	Describes the experience using game learning analytics to encourage the application and deployment of serious games in the classroom as learning tools.	V3	The authors concluded that to simplify the application and the implantation of games by the educators, a clear benefit in terms of utility and contribution must be provided.	0
(C1) Martínez-ortiz *et al.*, 2019	It seeks to increase the engagement of software engineering students through	V1	It was described the design of a class management web application implementation that allows dynamic changes in multilevel	0

Classification and Authors	Research question/Purpose	Visualization techniques	Results summary	Citations
	gamification.		analysis.	
(C2) Gibson & de Freitas, 2016	Analyzes and evaluates virtual performance based on games and data analysis.	N/A	The authors presented the importance of learning analysis when intensive mixed methods are adopted.	14
(C2) Rowe *et al*., 2017	It presents an evaluation proposal that allows recording behaviors and game data for the measurement of implicit learning.	N/A	The authors concluded that the measures of learning implied within the evaluated games, were significantly correlated with improvements in external post-test evaluations.	12
(C2) Klemke, Eradze & Antonaci, 2018	It presents evaluations for the first selection of elements of a serious game suitable for the Massive Open Online Course (MOOC).	N/A	The authors identified ten suitable game elements to be applied in the MOOC environment.	5
(C2) Mora, Caballé & Daradoumis, 2016	It presents the construction of a multifaceted electronic evaluation structure.	N/A	The authors provided a complete assessment of the participants' actual performance based on the proposed evaluation structure.	5
(C2) Chaudy & Connolly, 2018	EngAGe presents an evaluation mechanism designed to separate the game from its evaluation.	V3	The evaluation indicated that, having access to EngAGe, educators would be more likely to trust the evaluation of a game.	2
(C2) Serrano-Laguna *et al.*, 2018	It presents a methodology to evaluate the effectiveness of a game based on non-disruptive tracking.	N/A	The authors concluded that the methodology allowed to evaluate the levels of effectiveness of the game and to identify problems in the design.	2
(C2) Cariaga & Feria, 2016	It presents a proposal for evaluating educational games through learning analytics.	V1	The authors concluded that the challenges of learning analytics are related especially in the privacy and ethics of data.	2

Classification and Authors	Research question/Purpose	Visualization techniques	Results summary	Citations
(C2) I. J. Perez-Colado *et al*., 2019	Describes the most common problems encountered when validating games and introduces Simva, a tool designed to simplify the process of validating serious games.	N/A	Simva proved to be effective in simplifying data collection and processing, being faster and automating some of the most error-prone processes.	1
(C2) Slimani *et al.*, 2018	Collects and analyze experience data from the educational game Elisa for teaching the English language.	V1	Provided students' performance levels through clustering and data visualization methods.	1
(C2) V. M. Perez-Colado *et al*., 2019	It presents the first evaluation of uAdventure, an easy-to-use game development environment for graphic adventure narrative games.	N/A	The results of the evaluation, presented a creation of simple stories for profiles that had no previous knowledge of the mechanism and presented a positive feedback for more technical profiles that would use the tool as a prototyping model for complex projects.	1
(C2) Georgiadis *et al*., 2019	It proposes a generic tool for the arrangement of stealth assessment, in order to remove its current limitations and pave the way for its wider adoption.	N/A	In a controlled test condition, the accuracy of the stealth rating was inherently stable and high (usually above 92%).	0
(C3) Serrano-Laguna *et al*., 2017	Presentation of an interaction model that establishes a basis for the application of learning analytics in serious games.	N/A	The article presented a new interaction model to track serious games and their implementation with the xAPI specification.	30
(C3) Hauge, Berta, *et al*., 2014	It addresses the implications of combining learning analytics and serious games in the pursuit of game improvements.	N/A	It addressed how to improve the quality and progress of the game, as well as, monitor and evaluate the player's behavior.	10
(C3) Villagrá-Arnedo *et al.*,	The authors demonstrates that the complementation of behavioral data with	N/A	The system was able to otbain a weekly classification of each student with the	8

Classification and Authors	Research question/Purpose	Visualization techniques	Results summary	Citations
2016	other more relevant data, can lead to a better analysis of the learning process.		probability of belonging to one of the three classes: high, medium and low performance.	
(C3) *Staubitz et al*., 2017	It presents a gamification process carried out on a MOOC platform.	N/A	With the use of gamification, it was possible to use the discussion forum as a kind of "soft" exercise.	5
(C3) Chaudy *et al*., 2014	It features a mechanism to be used by serious game developers and teachers.	V1	The presented solution acts as a communication tool between developers and educators.	4
(C3) Ganan *et al*., 2016b	It proposes a solution to satisfy the requirements in terms of software artifacts.	N/A	The authors presented the first steps in the development of an e-learning platform called ICT-FLAG.	4
(C3) I. Perez-Colado *et al*., 2018	It manages multilevel analysis through improvements in policy and in the mechanism for introducing analytical models of meta-learning.	N/A	Learning objectives can be shared between different sub-games.	3
(C3) Pérez-Berenguer & García-Molina, 2018	Development of the UPCTforma tool, whose main objective is interoperability.	V3	The innovative aspect of the proposed architecture was the transformation of tracking data into "learning analytics models".	3
(C3) Hauge, Kalverkamp, *et al.*, 2014	It analyzes under what circumstances an online game, produced for a particular course, could be integrated in an easy and non-facilitated way.	N/A	The learning outcome is shown to be random, and it is expected that only students with prior knowledge will be able to place the observed content in the right context and thus learn about the impact of their decision through the game.	2
(C3) Ganan *et al*., 2016a	It presents the implementation of the ICT-FLAG platform and reports the first experiences of connection and integration of	N/A	The authors reported the experiences with the innovative web-based e-learning platform which combines gamification and learning	2
Classification and Authors	**Research question/Purpose**	**Visualization techniques**	**Results summary**	**Citations**
	the platform with a real e-learning tool.		analytics.	
(C3) Callaghan *et al*., 2018	It presents an extension to the ATMSG framework that facilitates the identification, selection and integration of analyzes in serious games.	N/A	The framework was able to identify the gameplay and performance challenges.	2
(C3) Santamaría-Bonfil *et al*., 2019	It presents the development of an ecosystem for training line operators in maintenance maneuvers, using the Experience API standard, Big Data components and learning analytics.	N/A	The results have shown that a suitable domain model to customize the training path of the power line players can be built directly from legacy text data.	1
(C3) Cano *et al*., 2016	It analyzes necessary processes to develop a serious game for the training of people with intellectual disabilities to get around the city using public transportation.	N/A	The authors concluded that applications related to Game Learning Analytics (GLA) models and learning analytics techniques, such as clustering or predictive techniques, are necessary in future analyzes.	1
(C3) Calvo *et al*., 2016	It analyzes factors that contribute to the total cost in a serious game and proposes strategies to keep it in line with the requirements.	N/A	The authors concluded that specific assessment resources for behavior analysis make the game expensive.	1
(C3) Kim & Moon, 2018	It presents a model that makes it possible to identify activities based on a series of apprentice actions over time.	N/A	The model was able to offer a view on the continuity and persistence of objects, for the understanding of teaching-learning activities.	1
(C3) Azcona, Hsiao & Smeaton, 2019	It presents a research methodology to detect students at risk of failing in computer programming modules.	V3	The methodology allowed the construction of a predictive model using static information from the students.	1
(C3) Alachiotis, Stavropoulos &	Analyzes data from the Modular Object-Oriented Dynamic Learning Environment	V3	The results showed the students' interest in each structural component, their dedication to the	0

Classification and Authors	Research question/Purpose	Visualization techniques	Results summary	Citations
Verykios, 2019	(Moodle) by tracking students' daily and weekly activities.		course and their participation in the forums.	
(C3) Shoukry & Göbel, 2019	It presents the design and development of "StoryPlay Multimodal", a mobile platform for multimodal analysis for the evaluation of serious games.	V3	The platform was able to describe how the multimodal data can be captured in a discreet way for the evaluation of serious games.	0
(C3) Chaudy & Connolly, 2019	Presents the benefits of EngAGe for game developers.	V3	The results showed significant differences in usability between beginning and experienced developers, but did not show differences in terms of usefulness.	0
(C3) Ali *et al*., 2018	It presents the use of serious games with learning analytics in the domain of product marketing.	N/A	The authors concluded that based on the user's decisions, the company can obtain customer choices, feedbacks or marketing results and make decisions based on the results.	0
(C3) Skalka & Drlík, 2019	It presents the architecture of a system for teaching and learning programming based on interactivity and modern educational approaches.	N/A	The authors described the structure of educational content divided into levels, according to the architecture of the system.	0
(C3) Morata *et al*., 2019	Features the life cycle description of serious games designed to be used in tasks.	N/A	Educators' tasks were able to be simplified to: initial game validation; application in an effective and controlled manner; and automatic assessment based on the student's actions in the game.	0
(C3) De Oliveira & Santos, 2016	The authors present a virtual teaching and learning environment, called Problem-based Learning (PBL) Master.	N/A	As a result of the maturity acquired in xPBL, it was possible to define the requirements and the implementation of the PBL Master.	0

Classification and Authors	Research question/Purpose	Visualization techniques	Results summary	Citations
(C4) McCoy, Lewis, & Dalton, 2016	The authors present the benefits of using gamified training platforms for medical education and training.	N/A	The authors demonstrated better learning results with virtual patient simulations.	22
(C4) Vieira, Parsons, & Byrd, 2018	Analyzes visual learning through educational data.	N/A	The authors concluded that just a few studies bring visual learning analysis tools to classroom environments.	18
(C4) Mavroudi, Giannakos & Krogstie, 2018	The authors present future developments, challenges and opportunities in the area of adaptive learning using learning analysis.	N/A	The authors concluded that there is a need for more research on the topic in specific domains and configurations of learning.	7
(C4) Alonso-Fernández, Calvo-Morata *et al*., 2019	How the data is applied in a technical way taking into account analytical learning in serious games.	N/A	The authors concluded that serious game interaction data can reduce the complexity of the area, simplifying the game's design and development, and measuring the real impacts of the games.	4
(C4) Montoro *et al*., 2019	It proposes a meta-analysis in the area of social sciences and emerging technologies.	N/A	Scientific production on emerging technologies is related to collaborative learning, deep learning, adaptive learning, learning analytics, and e-learning.	2
(C4) Buenaño-Fernandez *et al*., 2019	Analyses the use of data mining tools for decision making in engineering education.	N/A	They concluded that there is currently a trend towards case study research, which is more directed towards software engineering and computer science.	1
(C4) Petrov *et al*., 2019	Investigation of new relationships to the educational process, learning analytics and serious games.	N/A	When learning analytics and serious games work together, positive influence can be gained in areas of education.	0

Classification and Authors	Research question/Purpose	Visualization techniques	Results summary	Citations
(C4) Massa & Kuhn, 2019	Investigation of applications in real learning environments.	N/A	The development of serious games and their application in the real learning environment is promising, but quite poor in terms of the resources used for its implementation.	0
(C5) Melero *et al.*, 2015	Application of visualizations for self-assessment.	V1	The students obtained a significantly higher score in the post-test using visualization resources than in the pre-test without using visualization resources.	29
(C5) Alonso-Fernandez *et al.*, 2017	It presents two main steps for the systematization of games in learning analytics.	V3	They presented two important steps to achieve the systematization of games: The use of the Experience API library (xAPI) and a set of data visualizations.	12
(C5) *Minović et al.*, 2015	Presentation of a learning visualization tool in a serious game.	V1	Based on the findings the participants of the case study were in favor of the proposed approach and justified additional investments in the development of the method.	12
(C5) Bull & Wasson, 2016	Presentation of a tool for visualizing language learning skills for students and teachers.	V1	Data visualization helped students to reflect and monitor their learning and teachers in the decision-making process.	8
(C5) Serrano-Laguna & Fernández-Manjón, 2014	The authors introduce educational video games as class exercises in face-to-face education.	V1	The approach met the proposed needs. Objective-oriented visualizations helped the teacher to have a complete view of student performance.	2
(C5) I. J. Perez-Colado *et al.*, 2018a	It presents the functional implementation of a multilevel analysis (MLA).	V2	With the framework it was possible to obtain functionalities to track and evaluate game scenarios at various levels.	0

Studies Classification: **C1**: Studies with an Emphasis on Educational Technologies; **C2**: Proposals for Evaluation Methodologies; **C3**: Studies with an emphasis on Computational Technologies; **C4**: Literature Review Studies on Learning Analytics; **C5**: Studies with an Emphasis on Data Visualization.

Visualization techniques: **V1**: Visualization through static dashboards with individual results and/or group of users; **V2**: Visualization through hierarchical maps; **V3**: Visualization through interactive dashboards with individual results and/or group of users; **N/A**: Not applicable.

Profile of Supervised Internship Reports of the FT/UFAM Industrial Engineering Course

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Abstract

The article analyzes the profile of the Supervised Internship reports delivered by students of the Industrial Engineering course at the Faculty of Technology of the Federal University of Amazonas (FT/UFAM), to provide useful information to the course department, as well as providing knowledge and reflection on how the discipline has been approached over time. The research is applied, documentary, using descriptive statistics along with data obtained from the collection of internship reports approved between 2008/1 to 2018/1. After analyzing the results, the main conclusions were that the average score of the 469 reports is 8.56, the industry is the segment in which the majority of the internships (76%) were carried out, while the Operations Engineering, and Production Process, Organizational Engineering, Quality Engineering, Logistics, and Work Engineering were the main areas of Industrial Engineering in which the students interned.

Keywords*:* Internship report; Supervised Internship; Industrial Engineering.

1. Introduction

The Federal University of Amazonas (UFAM) was founded in 1909 with one of the objectives of stimulating the development of the professional career of its members.

Over time, courses were created in the various teaching areas: biological sciences, agrarian sciences, social sciences, and exact sciences. Among the 18 academic units in Manaus, there is the Faculty of Technology (FT) composed of the following departments: Department of Civil Engineering, Electronic Engineering and Telecommunications, Architecture and Urbanism, Materials Engineering, Mechanical Engineering, Design, and Graphic Expression, Chemical Engineering, Electrical Engineering, Oil and Gas Engineering, and Industrial Engineering.

According to data from the Dean of Education and Graduation (PROEG), in the second semester of 2018, about 2327 students were enrolled in 12 undergraduate courses at the Faculty of Technology. Among the 12 undergraduate courses, there is the Industrial Engineering course, whose teaching activities started in the first semester of 2004 and by the end of the first semester of 2018, around 785 students were enrolled, of which 221 completed the course (UFAM, 2018).

The graduation in Industrial Engineering consists of 10 semesters, with subjects contained in the pedagogical project of the course. To conclude the course, due to the current pedagogical project, in the last two periods, the student must take the disciplines of supervised internship I and supervised internship II, to apply the knowledge, as well as report the experiences with the due monitoring and evaluation of a professor-advisor of these disciplines (UFAM, 2004).

In 2017, a group of students in this course began the work of physically organizing each internship report delivered since 2009, as well as the digital registration of most of the reports approved by the supervisors until the first semester of 2017. The organization was necessary for that the Industrial Engineering Department had a database for historical records and consultation with interested parties.

The research problem lies in the fact that in 2018/2 the teachers of the course were completing their new pedagogical project, seeking to improve the services provided to the students, and at that time there was no scientific research on the profile of the internships carried out by the students over the years.

Thus, the general objective of this article is to investigate the profile of the supervised internship of the Industrial Engineering course at FT/UFAM. To this end, the following specific objectives were outlined: (a) to update the supervised internship reporting database; (b) studying how the internship reporting discipline is covered in the top ten Industrial Engineering courses in Brazil; (c) analyze the profile of the internships carried out by the students of the course.

The research is important for the managers of the course due to the necessary document organization for the presentation to the auditors of the evaluating bodies of the Ministry of Education. The students and teachers of the course will know the main areas of Industrial Engineering in which students are applying their knowledge. It is also relevant to provide the academic community with a reflection on the supervised internship and can serve as a basis for further research.

2. Theoretical Reference

2.1 Supervised Internship in Engineering (MEC Guidelines)

According to Resolution 11 of the National Education Council/Higher Education Chamber of March 11, 2002, which establishes the national curriculum guidelines for the Engineering course in its Article 4, it states that the training of the engineer aims to provide the professional with the knowledge required for the exercise of general competences and skills listed below (CNE/CES, 2002).

- Apply mathematical, scientific, technological and instrumental knowledge to engineering;
- Design and conduct experiments and interpret results;
- Conceive, design and analyze systems, products, and processes;
- Plan, supervise, develop and coordinate engineering projects and services;
- Identify, formulate and solve engineering problems;
- Develop and/or use new tools and techniques;
- Supervise the operation and maintenance of systems;
- Critically evaluate the operation and maintenance of systems;
- Communicate effectively in written, oral and graphic forms;
- Work in multidisciplinary teams;

- Understand and apply professional ethics and responsibility;
- Assess the impact of engineering activities in the social and environmental context;
- Assess the economic viability of engineering projects;
- Assume the position of a permanent search for professional updating.

Therefore, the skills/competencies listed must be developed or part of them started, not only with the theoretical knowledge transmitted in the classroom but also with the student's performance in the practical field through a supervised internship.

The article 7 deals with the conclusion of the student's graduation in the Engineering course, including the performance of mandatory curricular internships under the direct supervision of the teaching institute, through technical reports and individualized monitoring during the period of activity realization.

2.2 The Law that conceptualizes and regulates the internship in Brazil

Law 11,788 / 2008 of September 25, 2008, conceptualizes the internship as a supervised educational act, aiming at preparing the student as a citizen and worker, through the effective application of the knowledge acquired at school, and the development of their skills.

Internship is a supervised school educational act, developed in the work environment, which aims to prepare students for productive work who are attending regular education in institutions of higher education, professional education, high school, special education and the final years of elementary education, in the professional modality of youth and adult education (BRASIL, 2018).

This law has six chapters that address: a) Chapter I: deals with the definition, classification, and relationship of the internship; b) Chapter II: deals with the educational institution; c) Chapter III: addresses the granting part; d) Chapter IV: addresses the intern; e) Chapter V: deals with inspection; f) Chapter VI: deals with final considerations.

2.3 The Importance of Supervised Internship

For Tonini and Lima (2008) the “knowledge society” requires jobs that are increasingly aware of the need for technical, human and theoretical knowledge, but for this productive configuration, it demands teaching that allows the development of skills for the training of a worker “ thinking-performer ”, able to perform both the technical and the intellectual field. Thus, a solid foundation of the student's training in the field of performance of the internship is necessary to have a better use, but this moment, in principle, occurs when the student is taking the professional and specific subjects. This way, will more security to carry out the activities.

According to Morin (2001), to develop and organize knowledge and thus know about environmental issues, reform of thought is necessary, this being the fundamental question of education and refers to the ability of each subject to organize articulated and organized knowledge in engineering practice. This practice sought in the curricular internship must not be contextualized only in pure technicality, in the use of technology, in know-how. Other values must be added to this activity: human, social, political and environmental values.

The supervised Curricular Internship is one of the answers to the challenges faced by students, among which are inexperience and insecurity and which, also, allows to reconcile the theory seen in the academic world with practice. It also makes it possible to complement professional training based on two pillars:

learning and entrepreneurship. On the other hand, the internship has fundamental importance for companies, as it is there that they find the link that connects them to the academic environment and serves as a means to pass on their needs and market trends (PADOIN, 2001).

For Rios (2003), the internship is relevant to awaken the professional vocation, obtain knowledge of different types of companies, offers experiences in the field of human relationships, apply the knowledge acquired at the university and can bring doubts to the classroom, as well how to enable the student to obtain employment in his future professional career.

3. Methodology

The research is applied, descriptive and involved in a bibliographic and documentary study. The research methodology had the following steps:

3.1 To update and organize the supervised internship reports

In January 2017, a group of volunteer students from the Industrial Engineering course started collecting data using spreadsheets and folders in electronic format. The organization of the physical collection was made alphabetically in boxes referring to the supervised internship reports held by the course department. This work was completed in December 2017, and it is necessary to continue updating the collection for the periods of 2017/2 and 2018/1. Thus, in August 2018, the physical and digital collection was organized and updated in the remaining periods, involving 34 reports in possession of the course coordinator. In all, 276 reports of internships I and 227 reports of internships II of the course were registered.

3.2 To collect information from the ten best Industrial Engineering courses in Brazil

During the second half of October 2018, the ten best courses in Industrial Engineering in Brazil were chosen using the Folha University Ranking (RUF), which is held annually by the newspaper Folha de São Paulo, to evaluate the courses higher education institutions that are offered by public and private institutions. At the time the research was carried out, the RUF of 2017 was used, whose ten best courses in Industrial Engineering in the country are shown in Chart 1.

Ranking	Institutions	State
1º	Federal University of Rio de Janeiro (UFRJ)	RJ
2º	University of São Paulo (USP)	SP
3º	Federal University of Santa Catarina (UFSC)	SC
4º	Federal University of Minas Gerais (UFMG)	MG
5º	State University of Campinas (UNICAMP)	SP
6º	Federal University of São Carlos (UFSCAR)	SP
7º	Federal University of Paraná (UFPR)	PR
8º	Federal University of Rio Grande do Sul (UFRGS)	RS
9º	Paulista State University of Júlio de Mesquita Filho	SP
10º	Federal University Fluminense (UFF)	RJ

Chart 1: The ten best courses in Industrial Engineering in Brazil in 2017.

Source: Jornal Folha de São Paulo (2017)

From there, a study was carried out on the pedagogical projects of these courses to identify the profile of the supervised internship discipline, observing the nomenclature of the subject, the semester workload, the period/semester in which the discipline is offered to students and which the method of evaluation by the teacher-supervisors.

3.3 To define the variables and prepare tables and figures

During the first half of November 2018, the variables were defined so that the data collected from the supervised internship report bank of the Industrial Engineering course at FT/UFAM could be analyzed, observing the average of the grades of the reports delivered, the student's areas of practice in the internship field and the number of reports evaluated per year.

Finally, the analysis was performed with an electronic spreadsheet and descriptive statistics, to generate the tables and figures for the discussion of the results.

4. Discussion

4.1 The profile of supervised internship of the ten best Industrial Engineering courses in Brazil

Table 1 presents the main characteristics of the supervised internship discipline in the ten best Industrial Engineering courses in Brazil in 2017.

Table 1: Supervised Internship Characteristics in the 10 best EP courses in Brazil

Universities	Course Name	CHS	Semester	Type
UFRJ	Mandatory internship	160	9º	Report
USP	Supervised Internship	195	9º	Report
UFSC	Supervised Internship in Industrial Engineering	450	9º	Report
UFMG	Curricular internship I and II	60	7º/8º	Report
UNICAMP	Curricular internship I and II	60	9º/10º	Report
UFSCAR	Supervised Internship for Industrial Engineering	180	10º	Report
UFPR	Internship I and II	120	9º/10º	Report
UFRGS	Supervised Internship	240	8º	Report
UNESP	Internship I and II	90	9º/10º	Report
UFF	Supervised Internship	160	10º	Report

Source: Author (2018)

The results show that:

1st) there is no uniformity as to the name of the supervised internship subjects, but half of the courses designate the subject as Supervised Internship, twenty percent as a curricular internship, another twenty percent as an Internship and ten percent as a mandatory internship;

2nd) 40% of the courses separate the discipline in two semesters, 50% offer the discipline in just one semester and only 10% there is not even information about the semester in which the discipline is offered;

3rd) the average course load per semester is 173 hours, highlighting the courses at UFSC and UFRGS with the highest semester load of 450 hours and 244 hours, respectively. Moreover, the courses of UNICAMP

and UFMG with the lowest semester load of 60 hours each.

4th) the majority (60%) of the courses offer the supervised internship discipline in the last two periods of the year, except the courses from UFMG and UFRGS that offer the discipline in the 7th/8th period;

5th) in all cases, the students of the discipline are evaluated using a report.

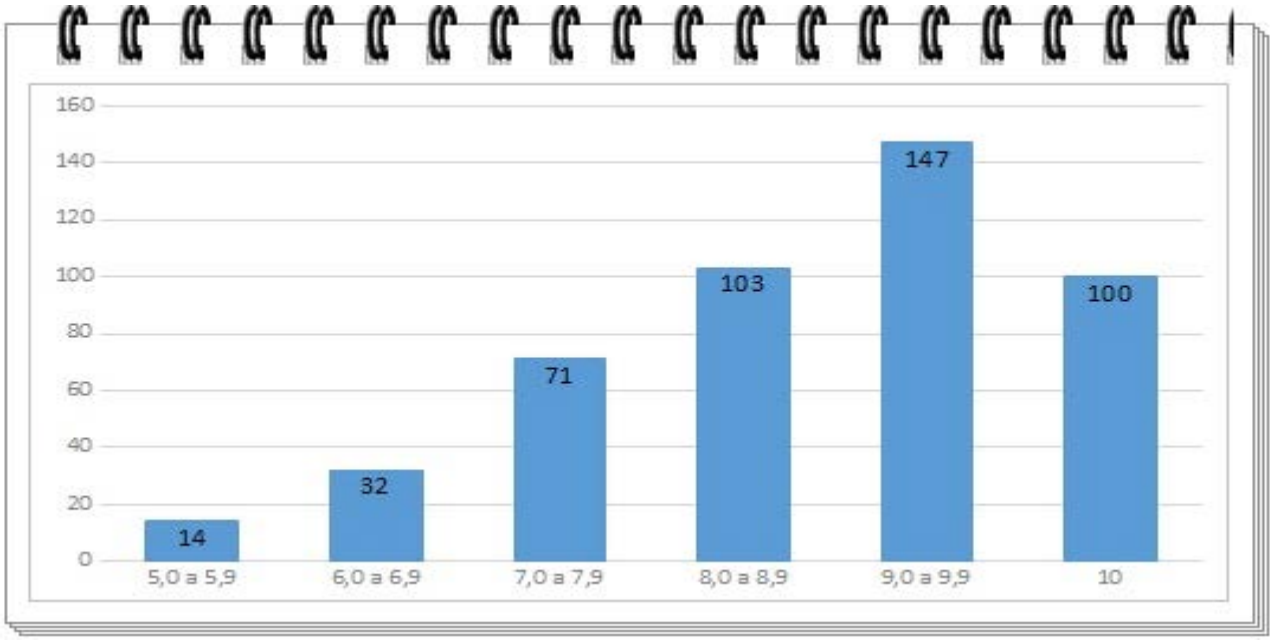

Figure 1: Number of supervised internship reports approved by grade interval.
Source: Author (2018)

4.2 The profile FT//UFAM Industrial Engineering course supervised internship

According to the Pedagogical Project of the Industrial Engineering course that was in effect in the second half of 2018, the Supervised Internship discipline is offered in the 9th and 10th periods, each with a total workload of 210 hours, totaling 420 hours. To be approved in the disciplines, the student must obtain a grade equal to or higher than 5 points, attend the guidelines and have a minimum frequency of 75%.

When analyzing the profile of the interns, it was observed that the majority (63%) are male, while 37% are female.

Regarding the type of organization in which the internship acted, it was observed that most internships are in the industry (76%), while the rest (24%) are in commerce and services.

When analyzing the average score value of all reports (275 Internship I reports and 226 Internship II reports), the arithmetic mean of 8.56 points and a median of 9.0 points were obtained. Figure 1 shows the number of reports approved per grade range, and it is possible to see that most are between 8 and 10 points. Looking at each interval in more detail, first, it goes from 5 to 5.9 points, with 14 (3%) reports. The second interval is equivalent to scores of 6.0 to 6.9 points, where 32 (6.85%) reports were found. The third interval is equivalent to 71 (15.20%) approved reports with scores between 7.0 to 7.9 points. The fourth interval is equivalent to reports approved with a score of 8.0 to 8.9, which were 103 (22.06%). The fifth interval is equivalent to the marks of 9.0 to 9.9 in which it deserves a highlight because it contains the majority (147; 31.48%) of the reports delivered. The sixth interval is equivalent to the reports delivered that obtained a

score of 10 in the evaluation of their advisor, there are about 100 (21.41%) reports.

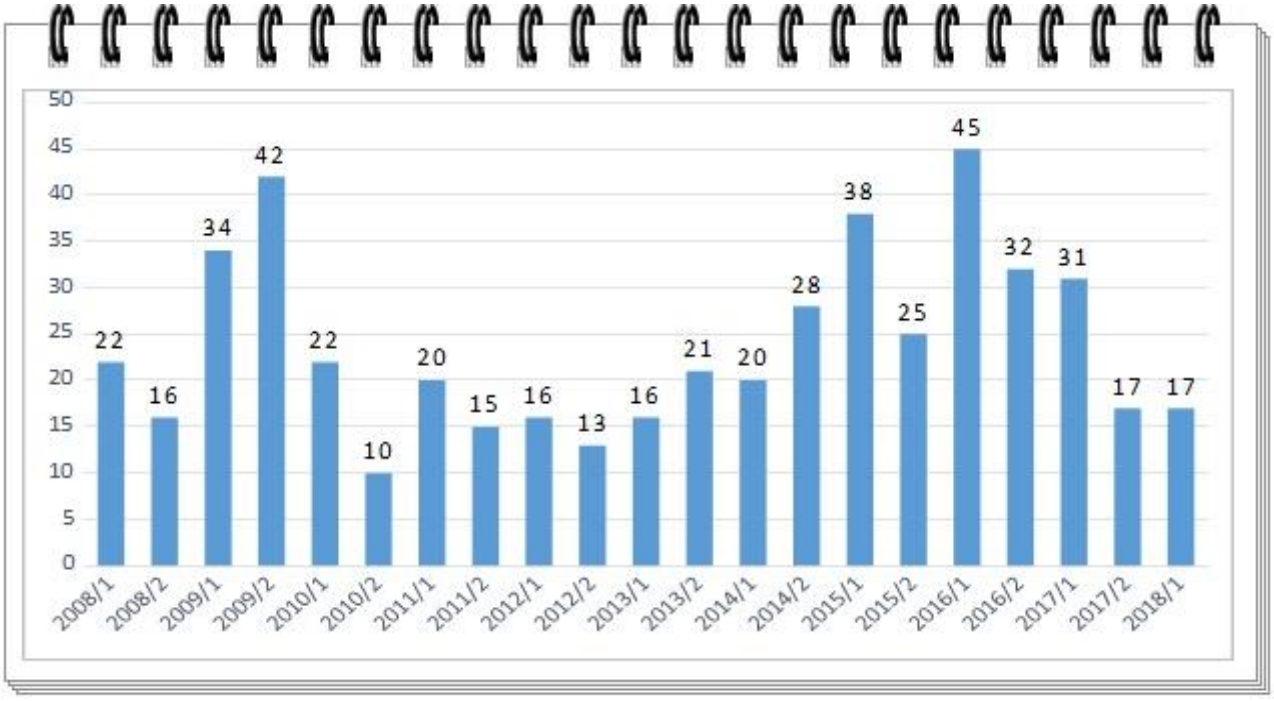

Figure 2: Number of internship reports approved per semester between 2008/1 and 2018/1
Source: Author (2018)

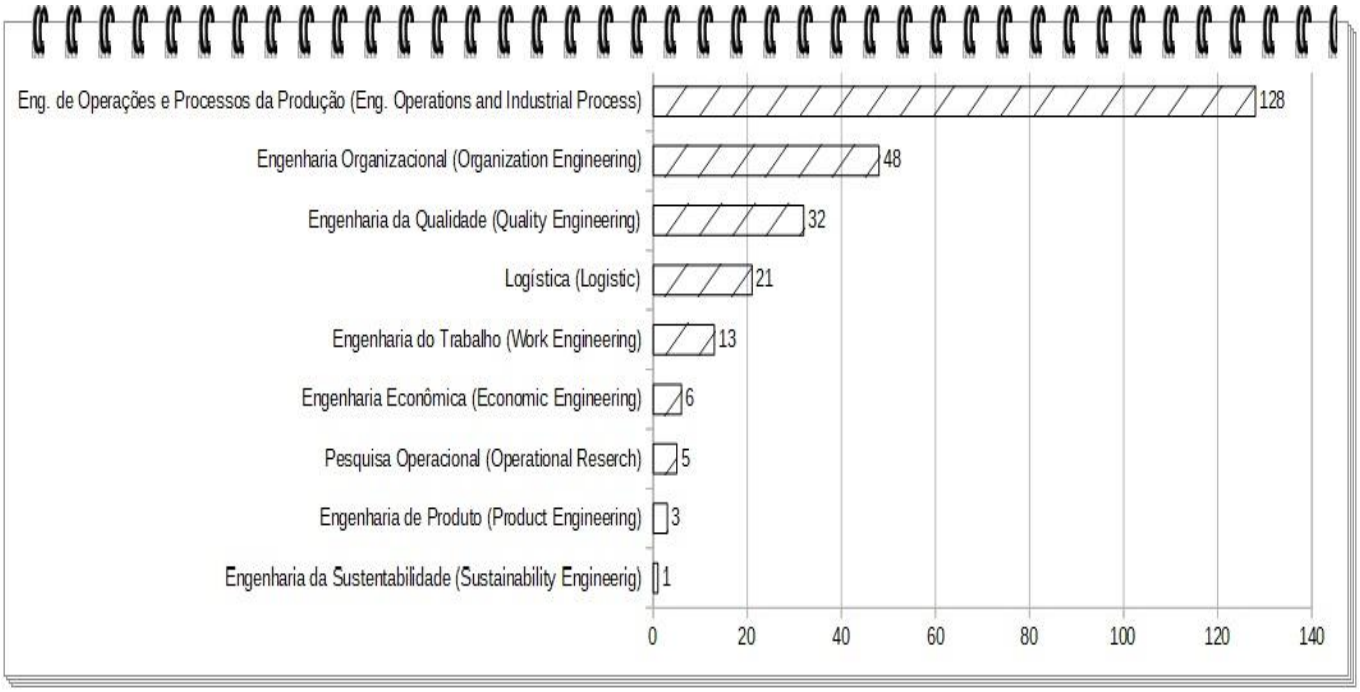

Figure 3: Industrial Engineering areas in which trainees worked between 2008/1 and 2018/1
Source: Author (2018)

Regarding the evolution of the number of supervised reports delivered over time, Figure 2 points out that the first 22 reports were delivered in the first half of 2008, with a slight drop (16) in the following semester. In general, the years 2009 and 2016 were the ones that presented the greatest amount of internship report delivery, while 2012 was the year that presented the lowest volume of reports, perhaps due to the low

number of teachers to guide students, as well as the strike that happened that year and that lasted for about 119 days.

In relation to the ten areas of Industrial Engineering in which the intern worked, Figure 3 points out that Engineering of Operations and Production Processes (128 = 49.23%), Organizational Engineering (48 = 18.46%), Quality Engineering (32 = 12.31%), Logistics (21 = 8.08%) and Labor Engineering (13 = 5.0%) were the areas that most concentrated the internships, while Sustainability Engineering (1 = 0.38%); Product Engineering (3 = 1.15%), Operational Research (5 = 1.92%) and Economic Engineering (6 = 2.31%) were the least represented.

5. Final considerations

The article analyzed the profile of the supervised internship of the graduates of the Industrial Engineering course at FT/UFAM between 2008/1 and 2018/1. After analyzing the data, it was concluded that:

a) about the Supervised Internship discipline in the 10 best Industrial Engineering courses in Brazil, it was observed that there is no standard nomenclature and workload. Also, the discipline is offered in most cases (60%) in two periods. New research can be carried out to identify how the managers of these ten courses are approaching the industry, commerce, and the public service to form partnerships and increase access for university students in these segments;

b) concerning the profile of the discipline in the FT/UFAM`s Industrial Engineering course, it was identified that a good number of reports delivered obtained scores between 8 and 10 points, with an average value of 8.56 points and a median of 9.0 points. Besides, 76% of the reports were written by interns who worked in the industrial sector, reason by which it is recommended that the managers of the course, form partnerships with organizations that work in commerce and other sectors of the service, to stimulate the performance of the internship in these segments;

c) the study also made it possible to identify that in the Industrial Engineering course at UFAM, the five areas of the greatest performance of the interns were: Operations Engineering and Production Processes, Organizational Engineering, Quality Engineering, Logistics, and Work Engineering. On the other hand, it is recommended that the department invest efforts to encourage teachers and students to research on subjects related to areas with low demand for internships, especially Sustainability Engineering, Product Engineering, and Operational Research.

6. Acknowledgments

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Parameters to reduce waste in the paper curl process in a PIM company

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Abstract

In a highly competitive environment among companies, standardization of processes has been one of the means to reduce errors, defects, and costs. Thus, the objective of this study is to investigate what is the best standard with parameters to be applied to the manufacture of corrugated cardboard in a company in the Industrial Pole of Manaus (PIM), aiming to reduce the number of wastes from this process. The data were collected from the production management system of company X and analyzed through brainstorming with the employees of the studied process. At the end of the research it was concluded that the parameters that most influence the generation of approximately 9 types of scrap are: (a) Temperature of the cover and core; b) Press pressure; c) Corrugate pressure; d) Glue crack; e) Pressure of the coil door brakes. To reduce factory waste, a standardized list was proposed containing the parameters for each composition, observing the peculiarities of this production process.

Keywords*:* Corrugated cardboard; Standardization; Parameterization;

1. Introduction

In 2016, the Brazilian corrugated cardboard packaging industry had a turnover of R$12 billion, employing around 32,000 people (ABRE, 2017). Within this scenario is the company object of this study, which for confidentiality purposes will be called Company X. It has been located in PIM for over 30 years and a large part of its demand is focused on the local market, mainly the electronics industry, supplying around 1500 tons of boxes monthly.

Company X has recorded losses due to the high level of waste generated in the production sector. This sector is divided into 2 areas, that of printers, responsible for printing and cutting boxes, and the corrugation area, responsible for the manufacture of cardboard sheets, where most of the waste generated in the sector is concentrated, which is why will be the focus of this study.

The main machine in the corrugation sector has several problems related to maintenance, but which do not interfere much in its performance and product quality. The employees in this area are trained and knowledgeable about the process. Lately, the company has been using raw material from several different suppliers, demanding even more from the process, this showed that the main deficiency of the corrugation process was the lack of standardization of the parameters used to manufacture the different types of cardboard. The lack of this standard may be generating waste of more than 3% of the total scrap of the

factory, especially in curved, peeled and cardboard sheets.

Thus, the objective of this study is to investigate what is the best standard of the parameters to be applied to the manufacture of corrugated cardboard, aiming to reduce the numbers of the aforementioned scrap. Therefore, this article sought to investigate the state of the art concerning standardization and statistical control of similar processes, to propose the ideal parameters for the manufacture of the main types of cardboard used in this industry.

For the company, the importance of this study is the reduction of costs, gains in productivity, a more structured operation, in addition to gains in efficiency and effectiveness in the process. For Dennis (2008), the standard is the foundation of production, meaning that all production parameters must be clearly defined, being a precise image of the ideal desired condition to achieve excellence in processes and products.

For customers, the importance is the gain in product quality and greater reliability in the company.

For the academy, it is gain in the state of the art of a productive process that is still poorly explored by scientific studies.

2. Theoretical Referential

2.1 Corrugated cardboard

2.1.1 Structure

Corrugated cardboard (Figure 1) is a flat structure formed by one or more corrugated elements (core=miolo) attached to two or more flat elements (cover=capa), using an adhesive (glue) applied to the top of the waves by automatic equipment scrolling.

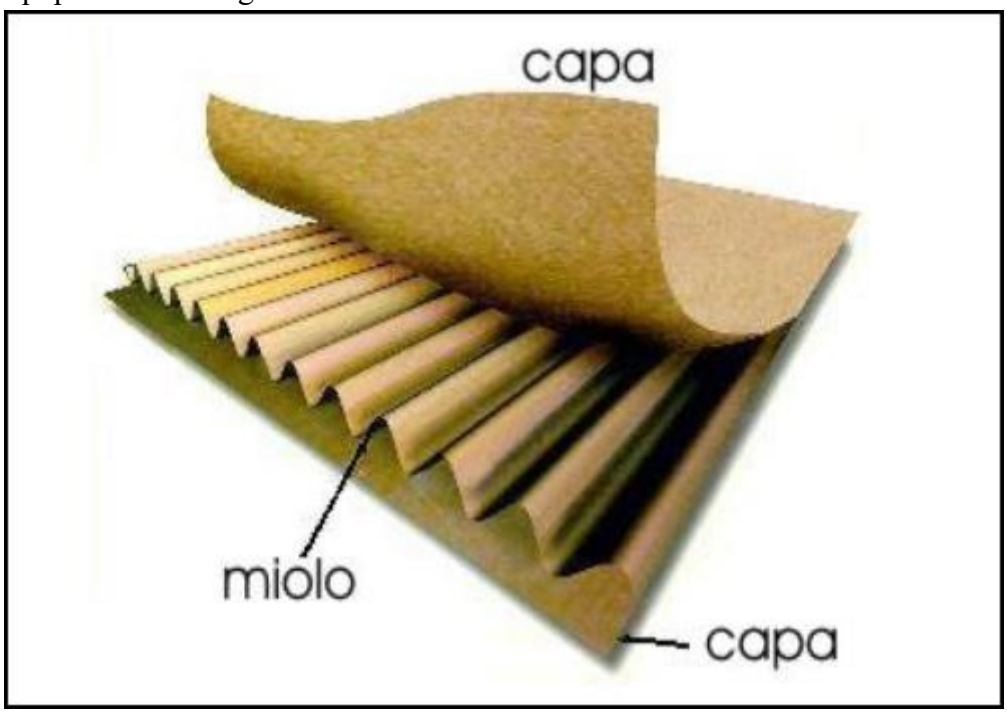

Figure 1 – Corrugated cardboard structure

Source: ABRE (2017)

The core of the corrugated board is formed by waves that are made in the paper during the manufacturing process, it is this configuration that gives the strength and the mechanical characteristics of the corrugated

cardboard. The waves differ by their height, in which each composition will give different qualities to the cardboard.

Company X uses only waves of types B and C, and Chart 1 contains the classification of the waves most used by the industry and their main characteristics.

Types of Wave	Height in mm	Waves per meter
A	5,0	110
C	3,8	130
B	2,6	150
E	1,2	300
F	0,7	450
G and N	0,5	550

Chart 1 – Characteristics of the types of wave

Source: Author (2017)

Cardboard sheets can be formed by joining 2 or more waves (core) which are interspersed with covers. This results in combinations widely used in the market, such as the BC model, which is the union of waves B and C, giving greater resistance to cardboard. According to the Brazilian Corrugated Cardboard Association (ABPO), corrugated papers are classified as described in Chart 2.

	Simple face: structure formed by a corrugated element (core) glued to a flat element (cover).
	Simple wall: structure formed by a corrugated element (core) glued, on both sides, to flat elements (covers).
	Double wall: structure formed by three flat elements (covers) glued to two corrugated elements (core) intercalary.
	Triple wall: structure formed by four flat elements (covers) glued in three corrugated elements (core) intercalary.
	Multiple wall: structure formed by five or more flat elements (cover) glued to four or more corrugated elements (core) intercalary.

Chart 2 – Classification of the types of corrugated cardboard.

Source: ABPO (2015)

2.1.2 Properties

The paper used to manufacture the corrugated cardboard is the kraftliner or testliner, depending on the raw material used for its manufacture, and whether it will be used in the cover or core. These papers are still

classified according to their weight (g/m²) which is the average weight in grams of a square meter of the paper, this same concept is also applicable to corrugated cardboard.

When the cover is made predominantly of virgin fibers, it is called Kraftliner (higher quality), when the predominance is made of recycled fibers it is called Testliner (lightly lower quality). Core paper is invariably produced from recycled paper and can weigh from 70 to 120 g/m2.

2.1.3 Manufacturing

The machines used to manufacture corrugated cardboard are called corrugator, which is the only machine that makes up the corrugation sector, so this is where the focus of this study will be. The process starts with the fixing of the paper reels on spindles attached to the machine, the reels are passed through the tensioning spindles that will keep the paper with the ideal tension during manufacture.

Figure 2 shows that the paper used for the core first passes through the tensioning rollers, then through the preheating roll (Rolo pré aquecedor), where it will be heated to the ideal temperature depending on the weight of the kraft. Right after it passes between two corrugated cylinders (Cilindros corrugadores) that, by a pressure process, take on a corrugated shape. Glue (Aplicador de Cola) is applied over the top of the formed waves, where the cover will be fixed, which in turn also passed through tensioning rollers and preheaters. The entire process is subjected to the action of heat.

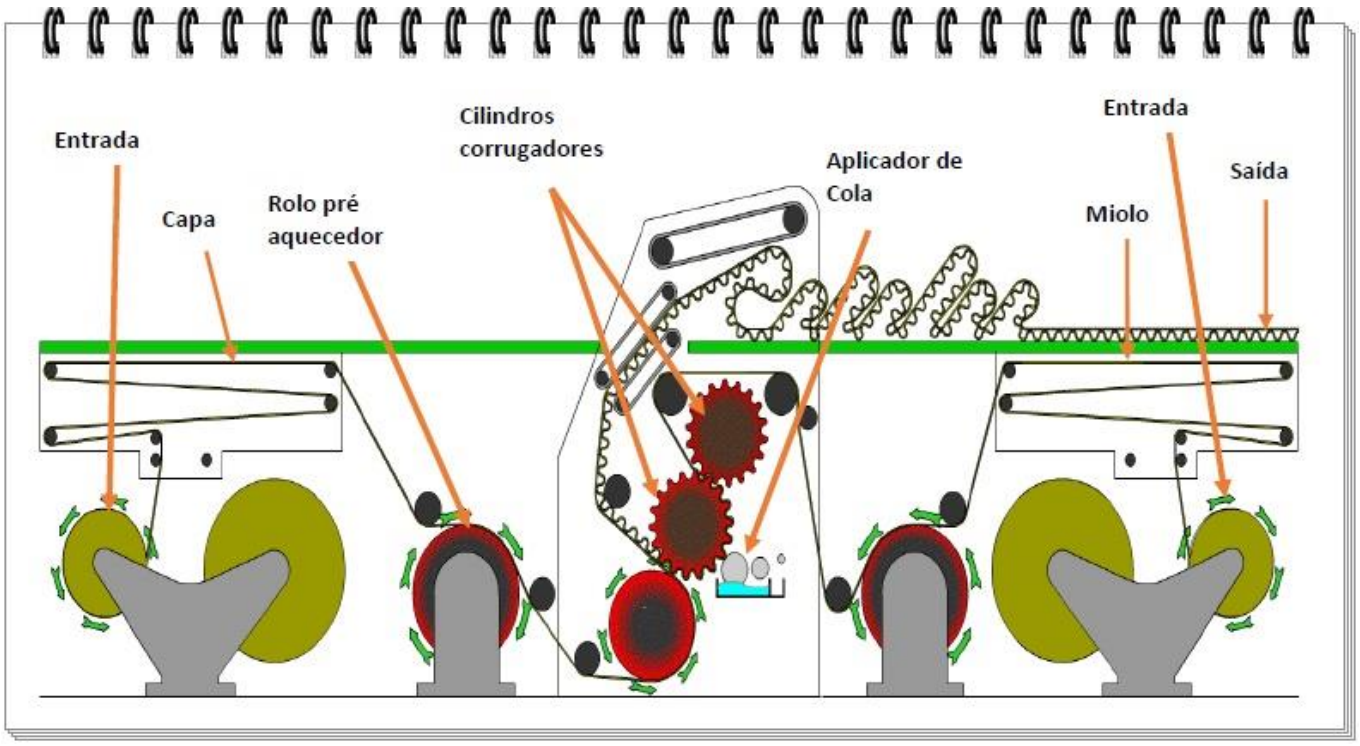

Figure 2 – Paper corrugating process on the cylinder head part

Source: Author (2017)

This process occurs in the part of the corrugator called the cylinder head, from where the simple face (face simples) with the inner cover comes out. In the next part of the machine, glue (aplicador de cola) is applied to the top of the exposed wave of the core, where the outer cover will be glued, the whole process also subjected to the application of heat. This process occurs in the part of the corrugator called "Forradeira"

(Figure 3).

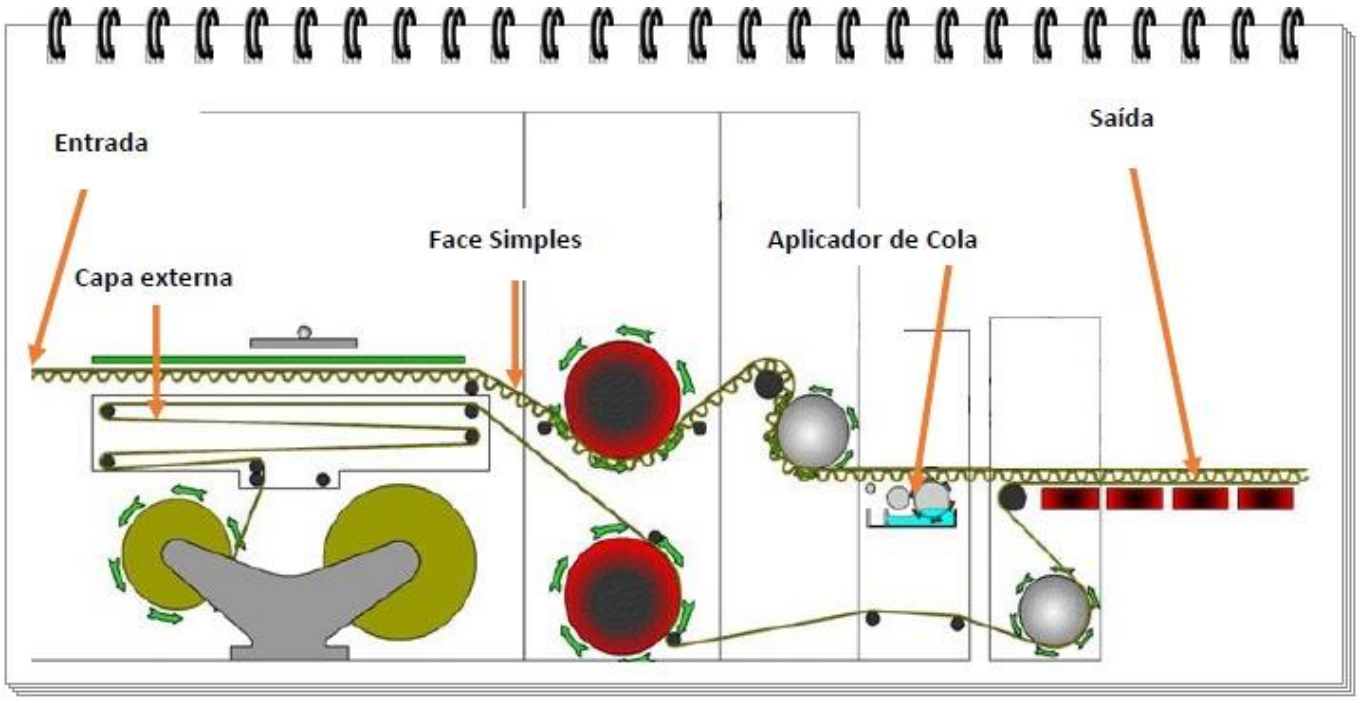

Figure 3 – Process of bonding the outer cover of the cardboard to the corrugator "forradeira" part
Source: Author (2017)

2.2 Standardization of Processes

Since the works of Taylor and Gilbreth, standardization of processes has been used as one of the main tools for process improvement and waste reduction. Since it is used to control, predict and minimize errors and deviations (SANDOFF, 2005), which are certainly one of the biggest villains of scrap within a factory.

When a company standardizes a process, it is guaranteeing that the products produced will be executed equally by any operator, in any shift provided that the mechanical and operational conditions are the same. According to Campus (1994) standard is the planning of the work to be performed by the employee or by the company. A standard indicates a goal to be achieved, shows the product or the ideal scenario to manufacture this product with high quality at the right time.

Employees must be trained and well educated not only about the service they will perform but about the entire context of the company (CREMONESE, 2013). It is important that when presenting the standard to the employee, he has a critical sense of reacting to errors caused by this standard and is motivated to propose improvements to the defined parameters whenever the customer or other sectors of the factory are being negatively affected.

It is not enough just to impose a new standard on employees, it needs to be created with those involved so that each one can give an opinion and be heard. This co-participation generates a feeling of "business owner" in the employee, bringing him greater responsibility and motivation. Thus, avoiding treating them as a mere substitute for a machine and prioritizing participatory management, there will be much less resistance to changes and, therefore, the chances of success of the standardization process will increase considerably (KONDO, 2000).

According to Perin (2005), the standardized process can reach high levels of quality and productivity since

the result is to obtain the reproduction repeatedly of a “best practice” for the activity.

For Cavanha Filho (apud JUNIOR EFIVAL, 2009) there are at least three different types of standardization in an industrial production environment, which are:

a) specification or technique: when it is intended to standardize tangible or intangible goods, such as materials, equipment, services, among others;

b) procedures: when it is intended to standardize how the activities internal to the organization are carried out, such as purchases, production, sales, etc;

c) documentary: when it is intended to standardize the documentation issued by the organization.

According to the methodology presented by Harrington apud Marccelli (2000), the improvement of processes is divided into 5 sub-processes or phases with related activities that are presented below:

Phase I: organization for improvement: define critical business processes; Select process owners; Define the preliminary limits of the processes; Form and train improvement teams; Define the limits of the processes; Establish Performance Indicators; Develop the Project;

Phase II: understanding of the process: elaborating a Process Flowchart; Prepare a simulation model; Conduct an on-site investigation process; Develop cost and cycle time analysis; Implement quick and immediate improvements; Align the procedures to the process;

Phase III: simplifying the process: redesigning the process (focusing on improvement); Design a new process (process reengineering; process innovation; macro process analysis); Macro Analysis; Theory of Restrictions; Automation, Mechanization, Computerization; Organizational Restructuring; Process Simulation. Benchmarking of the process; Improvement, costing and risk analysis; Select the best process; Preliminary implementation plan;

Phase IV: implementation and control: implementing a new process; perform measurements in the process; use feedback system; manage Quality costs.

Phase V: continuous improvement: seeking to carry out critical analysis in each process, identifying and implementing improvements over time.

3. Methodology

For data collection, the period used was from January to September 2017, these data were analyzed from September to October 2017. The entire investigation took place in the manufacturing environment of company X, more specifically in the waving sector, where the corrugating machine is located. The research steps are described in sections 3.1 and 3.2.

3.1 Data Collection

To elucidate the effects that the lack of standardization of the parameters causes, the productivity data of the corrugating machine, located in the corrugation sector, were taken from the reports of the factory's production management system, which monitors all material handling, performance machines, and production orders.

The scrap data was collected from the spreadsheet where the daily scrap weight of the day is allocated by reason and sector. Benchmark meetings were held in September 2017 with other units of the company that

had similar machines and processes. The objective was to learn about the standardization used by these factories, the complexity of their processes, in addition to surveying all material used by them for parameterizing the process.

Through productivity reports extracted from the production management system KiwiPlan used by the company, a survey was made of the formats that are mostly manufactured to be the first to be parameterized, formats that will be presented in the results chapter of this article.

Finally, raw material inspection procedures were collected from the quality team, in this case, kraft paper, and paper core, to assess how much the lack of these inspections could damage the process variability.

3.2 Data analysis

In October 2017, brainstorming meetings were held with process supervisors and machine operators, to discuss the difficulties of the process, analyze the reports generated in the system (stops, machine availability, scrap, productivity), to communicate the operators of the current situation of the machine, making them reflect on the immediate need to parameterize the corrugator machine variables, located in the corrugation process.

Cylinder Head Parameters	Forradeira Parameters
Cover Temperature	Inner Cover Temperature
Core Temperature	Outer Cover Temperature
Press Roller Pressure	Glue Crack
Corrugator Pressure	Paper reel brake pressure of the outer cover
Glue Crack	Simple side brake pressure on the bridge aligner
Paper reel brake pressure of the inner cover	
Paper reel brake pressure of the core paper	

Chart 3 – Standardized variables

Source: Author

From the debates, parameters were raised that are always adjusted to manufacture each cardboard format. This part of the research was very empirical, based on the experience of the employees to obtain the average values of the variables that were being standardized. Thus, a range of variation was defined based on the lowest and highest value of the parameter so that the paper had quality, values that will be shown in the results chapter of this study.

Then the parameters defined by the operators went through the evaluation stage, where the process was monitored to see if the parameters needed different adjustments for the manufacture of each type of cardboard.

The Chart 3 shows the parameters chosen to have their values standardized on the two parts of the corrugating machine.

4. Discussion

The results are divided into four topics, the first addressing a more detailed survey of the main scrap generated in the process, in addition to showing a graph of availability of the printers, evidencing the impact of the lack of standardization of the corrugating machine. The second presents the correlation between the major reasons for scrap and the variables to be parameterized, then the types of cardboard that will have their standardized variables are presented. Finally, the standards established for each type of composition mentioned in the previous topic are displayed.

4.1 scrap generated in the corrugating process

In 2017, company X started to carry out a scrap control with separation in percentage by type of scrap. This control made the action plans for the reduction of scrap more precise and specific, in addition to being able to visualize with greater clarity of data the highest index of the scrap of the plant.

It was found that more than 4.28% of scrap in 2017 was generated in the corrugation sector, with the sector with the highest percentage of plant scrap (corrugation Sector = 4.28%; Printers Sector = 3.01 %; Commercial Sector = 0.55% and Logistics Sector = 0.03%), taking into account the figures up to September 2017. Also, the corrugation sector is the place where operational improvement actions affect, with opportunities for the intervention of low-cost actions.

Table 1 – Types of waste in the corrugating sector

Types of waste	%
Curved plates	0,54%
Peeled plates	0,39%
Dried plate with bubbles	0,25%
Simple side	0,20%
Wave Kneading	0,18%
False Folded Cardboard	0,18%
Glued Plates	0,13%
Bushing	0,08%
Wet plates	0,04%

Source: Author

Table 1 shows the largest types of scrap in the corrugating sector in decreasing order by percentage about the gross cardboard production of company X, with curved plates (0.54%), peeled plates (0.39%) and dried plates with Bubbles (0.25%) were the main causes of scrap.

The waste shown in Table 1 can impact other indicators and sectors of the plant. When poor quality sheets are not filtered in the corrugator, they cause enormous inconvenience in the printer sector, making their

work more difficult. Figure 4 shows the number of hours the printers stopped due to bad material coming from the corrugator.

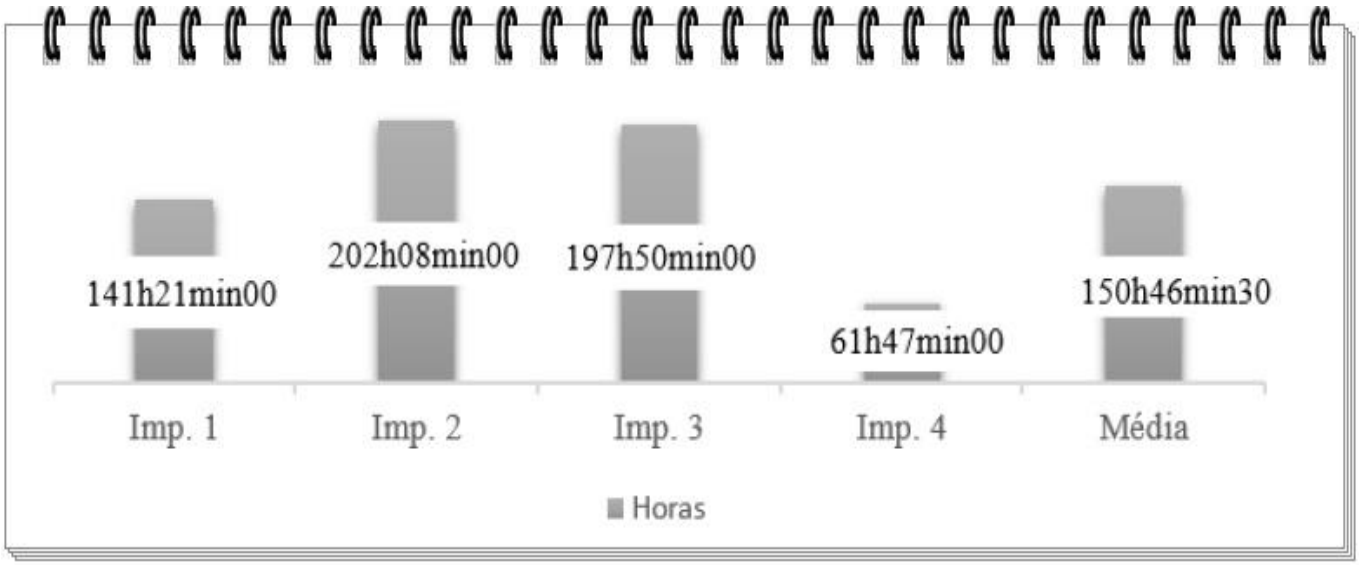

Figure 4 – Machine downtime per printer
Source: KiwiPlan (2017)

To be aware of the impact size, printer 2, which was the most affected, the number of hours stopped is equivalent to 14 days of production, if you consider all printers, there are 43 days with production stopped. Figure 4 shows the time (in hours) of machine stops caused by the poor quality of cardboard coming from the corrugator between January and September 2017.

4.2 Influence of parameters on waste generation

All the wastes shown above are directly related to the process parameters shown in the methodology of this study. These parameters are always adjusted at the beginning of each order.

Chart 4 shows the influence of the parameters on the largest types of scrap, with the left column showing the parameter that influences the scrap in the right column.

It can be seen that the lack of control of the temperature parameter in several parts of the machine and the wrong amount of glue application (glue crack) are causes of many process non-conformities.

This is because each composition requires different temperatures and glue levels, due to the weight characteristics of the cover and core papers.

Parameters	***Influenced parameters***
Cover and core temperature in the cylinder head and “forradeira”	Curved plates
	Dried plate with bubbles
	Bushing
	Wet plates

Press Pressure	Wave Kneading
Corrugated pressure	Wave Kneading
	Curved plates
Glue crack	Peeled plates and Glued plates
Coil door brake pressure	Simple side and false folded

Chart 4 – Relationship of parameters to the reasons for scrap in the corrugation sector
Source: Author

4.3 General characteristics of the compositions

The composition is the name given for the union of the kraft papers that will be used in the cover and core, where the combination of both will give peculiar characteristics to the cardboard depending on its weight. Company X uses 4 types of paper, its weights are 110g, 117g, 165g, and 190g. The inner and outer covers of the kraft papers used are O2, O3, and O5. So if the cardboard formed by the inner and outer covers of type O2 and the core of type 165g with type B wave, then the reference of this composition will be O2O2/B-R.

The rule for parameterization is simple, the greater the weight of the elements that make up the cardboard, the greater the values of the parameters. This means that the temperature applied to a composition containing O5 paper must be higher than the temperature applied to a composition containing O2 paper.

Chart 5 shows the 10 compositions with the highest production volume in 2017, which will be the first to be standardized and will serve as a pilot test. Also, this table shows the main characteristics of these compositions.

And Chart 6 (Appendix A) does not present exact values of the parameters, but variations, due to the particularity of this type of production process, as the paper corrugating process is not 100% reliable. It is worth noting that there are many equal values for various parameters between the compositions, this is due to the similarity of the compositions that often only change the quality of one of the covers or the type of the wave.

Composition	**Characteristics**
O303/C-R	Simple wall cardboard with intermediate weight paper
O2O2/B	Simple wall cardboard with light weight paper
O3O3/BC	Double wall cardboard with intermediate weight paper
O5O3/C-R	Simple wall cardboard with between high and intermediate weight paper
O3O3/C	Simple wall cardboard with intermediate weight paper
O3O3/B-R	Simple wall cardboard with intermediate weight paper
O5O5O5/BC	Double wall cardboard with high weight paper

O2O2/C	Simple wall cardboard with light weight paper
O5O5/C-R	Simple wall cardboard with high weight paper
O5O5/BC	Double wall cardboard with high weight paper

Chart 5 – The characteristics of ten compositions
Source: Author

5. Conclusions

The objective of this study was to investigate the best standard of the parameters to be applied to the manufacture of corrugated sheets, aiming to reduce the amount of scrap from the factory. Therefore, this article sought to investigate the state of the art concerning standardization and statistical control of similar processes, to propose the ideal parameters for the manufacture of the main types of cardboard used in this industry.

After data collection and analysis, the Chart 6 was generated with the necessary parameters for the production of the 10 most corrugated cardboard compositions manufactured by company X. It is worth emphasizing the importance of the reporting system and indicators that company X provided, allowing access to all information necessary for decision making. The participation of employees who are directly involved with the operation was of great value so that in this first moment the parameters are more reliable and accurate.

Therefore, it is concluded that the parameters that most influence the generation of approximately 9 types of scrap are: (a) Temperature of the cap and core in the cylinder head and "forradeira"; b) Press pressure; c) Corrugate pressure; d) Glue crack; e) Pressure of the coil door brakes. To reduce factory waste, a standardized list was proposed containing the parameters for each composition, observing the peculiarities of this production process. The proposal, if adopted with other management measures, has the potential to assist in the reduction of waste in the process, as these problems are centered on the lack of control of the parameters raised by this study. Also, the company can gain in productivity, since the problems generated by the lack of standardization of the corrugator parameters generate many hours of stoppages in the printer sector.

This study was limited to a specific process of corrugating paper, without addressing the entire production chain of corrugated cardboard, from the manufacture of kraft paper, which is a major influence on the quality of cardboard, and it is recommended to conduct research to address these processes.

In this first moment, the opportunities for improvement in the machinery were not taken into account. Besides, the study did not focus on processes related to post curling (storage, printing, etc.). Thus, it remains a proposal for further studies for the creation of process control charts more suitable for the peculiarities of the factory. It is also recommended to research the raw materials used, their specifications and formulate quality control tests for them.

6. Appendix A

LIST OF PARAMETERS	COMPOSITIONS				
	O3O3/C-R	**O2O2/B**	**O3O3/BC**	**O5O3/C-R**	**O3O3/C**
Cylinder Head Parameters					
Cover temperature	60 to 90 ºC	65 to 75 ºC	75 to 85 ºC	65 to 90 ºC	60 to 90 ºC
Core temperature	65 to 85 ºC	70 to 80 ºC	80 to 90 ºC	70 to 85 ºC	65 to 85 ºC
Press Roller Pressure	45 to 55 Kfg	50 to 55 Kfg	56 to 59 Kfg	47 to 54 Kfg	45 to 55 Kfg
Corrugator Pressure	55 to 60 Kfg	50 to 55 Kfg	55 to 60 Kfg	57 to 60 Kfg	55 to 60 Kfg
Glue crack	10 to 20 mm	25 to 30 mm	30 to 35 mm	15 to 20 mm	10 to 20 mm
Paper reel brake pressure of the inner cover	1 to 2 Bar	1 Bar	1 Bar	1,5 to 2 Bar	1 to 2 Bar
Paper reel brake pressure of the core paper	1 to 2 Bar	2 Bar	1 Bar	1 to 2 Bar	1 to 2 Bar
Forradeira Parameters					
Inner Cover temperature	80 to 100 ºC	80 to 100 ºC	90 to 100 ºC	90 to 105 ºC	80 to 100 ºC
Outer Cover temperature	50 to 65 ºC	68 to 65 ºC	60 to 65 ºC	70 to 95 ºC	50 to 65 ºC
Glue crack	21 to 25 mm	18 to 20 mm	21 to 25 mm	25 to 35 mm	21 to 25 mm
Paper reel brake pressure of the outer cover	1 to 2 Bar	2 Bar	1 to 2 Bar	2 Bar	1 to 2 Bar
Simple side brake pressure on the bridge aligner	50 to 60 Bar	50 to 55 Bar	59 to 62 Bar	55 to 60 Bar	50 to 60 Bar
List of Parameters	Compositions				
	O3O3/B-R	O5O5O5/BC	O2O2/C	O5O5/C-R	O5O5/BC
Cylinder Head Parameters					
Cover temperature	75 to 85 ºC	75 to 95 ºC	65 to 75 ºC	75 to 95 ºC	75 to 95 ºC
Core temperature	80 to 90 ºC	70 to 85 ºC	55 to 75 ºC	70 to 85 ºC	70 to 85 ºC
Press Roller Pressure	56 to 59 Kfg	50 to 55 Kfg	45 to 51 Kfg	50 to 55 Kfg	50 to 55 Kfg
Corrugator Pressure	55 to 60 Kfg	57 to 62 Kfg	50 to 55 Kfg	57 to 62 Kfg	57 to 62 Kfg
Glue crack	30 to 35 mm	20 to 30 mm	10 to 15 mm	20 to 30 mm	20 to 30 mm
Paper reel brake pressure of the inner cover	1 Bar	2 Bar	1 Bar	2 Bar	2 Bar
Paper reel brake pressure of the core paper	1 Bar	2 Bar	1 a 2 Bar	2 Bar	2 Bar
Parâmetros da Forradeira					
Inner cover temperature	90 to 100 ºC	95 to 105 ºC	80 to 94 ºC	95 to 105 ºC	95 to 105 ºC
Outer cover temperature	60 to 65 ºC	80 to 95 ºC	50 to 60 ºC	80 to 95 ºC	80 to 95 ºC
Glue crack	21 to 25 mm	28 to 35 mm	18 to 22 mm	28 to 35 mm	28 to 35 mm
Paper reel brake pressure of the outer cover	1 to 2 Bar	2 Bar	1 Bar	2 Bar	2 Bar
Simple side brake pressure on the bridge aligner	59 to 62 Bar	57 to 62 Bar	50 to 58 Bar	57 to 62 Bar	57 to 62 Bar

Chart 6 - List of compositions and their parameters.

Source: Author

7. Acknowledgments

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OBTAINING GRAPHITE OXIDE FROM MECHANICAL GRAPHITE GRINDING

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Abstract

This work sought to obtain graphite oxide from the application of the high-energy ball mill (HEBM). The grinding process occurred by inserting 4 g of the sample of a commercial graphite in the HEBM for the times of 30min, 1 hour and 4 hours. Scanning electron microscopy (SEM) analysis was used for the samples morphological characterization. The analysis of X-ray diffractometry (XRD) allowed to measure the interplanar distances obtained from the comminution of the sample, in addition to evaluating the structural difference between the post-ground samples obtained by the mechanical amorphization process. The results indicated that the increase in the grinding time disturbed the structural order of the graphite and increased the interplanar distance of the post-ground samples in comparison to the precursor graphite.
Keywords: graphite oxide, high energy ball mill, morphological characterization, interplanar distance.

1. Introduction

Carbon is one of the most important chemical elements, as it is indispensable for the existence of life and for exhibiting applications in different areas of knowledge. Carbonaceous materials are those mainly composed of the carbon element, with levels of 99% or more, which can be found in nature or synthetic (MANTEL, 1968; SAVAGE, 1993; MARSH, 1998; CGEE, 2010).

CGEE (2010) explains that carbonaceous materials can be developed from several organic raw materials in solid, liquid or gaseous states. Depending on their formation conditions (natural or processed), carbonaceous materials can be found in several ways. Natural carbonaceous materials have several allotropic forms such as: amorphous carbon (carbon black, common coal, coke, glassy carbon, etc.), crystalline in the form of natural graphite (hexagonal crystalline structure) or diamond (cubic crystalline structure), fullerenes , graphene and carbon nanotube (ZARBIN & OLIVEIRA, 2013). Figure 1 exemplifies some of these configurations.

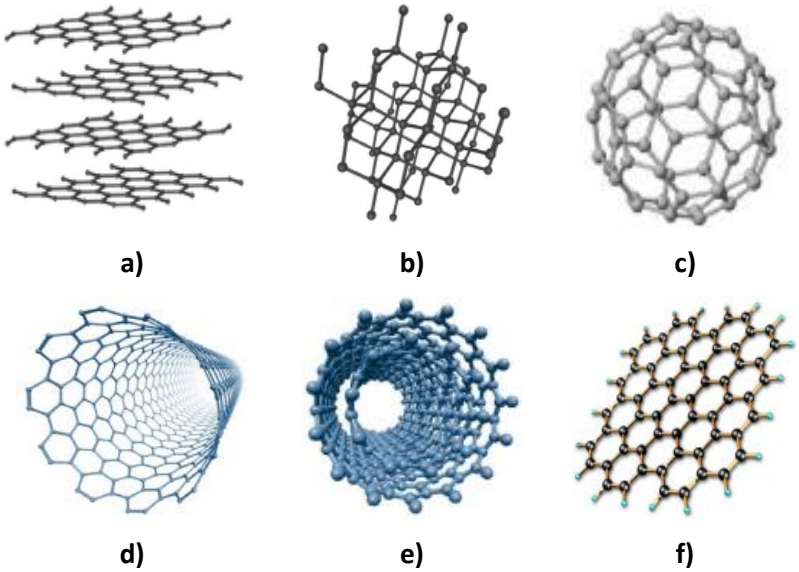


Figure 1 - Schematic representation of different carbon allotropes: a) natural graphite; b) diamond; c) fullerene; d) single-walled carbon nanotube; e) multi-walled carbon nanotube; f) grapheneSource: Zarbin and Oliveira (2013).

Synthetic or processed carbonaceous materials are artificially obtained, that is, they present laboratory developed substances by the use of raw materials, such as: synthetic graphite, carbon fibers, glassy carbon, carbon fiber reinforced carbon composite (CRFC), composite carbon/carbon (C/C), cokes, coals, resins, piches and organic gases, being predominantly polygranular materials, composed of particles, fibers and binders of organic origin (MANTEL, 1968; MARSH, 1988; MARSH, HEINTZ and REINOSO, 1997; CGEE, 2010).

Graphite is one of the allotropic forms of naturally found carbon, being a classic example of a solid with lamellar structure, in which each carbon atom with sp2 hybridization is linked to three other atoms forming thousands of two-dimensional sheets (sheets) with the appearance of a hive (DRESSELHAUS, DRESSELHAUS and EKLUND, 1995). Each slide is called graphene, and stacking them, via van der Waals attractions, gives several planes of carbon atoms arranged in a hexagonal symmetry network (BELÉM, 2006; GEIM and NOVOSELOV, 2007; ZARBIN and OLIVEIRA , 2013). The graphite structure can be seen in Figure 2.

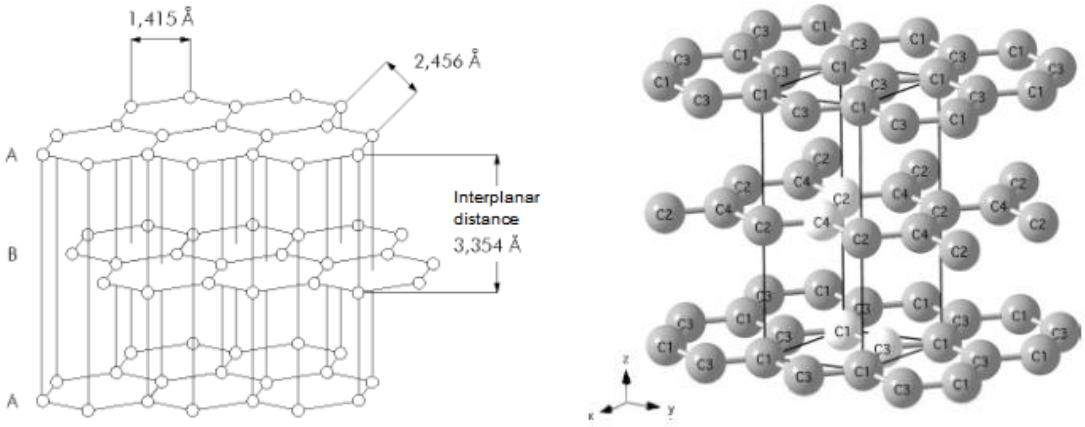


Figure 2 - Structural representation of graphite: a) crystalline arrangement; b) hexagonal structure
Source: OLIVEIRA *et al*., 2000; STANJEK and HÄUSLER, 2004.

More recently, with the consolidation and accelerated growth of nanoscience and nanotechnology, different physical, chemical and mechanical procedures have been developed for the preparation of nanometric materials. Among the methods, the mechanic, usually called high energy grinding, stands out for being easy to handle, efficient and quick to obtain nanometric powders. High energy ball milling is characterized by subjecting a material to repeated cycles of deformation, cold welding, grinding and fragmentation within a controlled atmosphere that causes high energy compressive impact forces (SURYANARAYANA, 1994; SURYANARAYANA, 2004). High energy mills produce shearing or impact on material particles by means of balls with powder at high speed generating a constant refinement of the material (MURTY and RANGANATHAN, 1998; CERQUEIRA, 2014). As a result, there is a reduction in particle size and structural variation of particles (SURYANARAYANA, 1994; SURYANARAYANA, 2004). This technique was developed around 1996 at the INCO Research Laboratory where Paul D. Merica, whose objective was to produce reinforced oxide dispersion in a nickel-based superalloy for gas turbine applications (MURTY and RANGANATHAN, 1998).

It should be noted, according to the literature, the scarcity of works related to obtaining graphite oxide using the high-energy ball mill (HEBM) of the SPEX type, in which few correspondents are found. To get an idea of the research using the SPEX vibratory mill in Brazil, a survey was carried out on the CAPES / MEC Portal page. As a result, there is only the research carried out by Junior in 2019, at the Federal University of Amazonas. Junior's research (2019) sought to synthesize commercial graphite using the high-energy SPEX mill to obtain graphene for application in supercapacitors. In this regard, the present research aims to obtain graphite oxide by means of MAE, even understanding that there is a finding that the procedure and theory issues have not yet been sufficiently explored in the specialized literature.

2. Materials and methods

2.1 Graphite Comminution

The proposed methodology for the execution of this work consisted of using the HEBM technique as a study route for obtaining graphite oxide. In this context, its reduction was studied through the following milling times: 30 minutes, 1 hour and 4 hours. The grinding process started with weighing the sample, and then the material (4g) was inserted into the cylindrical container (D = 2 ¼ ”and h = 3”) with a load capacity of up to 10g, along with two ½ inch steel balls to then start the mechanical comminution/amorphization process. Figure 3 illustrates the HEBM of the Prep 8000 M Mixer/Mill® line from Spex Sample.

Figure 3 - High power ball mill/homogenizer used in this work
Source: Suryanarayana (2001).

2.2 Scanning electron microscope (SEM)

For morphological investigation of the graphite samples, scanning electron microscopy (SEM) analysis was used. For this, a scanning microscope, brand TESCAN, model VEGA 3 SBH, was used under acceleration voltage of 15 kV. The analyzes were carried out at the Thematic Laboratory of Electronic Microscopy and Nanotechnology (LTMN) of the National Institute for Research in the Amazon (INPA).

2.3 X-ray diffraction (XRD)

The x-ray diffraction technique was used to characterize the crystalline structure of the precursor (material without grinding) and powders ground at different times (30 minutes, 1 hour and 4 hours). The samples were analyzed by a PANalytical diffractometer, model Empyrean, with Cu-Kα radiation (1.541838Å), operating at 40 kV voltage and 40mA current intensity. With a scanning range of 10° <2θ <80º of 2θ, and with a rate of 0.02º/min. The preparations and measurements of XRD samples were performed at the Materials Laboratory (LabMat) of the Federal University of Amazonas (UFAM). The average size and average width of the crystallites can be calculated using the formula developed by Scherrer (1918) (CULLITY and STOCK, 2001; XIAO et al., 2017).

$$L_a = \frac{k\lambda}{B\cos\theta} \quad (1)$$

$$L_c = \frac{k\lambda}{B\cos\theta} \quad (2)$$

Where Lc corresponds to the average size of the crystallite in the perpendicular direction to the basal planes of the graphite, K the form factor, 0.90 for the diffraction peaks (002) (STOBINSKI et al., 2014), La represents the average thickness of the crystallite 1.84 (Warren's constant) for bands (10) and (110) (WARREN, 1941), λ = radiation wavelength (Å), for copper radiation (Cu-Kα) of 1.541838Å, = width at half the height of the most intensive diffraction peak (Figure 4) and θ is the peak Bragg angle (hkl), in degrees.
Interplanar distances (d002) can be calculated using the Bragg equation.

$$d_{002} = \frac{n\lambda}{2sen(\theta)_{002}} \quad (3)$$

The effective dimension of the crystallites (L) can be calculated from equation 4 (EMMERICH, 1995).

$$L = \left[\left(\frac{\pi}{4} \right) . \left(L_a \right)^2 . L_C \right]^{\frac{1}{3}} \quad (4)$$

Bowman (1956) explains that the widening of the crystalline planes is based on the combination of the widening of the plane due to the length of the crystallites , and due to the stresses arising from the fluctuation in the interplanar spacing value. The relationship between peak widening and deformation is defined as the structural stress (εc), along the c-axis and can be estimated by equation 5 (MIZUSHIMA, 1968).

$$\frac{1}{L_c} = L. \frac{\varepsilon_c}{2.d_{002}} \quad (5)$$

Depending on the Mering-Maire empirical formula, the graphite degree of graphite fibers can be calculated by equation 6 (XIAO et al., 2017).

$$G = \frac{0.344 - d_{002}}{0.344 - 0.3354} x100\% \quad (6)$$

The average number of layers per stack (N) can be calculated through the relationship between the size of the crystallite by the interplanar spacing between the graphite sheets (ALI UMAR et al., 2013). The average number of graphite sheets (N) can be represented by equation 7 (XIAO et al., 2019).

$$N = \frac{L_c}{d_{002}} \quad (7)$$

The packing density of the graphite layers can be expressed by Equation 8, as described by Popova (2017).

$$d = \frac{7,267}{d_{002}} \quad (8)$$

3. Results and discussion

3.1 Scanning electron microscope (SEM)

The graphite samples were characterized by scanning electron microscopy (SEM), where it was possible to monitor the morphological modification of commercial graphite as a result of mechanical grinding. Figure 4 shows the scanning electron microscopy images of the graphite before and after the mechanical comminution/amorphization process in the HEBM. The employment of SEM to analyze the structure of graphite is used to visualize the levels of comminution of the material on a 5μm scale.

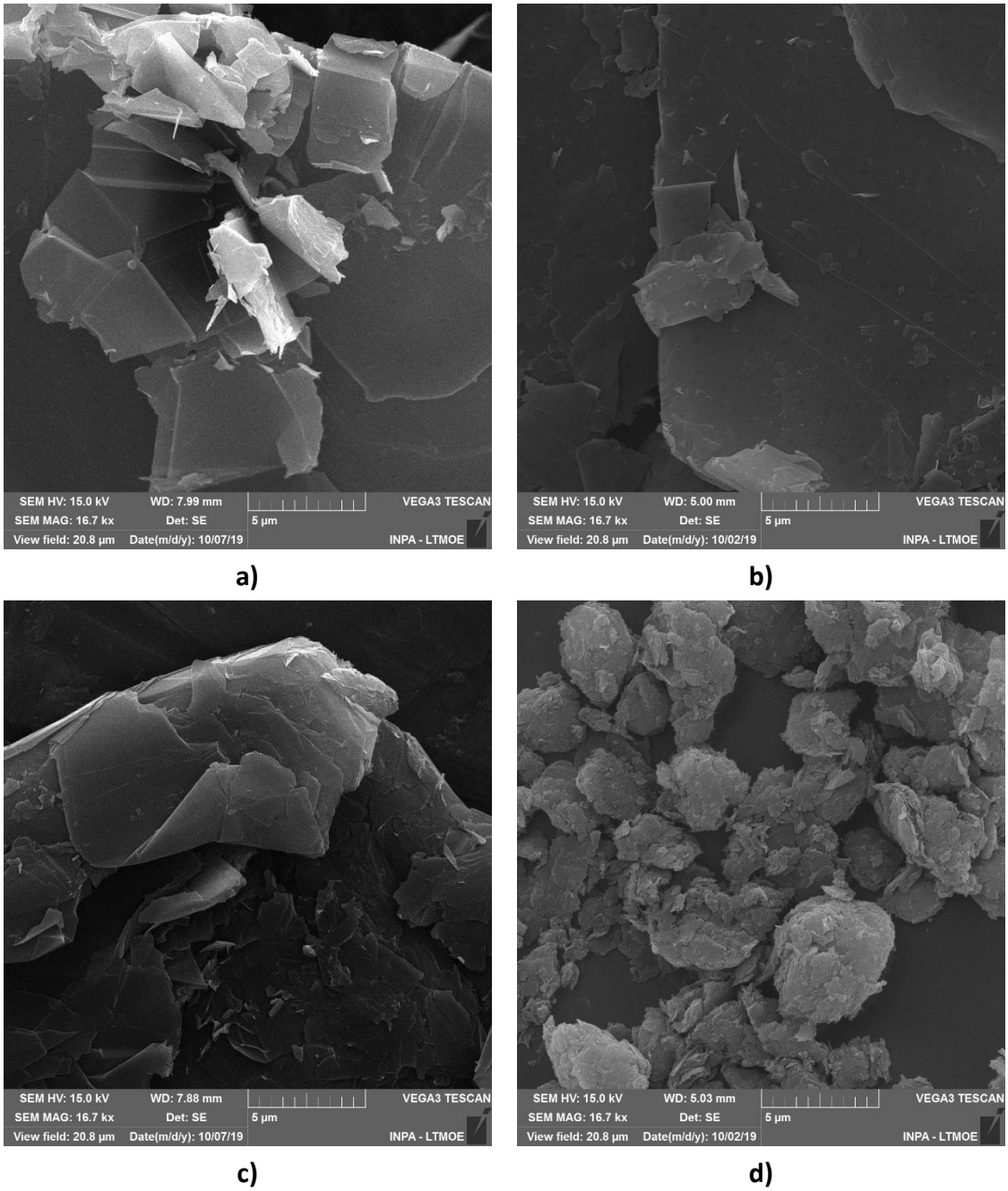
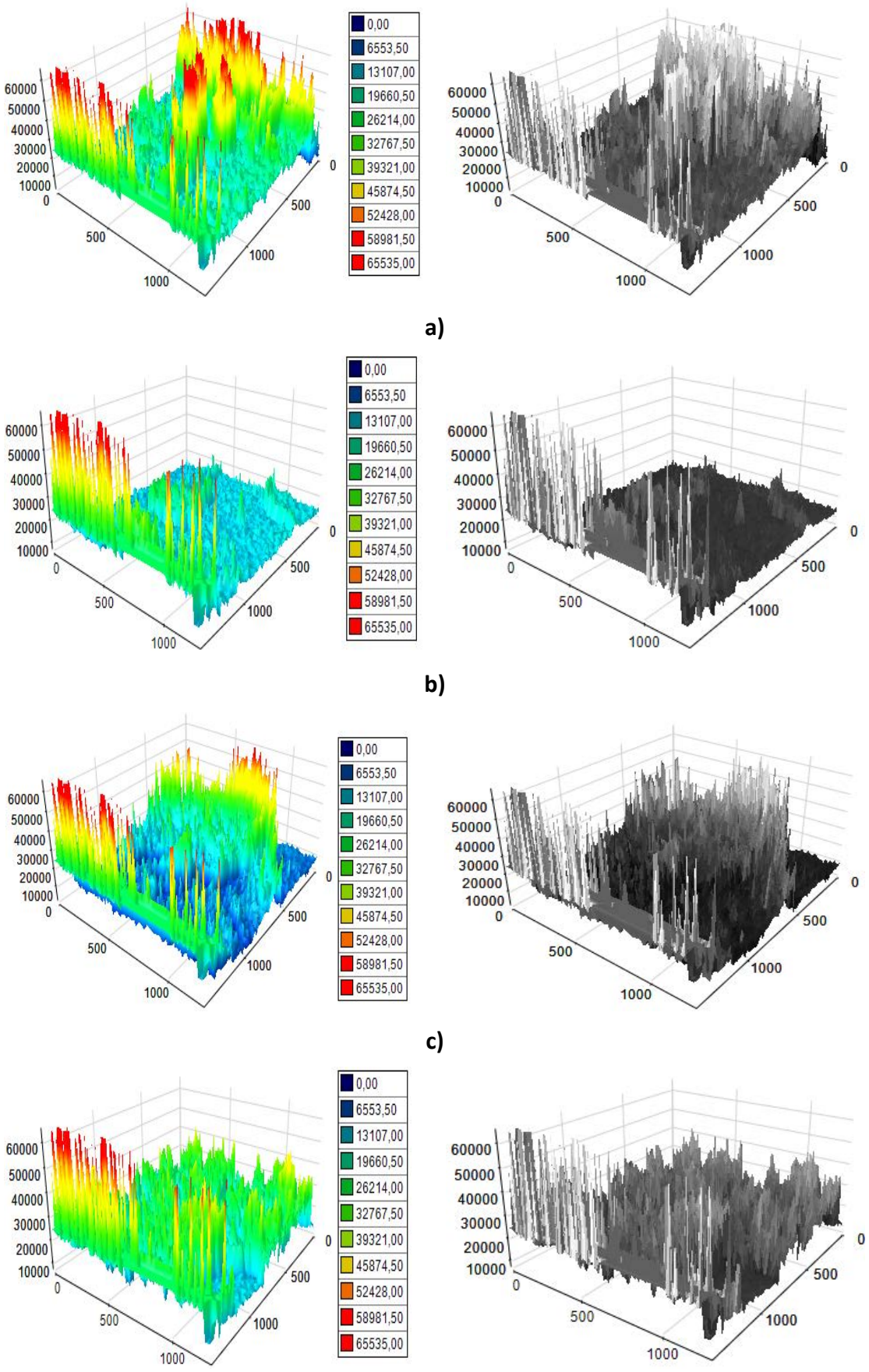


Figure 4 - Comparative micrographs of the precursor and ground powders: a) commercial graphite; b) graphite ground for 30 minutes; c) graphite ground for 1 hour; d) graphite ground for 4 hours.

Analyzing the images, Figure 4a shows the characteristic morphology of the graphite matrix, that is, it shows the structure of the graphite in well-defined plates in its crystalline state, with a smooth and uniform surface. Figure 4b shows the graphite comminuted for 30 minutes, where small changes in its crystalline structure can be seen. These changes are more significant in the graphite sample ground for 1 hour (Figure 4c). In Figure 4d there is a structure in the shape of spherical bodies (not perfectly spherical) after the mechanical grinding process for 4 hours. In particular, this almost spherical shape is characterized by the 4-hour mechanical amorphization process compared to commercial graphite, in which the graphite structure collapsed and deformed in a disorderly manner resulting in several pores of different sizes. It is also noted that the longer the grinding time, the greater the detachment between the plates. It is also worth mentioning the exfoliation of the material as the mechanical grinding time increases.

To better demonstrate the changes in the graphite samples due to the mechanical milling process, the Image-Pro Plus software was used to generate topographic images of the upper graphite surface, as shown in Figure 5.



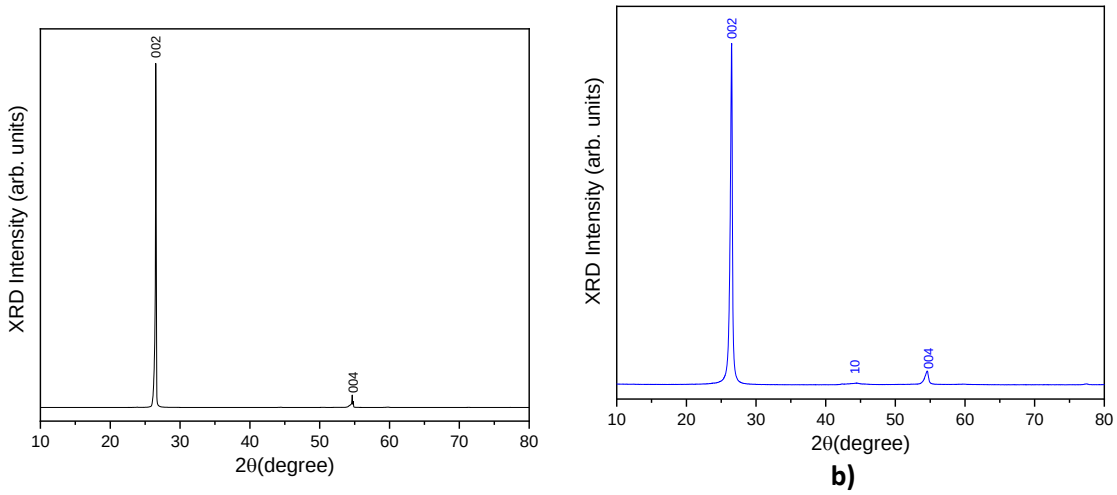
d)

Figure 5 - Peak intensity of surface micrographs: a) commercial graphite; b) graphite ground for 30 minutes; c) graphite ground for 1 hour; d) graphite ground for 4 hours.

Initially, in Figure 5a, the presence of intense peaks in the extremities is observed, which is characteristic of this material in its crystalline state. Figure 5b shows the evolution of the graphite sample in relation to the grinding time, in which the reduction of the peaks intensity in the central part to the extreme right of the surface is noticed. In Figure 5c, it is possible to verify the strengthening of the central and lateral peaks, indicating the structural change of the material. Observing Figure 5d of the graphite ground for 4 hours, the presence of peaks with medium intensity is observed in all the region of the microphotography. Also noteworthy is a more homogeneous distribution of the peaks in the matrix and differentiated color (closer to green) of the particles compared to the initial matrix and the matrices comminuted for shorter times, indicating that the degree of amorphization (non-crystalline layer) of the sample ground for 4 hours increased significantly due to the increase in the mechanical grinding time, which were initially totally crystalline. This suggests the formation of a new structure.

3.2 X-ray diffraction (XRD)

The analysis by XRD allowed to evaluate the structural difference between the precursor and the post-ground samples obtained by the mechanical amorphization process. Thus, for a better understanding of the obtained results, and at the same time to get a complete description of the behavior of the particles in relation to the mechanical effort, the diffractograms of the samples of commercial graphite and ground powders for the times of 15 minutes, 30 minutes, 1 hour and 4 hours were analyzed separately, as shown in Figure 6.



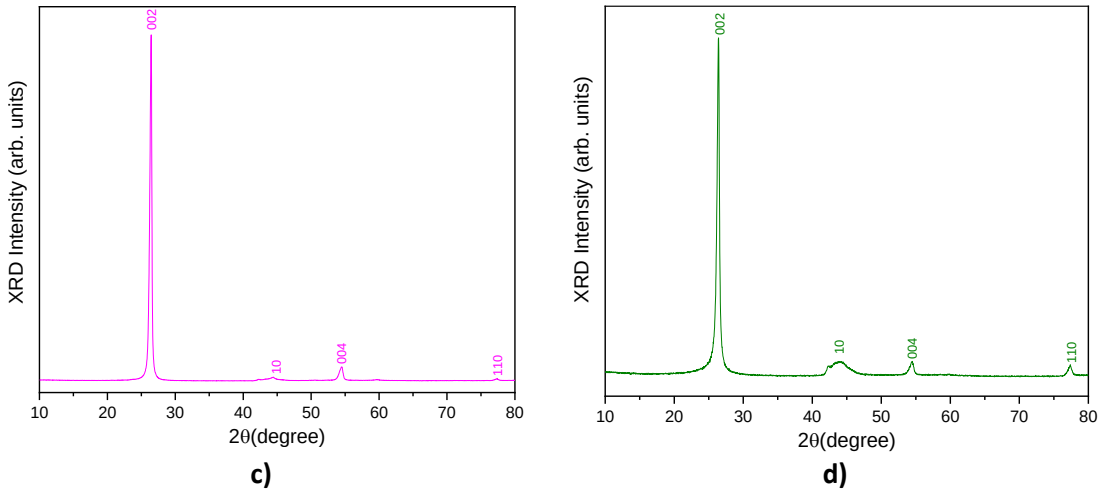


Figure 6 - X-ray diffractometers, individually analyzed a) commercial graphite, b) 30 min grinding, c) 1 hour grinding, e) 4 hours grinding.

In general, it appears that in all samples there is a crystalline plane (002), characteristic of graphite, located in the 26.6 ° region (IWASHITA et al., 2004; RODRÍGUEZ, 2015; LIU et al., 2017; GUO et al., 2017; VIEIRA et al., 2017) and (004) in 54.7º (RODRÍGUEZ, 2015), related to the average crystallite size (Lc) and pointing out to be a crystalline material. In Figure 6a, it is possible to check the planes (002), located at 2θ = 26.6º and (004) at 54.7º, which are characteristic of the hexagonal carbon network, both being well defined and without apparent noise, in which it reflects greater organization of the graphite layers (RODRÍGUEZ, 2015; BANDI et al., 2019). Regarding Figure 6b, there is a reduction in the intensity of the crystalline plane (002) and a small displacement of the peak (004) by 54.6º, probably caused by the reduction of the refractive index and the decrease in the size of the crystallite. A timid principle of exfoliation of the material also stands out, where the peak (10) appears at 44.45º, indicating a structural change due to the mechanical grinding time (STOBINSKI et al., 2014) consolidating the appearance of two-dimensional structures, possibly with hybridization (sp2). The XRD spectrum of graphite ground for 1 hour (Figure 6c) shows a small decrease in intensity and widening of the peak (002), which is indicative of changes in ordering in relation to the original material. It was also possible to verify the consolidation of the peaks (004) and (10). Finally, the peak (110) appears, this diffraction peak indicates a higher process of exfoliation of the material and proof of graphite oxidation. In Figure 6d, there is a consolidation of the crystalline planes (10) and (110), and a differentiated widening of all the crystalline planes in relation to the other samples, pointing to a possible disorder in its structure, as well as the formation of a new crystalline structure and reduction of the average particle size. This behavior is the result of defects in the crystal and it can be caused by distortion of the graphite structure orientation. However, it is clear that the characteristic structure of the graphite was not destroyed, that is, there was no complete oxidation of it, a fact justified by the presence of the plane (002), showing an incomplete exfoliation of the graphite.
Advancing the analysis of the results, the diffractograms were plotted together, as shown in Figure 7.

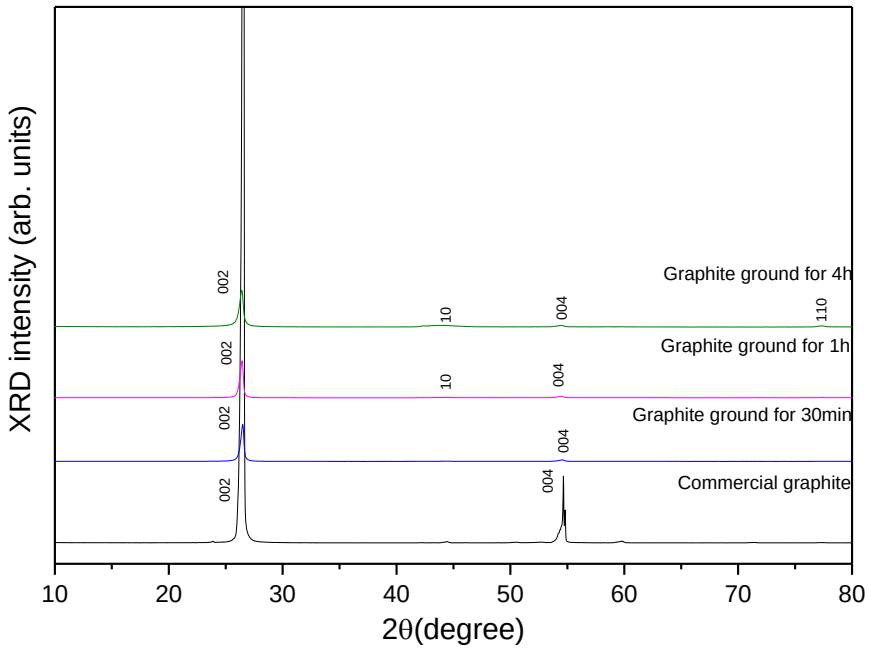


Figure 7 - X-ray diffractograms of commercial graphite and ground for different times: 15min, 30min, 1h and 4h

In Figure 7, a considerable reduction in the intensity of the crystalline plane (002) for the amorphized samples can be seen, when compared to commercial graphite, expressing a structure with a lower degree of organization and showing the graphite exfoliation. It is also verified that no milling time studied was able to exfoliate and separate the graphite layers completely, however differences were detected in the intensity of the crystallinity peaks related to commercial graphite, as well as the appearance of the peaks (10) and (110) for graphite samples ground for 1 hour and 4 hours. The highest intensity of the characteristic peak (002) was obtained in the commercial graphite sample.

3.2.1 Characteristic of post-ground graphites

Table 1 presents the structural parameters of the precursor and for the respective materials ground for 30 minutes, 1 hour and 4 hours.

Table 1 - Structural parameters of graphite samples determined from the results obtained by means of diffractograms.

Sample	d_{002} [nm]	L_{c002} [nm]	L_{a10} [nm]	L_{a110} [nm]	L [nm]	ε_c	N	d [g/cm³]	G (%)
Graphite ground for 30 minutes	3,359	26,31	20,03	-	20,23	0,012747394	7,83	2,1635	94,34
Graphite ground for 1 hour	3,360	25,42	18,86	32,16	19,22	0,014017653	7,57	2,1627	92,81
Graphite ground for 4 hours	3,361	21,02	4,19	29,24	6,62	0,076303736	6,25	2,1621	91,77

In Table 1, it is possible to observe a progressive change in the graphite structure, as the grinding time increases, in which the mechanical comminution process disturbed the structural order of the precursor grafite. A fact observed by the gradual reduction of the average size of crystallites in the perpendicular direction to the basal planes, and the degree of graphitization and an increase in the specific surface area, as the grinding time increases.

Consolidating the values of reduction of the average size of the crystalline particles for better visualization of the results, we have the graph shown in Figure 8 that correlates the size of the crystallites (ordered) according to the grinding time (abscissa).

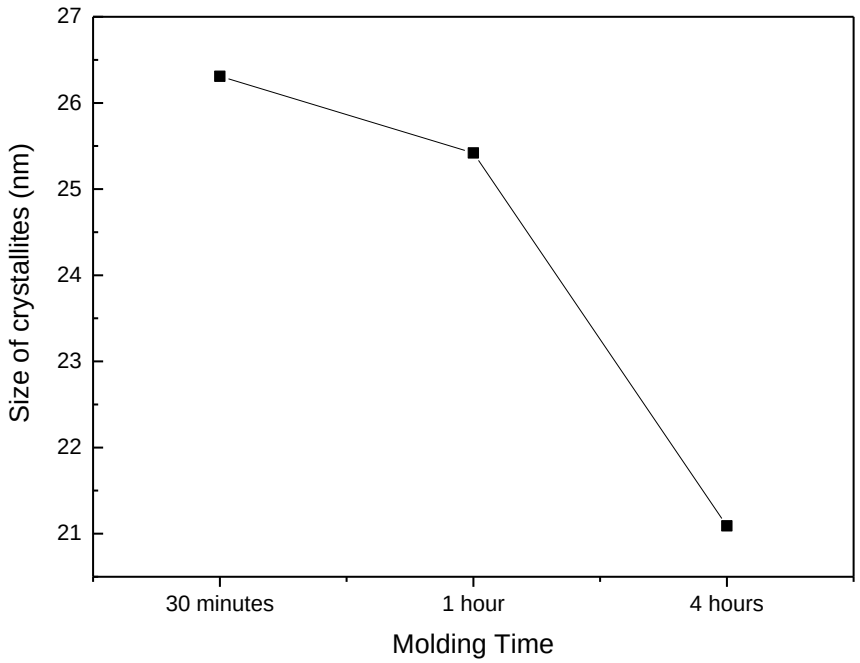
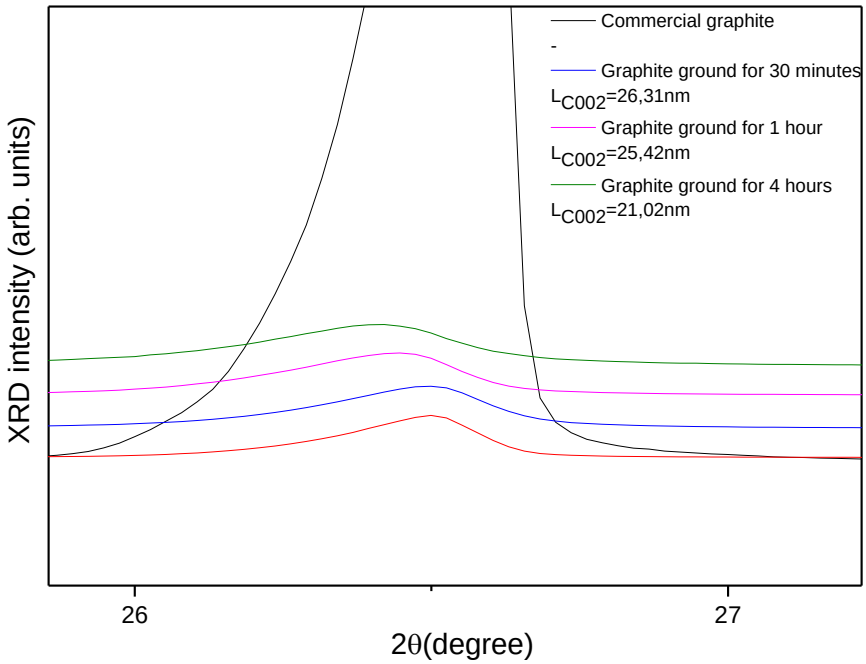


Figure 8 - Size of crystallites (L_{c002}).

According to the results of Figure 8, the graphite samples ground for 30 minutes, 1 hour and 4 hours show Lc002 of 26.31nm, 25.42nm and 21.02nm, respectively, that is, the higher the value, the more organized Lc002 the material is. In contrast, the longer the mechanical grinding time, the lower the value of Lc002 and G and, consequently, it translates into a less organized structure, an expected trend in the research in question, from the mechanical amorphization of graphite.

In Figure 9 the profile of the crystalline planes (002) of the graphite samples is compared. The respective values of Lc002 are also shown.



Figures 9 - Comparison of the intensity of the characteristic peaks (002) of the graphite samples.

When analyzing the profiles of the graphite peak (002) in Figure 9, it can be seen that the samples have different dimensions for the graphite band (002), mainly in intensity and displacement, exposing different degrees of graphitization. It is also possible to observe the micronization trend after the gradual grinding process in relation to the precursor. The high-energy mechanical grinding process, in addition to favoring changes in the properties of materials, is also responsible for a progressive process of mechanical amorphization of graphite particles. Thus, increasing the grinding time can promote comminution/amorphization of the particles, reducing their average size and increasing the specific surface area of the material. In this way, longer mechanical grinding times play a fundamental role in increasing the non-crystalline fraction, since the shearing action and the impact of the spheres on the crystalline particles, from the surfaces, cause a reduction in the average size of the crystalline particles (CARREÑO, 2008).

Also noteworthy are the results of the sample ground for 4 hours, in which it is possible to observe the smallest crystallite size recorded, indicating the structural change of the material as well.

Advancing in the results analysis, Figure 10 shows the results of the distances between the planes (d002) of the graphite samples as a function of the grinding time.

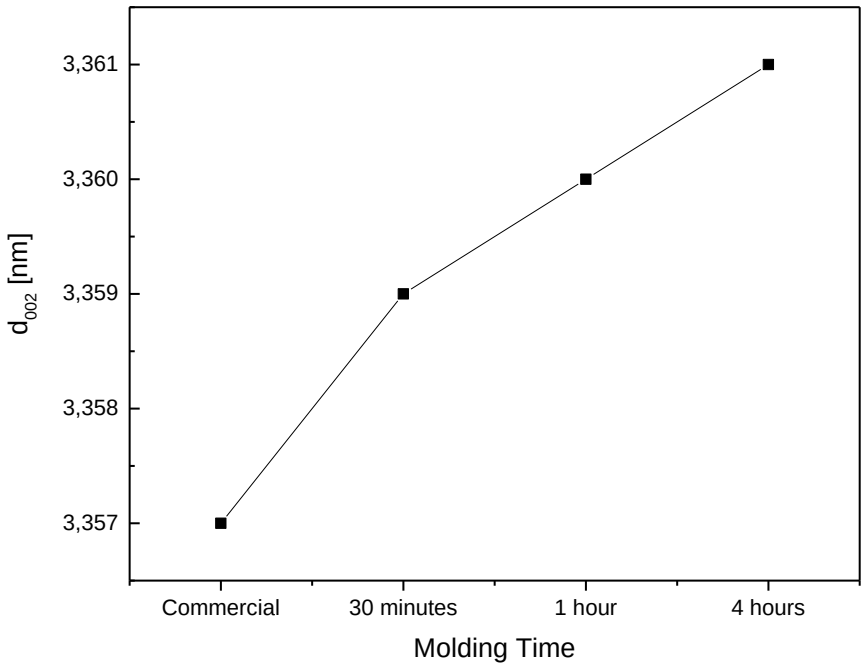


Figure 10 - Interplanar distance of samples as a function of grinding time.

Analyzing the graph in Figure 10, it is observed that the samples of commercial graphite, graphite ground for 30 minutes, 1 hour and 4 hours show d002 of 3.359nm, 3.360nm and 3.36108nm, respectively. That is, the post-ground samples have diffraction planes displaced to smaller angles, as the grinding time increases. According to Rodríguez (2015), the graphite d002 interplanar spacing is referred to by the value of 3.35nm, explaining a high crystallinity characteristic of the material. Therefore, the structural change of graphite through the grinding process is noticeable. Thus, increasing the grinding time, in general, causes the expansion of the blades present in the graphite structure. These changes in characteristic peaks (002) are more clearly shown in Figure 11.

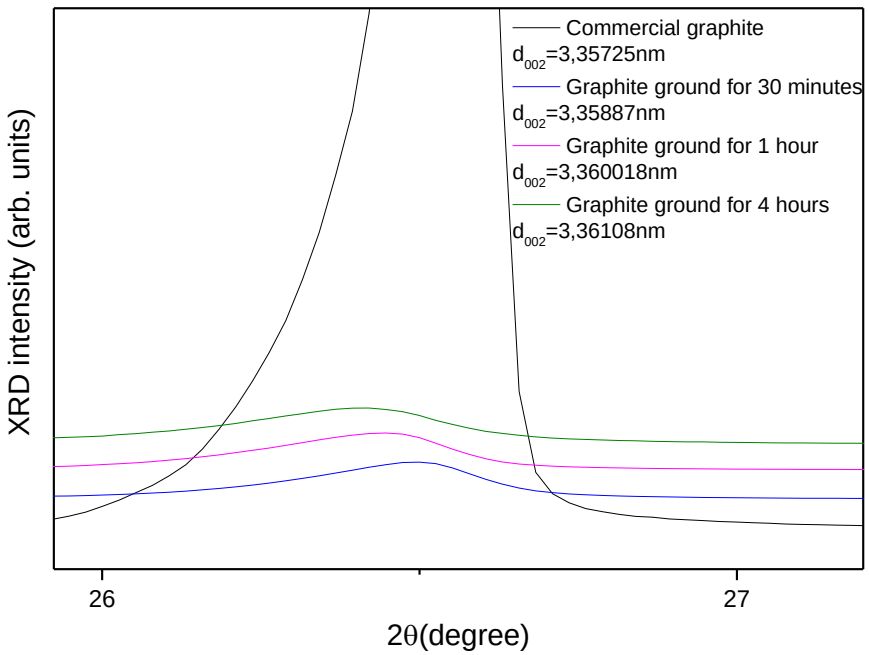


Figure 11 - Comparison of the d_{002} interplar distance of the graphite samples.

In Figure 11, an increase in the interplanar distance of post-ground samples compared to the precursor can be seen . However, this increase was slight in relation to the precursor, which indicates that there was no process of complete exfoliation of its structure to obtain graphite oxide.

4. Conclusion

This work aimed to study the obtaining of graphite oxide through the simple mechanical grinding process, without using oxidizing agents or concentrated acids. According to the XRD and SEM tests, the grinding process disturbed the structural order of the precursor graphite, in which both results agree that the structural change of the graphite is proportional to the increase in grinding. In this way, there is an interrelation between the results of XRD and the results of micrographs of the surface and SEM, in which there is a structural change in the graphite, as the mechanical grinding time increases. Although the structural changes are noticeable, as the mechanical grinding time increases, no time studied was able to exfoliate and separate the graphite layers completely.

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Diagnosis of accessibility in the FT/UFAM classrooms

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Manaus – Amazon – Brazil

Abstract

The article analyzes the accessibility problems in the classrooms of the Faculty of Technology of the Federal University of Amazonas (FT/UFAM) based on NBR 9050:2004, to propose suggestions for improvements. The data were collected through a checklist applied in 17 classrooms chosen at random. Besides, measurements and photographic records were performed to compare the reality of the classroom environment by meeting the requirements of this standard. The analysis concluded that most of the measured variables do not satisfy the requirements of NBR 9050:2004. The most critical problems are related to a) the gap in width and height of the doors; b) the width of the corridors between the rows of chairs; c) the signs on the doors; d) the height of installation of the blackboard; e) the absence of desks adaptable and available to a Person in Wheelchair; f) the height for installing sockets; g) the height of the light and air conditioning switches. All of these items were 100% disapproved, as they did not meet the minimum requirements required by the standard. Therefore, several recommendations were suggested to the FT/UFAM managers.

Keywords*:* NBR 9050:2004; Classrooms; Accessibility;

1. Introduction

The Federal University of Amazonas (UFAM) completed 110 years in 2019 and has 18 units in the capital, Manaus, and 5 other units in the inland, Benjamin Constant, Coari, Humaitá, Parintins and Itacoatiara. In the capital unit, UFAM has 4 institutes, a nursing school, and 12 faculties, among them, is the Faculty of Technology (FT) that offers 10 courses in the exact sciences of which are: Architecture and Urbanism, Design, Production Engineering, Mechanics Engineering, Electrical (electronics, telecommunications, electrotechnics)Engineering, Oil and Gas Engineering, Chemical Engineering, Civil Engineering, Materials Engineering, and Computing Engineering.

In this university environment, there are 122 teachers and 47 technicians to serve around 2500 university students, who have easy and free access to the university to have a good learning experience over time.

A doctoral thesis developed by the Federal University of São Carlos (UFSCar) involving 15 public

universities showed that many have not yet made adaptations to guarantee accessibility in their spaces (CASTRO, 2011).

The legislation states that public institutions, such as universities, must offer accessibility and the rules of the Brazilian Association of Technical Standards establish, for example, what the slope of a ramp should be and the required number of handrails, etc.

According to the Brazilian Association of Technical Standards (ABNT 9050), accessibility is the possibility and condition of reach, perception, and understanding for the safe and autonomous use of buildings, space, furniture, and urban equipment and elements.

Although the Federal Government has made funds available for adjustments within universities, it is still common to find several locations needing to meet accessibility standards. In the case of the Faculty of Technology, new buildings were constructed between 2007 and 2015, and some adjustments were made to buildings already built to improve accessibility. The new buildings were built by the company EBTA, each building with three floors costing R$ 6,000,000 and a building with a maximum of two floors costing approximately R$ 4,000,000 according to the college's administrative information. But are the 35 classrooms of the Faculty of Technology, built or renovated, adequate according to NBR 9050: 2004?

The interest in research arose from a project of complementary hours carried out at the Faculty of Technology, between May and December 2015, to create a Manual that obeyed NBR 9050:2004, and it was found that one of the highest rates of non-conformities in this faculty were concentrated in the classrooms.

Thus, the general objective of the research is to analyze the problems of accessibility to the FT/UFAM classrooms, to propose suggestions for improvements for the managers of this unit.

The research is relevant for the following reasons:

1) the classroom is the basis for the university to achieve its mission, which is to cultivate knowledge in all areas of knowledge through teaching, research, and extension, contributing to the formation of citizens and the development of the Amazon;

2) the Faculty of Technology, as it is an environment that uses technology and knowledge as tools, should be an example of universal design in its constructions for the other institutes and schools of UFAM and Manaus;

3) every person who attends the rooms of that Faculty must have the same conditions of use and access to the place;

4) the right to free access and mobility in any location, whether public or private, is not a favor, but a right that is protected by law;

5) NBR 9050:2004 says that every location, public or private, must meet the minimum requirements to be accessible to anyone;

6) SINAES assesses, in addition to other requirements, whether the space offered by the university to students and teachers is adequate;

7) managers must be aware of the causes of the problem of non-conformities in the classroom so that it is possible to take the necessary measures.

2. Theoretical Referential

2.1 Accessibility

2.1.1 Definitions

According to the dictionary by Aurélio Buarque de Holanda Ferreira (2010, p. 87), the word accessibility is derived from the Latin "accessibilitate", which designates the quality of accessibility and ease in approaching, dealing with or obtaining something.

For Godinho (2010) accessibility consists of the ease of access and use of environments, products, and services by anyone and in different contexts.

The National Secretariat for Human Rights (2015) says that accessibility is the absence of barriers that guarantees equal opportunities, but Manzini et al., (2003, p. 185-192) defines accessibility as a concept that is related to citizenship, in which individuals have rights guaranteed by law that must be respected, however, many of these rights come up against architectural and social barriers.

NBR 9050 (2004) states that accessibility is the possibility and condition of reach, perception, and understanding for the use, with safety and autonomy, of buildings, space, furniture, urban equipment, and elements.

Based on the definitions above, for this research, the term accessibility means easy and free access to a building, environment, equipment, and furniture by anyone and everyone who may or may not have any physical restrictions.

2.1.2 Universal Design

Rosso (2009) states that universal design is the keyword to achieve accessibility. For NBR 9050 (2004), universal design is seen as "one that aims to meet the greatest possible range of anthropometric and sensory characteristics of the population".

The term is used in building projects when you want to build a barrier-free environment, easy to move around and that can be used by as many people as possible.

Remião (2012) also states that the goal of universal design is to create an environment that is accessible to everyone who travels in it, regardless of whether the user is in a wheelchair, visually impaired, hearing impaired, elderly, child, a person with short stature, with temporary or permanent mobility.

The term universal design emerged in 1990 and was proposed by the American architect Ron Mace who with other architects established the seven principles of the universal design described below:

1) Equal: providing spaces, objects, and products that can be used by people with different capacities, making environments the same for everyone.

2) Adaptable: having a structure of products or spaces that meet varied skills and diverse preferences of people.

3) Obvious: being related to easy understanding so that anyone can understand, regardless of their experience, knowledge, language skills, or level of concentration. It has to do with the dimensions and spaces suitable for access, reach, handling and use.

4) Known: refers to the clear transmission of information to meet the needs of the recipient, be it a foreign person, with difficulty in vision or hearing.

5) Insurance: be related to the risks and possible consequences of the origin of accidental or unintentional actions.
6) Effortless: efficient use, with comfort and minimal effort.
7) Embracing: be related to the access to spaces and dimensions appropriate to all people.

2.1.3 Social Inclusion

Fresteiro (2010) states that social inclusion when it comes to accessibility is the elimination of barriers or constructive obstacles. Remião (2012) says that social inclusion is related to the inclusion of all types of people to participate actively in life, working in different parts of society such as recreation, work, sports activities, studies, among others.

Social inclusion is related to the search for social stability through social citizenship, that is, all citizens have the same rights in society. Social citizenship is concerned with the implementation of people's well-being as citizens (SHEPPARD, 2006).

It can be said that social inclusion is related to providing equal rights and access to all people in society, for example, in a cinema, a sports field, a shopping mall, a classroom, which is the case of the object of study of this article, etc.

2.2 Accessibility at Universities

A university said to be accessible, is one that is capable of allowing equal access to all dependencies of the environment for all users, including those who have some physical restriction. For Bittencourt et.al (2004), a built space, when accessible, is capable of offering equal opportunities to all people.

A public or private building, in this case, the university, can be considered accessible if it is designed taking into account the requirements of the technical standard of ABNT, NBR 9050 so that space provides comfort and safety to users.

A doctoral thesis carried out by the Federal University of São Carlos (UFSCar) showed that the facilities of 15 (fifteen) universities were not yet fully adaptable when it comes to the issue of accessibility (CASTRO, 2011).

A study carried out by students at the Federal University of Mato do Sul (UFRJ) in 2013, showed that the university still does not have an adequate structure when assessing accessibility at the site, for example, the classrooms have irregularities in circulation internal environment, where the place is very narrow and prevents students from easily moving, including those who have some physical restriction.

The Faculty of Science and Technology (FCT) of the Paulista State University of the Presidente Prudente campus carried out a study in which irregularities were found in the urban spaces and buildings of the university, mentioning, for example, the access to the athletics track, which had a stairway with very long steps and causing discomfort to the students and many of them preferred to go down the slope, that is, by the lateral inclination to the stairway. Another problem that was also encountered was the consultation terminal of the library, which had a very high height, where the consultation could only be performed by people standing, excluding access to a student who was in a wheelchair (DE ALMEIDA, 2011).

It can be seen in these surveys that many higher education institutions still need to improve their spaces to meet the needs of all people, however, we identified that two Faculties have stood out about the subject, namely: Faculty of Três Alagoas -AEMS and the Faculty of Medical Sciences of Santa Casa of São Paulo.

The Faculty of Três Alagoas-AEMS designed one of its buildings already with the concern to guarantee free movement of individuals, especially wheelchair users and the Faculty of Medical Sciences of Santa Casa of São Paulo has an institutional accessibility nucleus, the NAI, which aims to mobilize the various departments and segments of the Institution in promoting accessibility, which stands as a space for dialogue and collective construction of attitudinal accessibility.

The NAI has several purposes and among them are the promotion of accessibility not only to students with disabilities and/or difficulties but to the entire academic community and the population that frequents the place and that benefits in some way from its services and also has the purpose the dissemination of accessibility through actions and projects with the participation of the population to build an inclusive society.

2.2.1 Evaluation of SINAES about Accessibility

SINAES is the National Higher Education Assessment System created by Law No. 10,861, of April 14, 2004. It aims to identify the merit and value of institutions in the segments of education, research, extension, areas, courses, management, and training, also to improve the quality of higher education and promote social responsibility (INEP, 2011).

SINAES is based on three main components: institutional evaluation (internal and external), evaluation of courses and information collection.

Institutional and course evaluation are components that address, among other requirements, the term accessibility concerning physical infrastructure, physical installation and social responsibility.

Physical infrastructure and social responsibility are part of the institutional evaluation component, while the physical installation is part of the evaluation of courses, where each of these has a specific objective (MEC, 2014), such as:

• Physical infrastructure: consists of verifying whether the educational institution offers users conditions for the development of research, teaching, extension, and management in classrooms, administrative facilities, auditoriums, teachers' rooms, spaces for attending students, offices, workstations, sanitary facilities, laboratories, among others.

• Social responsibility: consists of checking if there are jobs, actions, activities, projects, and programs developed with and for the community, aiming at social inclusion, economic development, improving the quality of life, urban/local infrastructure and social innovation.

• Physical facilities: aspects such as the basic and complementary bibliographic material of the courses, informational resources, work personnel, financial resources are verified.

In this way, the information obtained with SINAES is used by higher education institutions (HEIs), to serve as a guide for their institutional and academic and social effectiveness; by government agencies to guide public policies and by everyone who wants to know the reality of courses and institutions (INEP, 2011).

2.3 Technical aspects of NBR 9050:2004

NBR 9050 (2004) is a regulatory standard that aims to provide accessibility for everyone regardless of height, age or physical or perceptual limitation, in public or private places. This standard is enforced by laws 10,048: 2000 and 10,098: 2000 to promote accessibility

The NBR 9050: 2004 establishes parameters and criteria so that when equipment, furniture or space is designed, it will meet what the standard requires so that it is considered accessible. The parameters and criteria covered in the standard refer to: 1) anthropometric parameters, 2) communication and signaling, 3) access and circulation, 4) toilets and changing rooms, 5) urban equipment and, finally, 6) furniture.

They are related to:

1) Anthropometric parameters: manual, auditory reach, dimensions of a person standing or wheelchair, transfer and circulation area and visual parameters.

2) Communication and signaling: visual, tactile, vertical, audible signaling and communication.

3) Access and circulation: floor, corridors, handrails, stairs, louvers, elevator, platform, escalator, doors, windows, etc.

4) Toilets and changing rooms: toilet, urinal, washbasin, floor, shower, bathtub, mirrors, cupboards, benches, among others.

5) Urban equipment: school, cinema, meeting room, auditorium, kitchen, swimming pool, parks, restaurants, cafeterias, libraries, beaches, and other places.

6) Furniture: drinking fountain, chair, seats, counters, ticket offices, desks, self-service equipment, etc.

3. Case study: Profile of FT rooms

The FT is located in the Northern sector of UFAM together with the Faculty of Law (FD), the Faculty of Education (FACED), Faculty of Social Studies (FES), Institute of Human Sciences (ICHL), Institute of Exacts Sciences (ICE) and Computing Institute (IComp) as shown in Figure 1 below:

Figure 1 – Northern sector of UFAM

The FT is composed of 2 (two) leisure areas, 2 (two) amphitheaters, 1 (one) parking lot and 16 (sixteen) pavilions represented by the blue blocks, as shown in Figure 2.

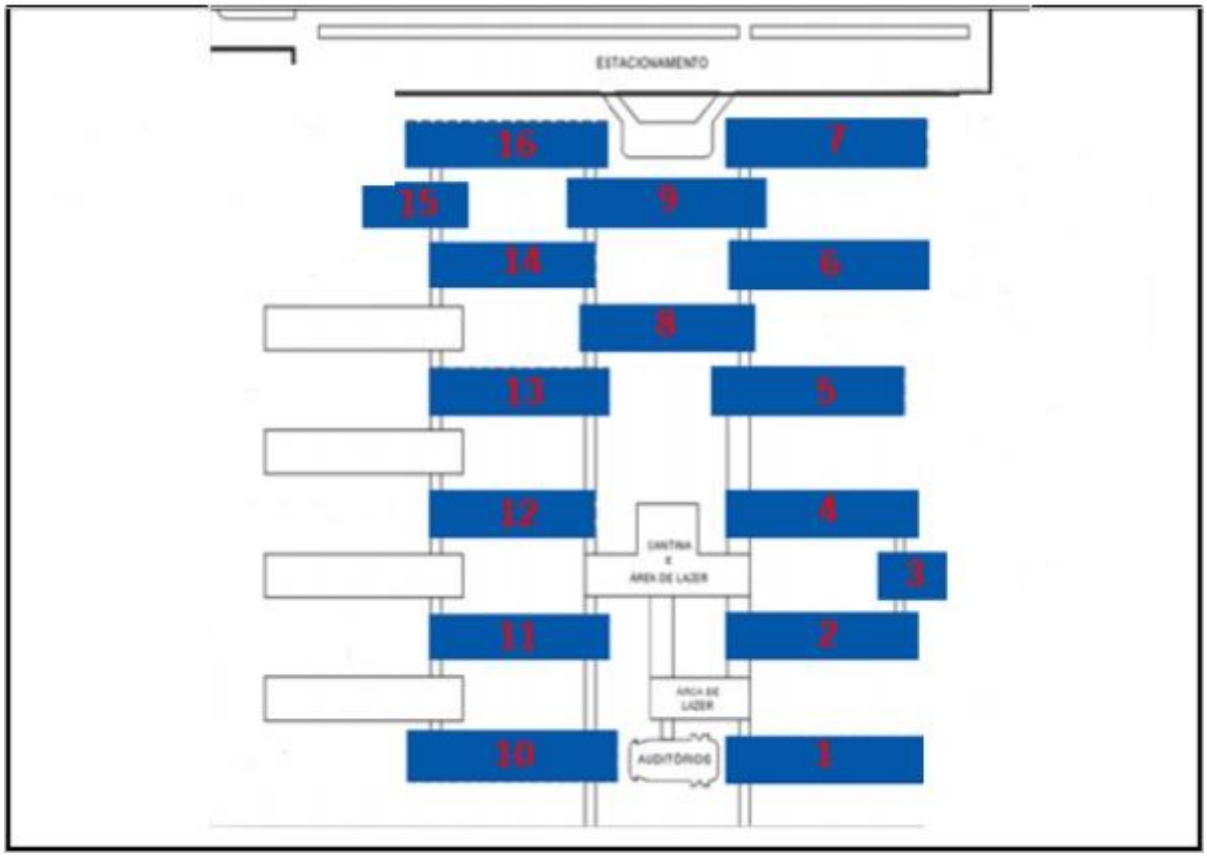


Figure 2 – Faculty of Technology Map

Source: UFAM (2016)

The 16 (sixteen) pavilions, represented in the blue blocks in Figure 2, are composed of:

1. Engineer Nelson Ribeiro: three floors with 28 classrooms, plus male and female bathrooms.
2. Rio Juruá Pavilion: allocated to the Design Department, it has a ground floor with 2 laboratories, 2 workshops, 2 centers, one of which is a research and development center and one of a product center, 1 support center for project extension and 1 room conservative.
3. Rio Tefé: belongs to the Department of Electrical Engineering (Electrical-Electronic) and has only 1 (one) ground floor which is reserved for the industrial automation and robotics laboratory.
4. Rio Purus: ground floor reserved for the Electrical Engineering Department, consisting of 1 professor room, 1 research room, 5 laboratories, 1 secretary and male and female bathrooms.
5. Rio Madeira: ground floor reserved for the Department of Electrical Engineering (Electrotechnics) with 2 laboratories, 1 room for researchers, scholars, and coordination, 1 room for vegetable oil projects, 1 center for energy development in the Amazon and male and female bathrooms.
6. Prof. Nilmar Lins Pimenta Pavillion: is reserved for the Center for Research and Development in Electronics and Information Technology (CETELI) and consists of 2 floors. It is divided between 9 laboratories, 11 teaching rooms, 1 archive room, 1 living room, 1 meeting room, 1 study room, 1 secretary, 1 directorship, 1 auditorium, male and female bathrooms.
7. Administrative Pavilion of FT and Teachers' Rooms: it is an administrative pavilion composed of 3 floors and is divided between 1 secretary, 1 directorship, 1 teacher service room, 2 multiple-use rooms, 2 meeting rooms, 79 teacher rooms, 5 academic centers, and male and female bathrooms.
8. Rio Nhamundá Pavilion: with 1 ground floor, it has 1 teacher's room, 1 project and extension room, 3

laboratories and 1 secretariat.

9. Rio Trombeta Pavilion: reserved for the Materials Engineering Department, divided between 3 laboratories, 1 researcher room, and 1 reception.
10. Rio Aripuanã Pavilion: it has 2 floors and consists of 1 library, 3 studios, 1 laboratory, 8 teacher's rooms, and 1 building maintenance coordination.
11. Rio Tapauá Pavilion: it has only the ground floor and consists of 4 rooms, 3 laboratories, and male and female bathrooms;
12. Rio Juruá Pavilion: reserved for the Mechanical Engineering Department and has only 1 floor. It consists of 7 laboratories.
13. Rio Canumã: it has a ground floor and is composed of 3 laboratories, 1 coordination, and 1 classroom.
14. Rio Xingu Pavilion: it has 1 ground floor and is composed of 1 management room for fluid mechanics laboratories, 4 laboratories, 1 equipment room, and 1 professor room.
15. Prof. Emani Vilar Parente da Câmara Pavilion: has only 2 floors and consists of 3 laboratories, 2 meeting rooms, 6 group member rooms, 1 secretariat, and 1 coordination.
16. Prof. Vilar Fiuza da Câmara Pavilion has two floors and the basement. It is divided into 3 laboratories, 1 master's room, 3 secretariats, one of which is for post-graduate studies, one for research and extension and one for the master's degree, 4 centers, 8 rooms reserved for various programs of the Faculty of Technology.

It can be seen that only the Engineer Nelson Ribeiro pavilions (28 rooms), Rio Tapauá (7 rooms) and Rio Canumã (1 room) are the ones with classrooms, totaling 36 identified rooms.

The rooms of the Rio Tapauá and Canumã pavilion are the oldest buildings in the college and all have the capacity for up to 60 students to carry out their activities with the teacher.

Meanwhile, the Engineer Nelson Ribeiro pavilion was opened in June 2015, containing small rooms with a capacity for 25 students and large rooms for 60 students, with chairs, desks, and blackboard differing from the other two pavilions.

3. Methodology

The data collection and analysis took place in the second half of 2015, divided into 10 (ten) stages:

Step 1) Bibliographic research: in the first half of June 2015, a search for books and related articles were carried out to support the research;

Step 2) Study of rules and legislation: in the second half of June 2015, the rule NBR 9050: 2004 and law decree 5296: 2004 were studied, to have technical and legal knowledge on the issue of accessibility;

Step 3) Sample definition: in the first week of August 2015, classrooms, pavilions and their quantities were defined to serve as a basis for the study of this article.

The definition of the sample counted with the help of the FT hours accessibility manual project, which aimed to assemble an accessibility manual, according to NBR 9050: 2004, based on the conformities and non-conformities found in the premises of the Faculty of Technology. In the development of this project, a data survey was carried out in which it was found that the classrooms were one of the places that most presented non-conformities concerning accessibility. With that, it was defined that the classroom would be

the object of study and that the pavilions that had some classroom would be part of the research.

The Engineer Nelson Ribeiro, Rio Canumã and Rio Tapauá pavilions are the only ones that have classrooms and are available to the academic community, as the remaining pavilions are divided between laboratories, workshops, studios, study and research rooms, among others.

The classrooms of the 3 pavilions, Engineer Nelson Ribeiro, Rio Tapauá and Rio Canumã, total 36 classrooms of which 17 were randomly chosen, representing approximately 47% of the total classrooms at the Faculty of Technology.

Step 4) Initial visit to the rooms: in the first week of August 2015, an initial visit to the rooms was made to see what could be analyzed considering NBR 9050/2004;

Step 5) Definition of parameters and criteria for analysis: in the second week of August 2015, the following parameters and criteria were defined: anthropometric parameters, access and circulation, signaling, furniture, and urban equipment. The parameters are related to the manual reach of sockets, light switches, and air conditioning and the criteria are related to the measurements and specifications of the gap in the door, advancement and lower height for desk, installation of a handle, blackboard, spacing between corridors, signs on the doors and at the walls.

Chart 1 shows what will be analyzed as a parameter and as a criterion and what is related to them:

Criterion				**Parameter**
Access and Circulation	**Signaling**	**Urban equipment**	**Furniture**	**Anthropometric parameters**
Door	Visual signage at the door entrance	Blackboard	Desk	Light switch
Corridor between the row of chairs	Signaling at the wall	-	-	Air conditioning switch
Corridor between the chairs and wall	-	-	-	Socket

Chart 1 – Criterion and NBR 9050:2004 Parameters.
Source: Author (2016).

In each parameter and criterion, the following was analyzed:

1. Doors: the gap of the width, the gap of the height of the door, the height of the handle installation and the type of handle were verified. In the signage criterion, the signage on the fence (wall, panel or partition), visual signage about the information and the installation heights were analyzed.
2. The corridor between the rows of chairs: the free space between the rows of chairs in the classroom was analyzed;
3. The corridor between the chairs and the wall: the free space between the first chairs and the wall where the blackboard is installed was verified;
4. Light, air conditioning and socket switches: the anthropometric parameter analyzed in these items refer to the installation height, that is, lower height;
5. Desk: it is a standard furniture criterion, where there were a lower height and the advance that can be

made on the desk and if there is an adaptable desk available to a person in a wheelchair;
6. Blackboard: this last item of the furniture criterion, the lower height of installation of the slate was verified.
Step 6) Creation of the data collection instrument: in the third and fourth weeks of August 2015, a checklist was developed (Appendix A) to assess the physical space of the rooms based on the definitions in step 5;
Step 7) Data collection: the checklist was applied in 17 rooms during September 2015 with measurements and record of activities through photographs;
Step 9) Data analysis: between October and November 2015, during the collection, the data were collected and then digitalized and built charts, desks, and graphs to discuss the results and build the article;
Step 10) Construction and defense of the article: between January and April 2016, the article was written for defense in early May 2016.

4. Discussion

The results of the data collection, in general, were not positive, the numbers in red color mean that they do not meet the requirements of the standard, as discussed below.

4.1 Access and Circulation

4.1.2 Access and Circulation at the classroom door.
Item 6.9.2.1 of NBR 9050: 2004 states that the door of a location must have a minimum width and height of 0.80m and 2.10m, respectively. The handles must be installed at a height between 0.90m and 1.10m high and be of the lever type according to item 6.9.2.3.

Pavilion	Gap - Height (2,10m)			Gap - Width (0,80m)			Handle installation height (0,90 à 1,10m)			Handle
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value	Lowest Value	Medium Value	Highest Value	Lowest Value	Medium Value	Highest Value	Lever type
	2,06m	2,07m	2,08m	0,76m	0,77m	0,78m	1,04m	1,05m	1,08m	Yes
Rio Tapauá	2,08m	2,10m	2,13m	0,76m	0,77m	0,78m	1,05m	1,07m	1,08m	No
Rio Canumã	2,13m			0,78m			1,05m			No

Chart 2 – Values of items for access and circulation in the doors
Source: UFAM (2016).

Analyzing the results of Chart 2 above, it was found that 100% of the doors were disapproved concerning item 6.9.2.1, as they do not simultaneously meet the minimum values of width and height. However, about the installation height and the handle type, it was considered that 70% complies with what item 6.9.2.3 of NBR9050: 2004 asks for.

It is worth mentioning that the non-conformity related to the dimensions above (values in red color) can compromise the access of a student, teacher or even visitor who has a temporary or permanent physical

restriction in a wheelchair, walker or even a crutch in the classroom.

In the Rio Tapauá and Rio Canumã pavilions, although the height of the door handles was considered to be within the standard, the door handles are not a lever type, which causes a person to enter the classroom to exert a force more than 36N.

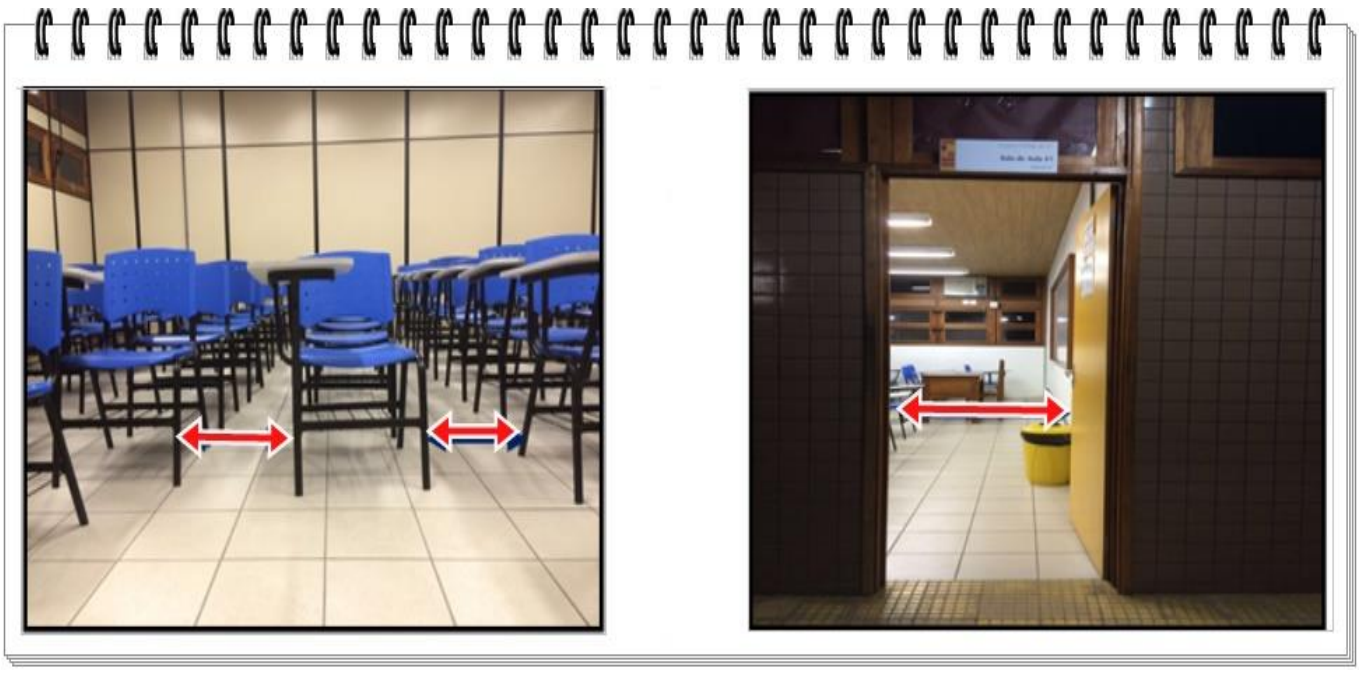
4.1.2 Access and Circulation involving chairs and wall

Item 6.9.1.1 of NBR 9050: 2004 states that the space in the corridors must be 1.20 m for corridors in common use with an extension up to 10.00 m; and 1.50 m for corridors longer than 10.00 m.

To define the free space, both for the main corridor formed by the distance from the first chairs to the wall where the blackboard was installed, and for the free space between the rows of chairs, it was necessary to know the length of the corridors.

The corridor between the rows of chairs is approximately 5.0 m long and the main corridor is approximately 9.0 m long, so the analysis took into account that the two corridors had to have a free space of at least 1.20 m width.

Figures 3 and 4 below represent the corridors existing in the classrooms and the arrows represent where measurements were taken for comparison with the standard.



Figures 3 and 4 - Corridor between the rows of chairs (left) and classroom main corridor
Source: Author (2016)

The values found for the corridors between the rows of chairs and the main corridor are shown in Charts 3 and 4:

Pavilion	Corridors between the rows of chairs /desk (1,20 m)		
Engenheiro Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	0,40m	0,73m	0,90m
Rio Tapauá	0,68m	0,72m	0,80m
Rio Canumã	0,78m		

Chart 3 –Access and Circulation between the rows of chairs.
Source: Author (2016)

Pavilion	Main corridor (1,20 m)		
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	1,38m	1,52m	1,62m
Rio Tapauá	1,59m	1,62m	1,69m
Rio Canumã	1,75m		

Chart 4 – Access and Circulation in the classroom main corridor
Source: Author (2016)

It can be seen (Chart 3) that the corridors between the rows of chairs in the Engineer Nelson Ribeiro, Rio Tapauá and Rio Canumã pavilions do not meet item 6.9.1.1, which defines the width for corridors up to 10m must be 1.20 m, so they fail 100%.

On the other hand, the values raised in (Chart 4) the main corridor of the 3 pavilions meet the minimum requirement required by the standard and are 100% compliant since the lowest value found in the corridors was 1.38 m which shows that any person independent of his physical condition can move about him without any problem.

It is important to note that the non-conformity related to the free space between chairs implies poor circulation of students in the room, because, often, so that they have access to the desired place to sit and watch the class, they enter the corridor of the rows of chairs due to lack of space. This situation is even worse for a student with physical restraint, such as a wheelchair or on a crutch, for example, to have access to the chairs, at least, the student will have to ask someone a place or ask for help from people in the room to move their chairs away.

4.2 Signaling

4.2.1 Signaling at the doors.

Item 5.10 of NBR 9050: 2004 says that there must be visual information on the door (room number, function, etc.), installed at a distance of 1.40 m from the floor. The tactile signs (in Braille or embossed text) must be installed on the door casing or in the fence (wall, partition or panel), on the side where the handle is, at a height between 0.90 m and 1.10 m.

The circles and arrows in Figure 5 shows where the information for the data collection in Chart 5 was taken from.

The survey (Chart 5) showed that there are signs on the doors, but they do not meet item 5.10 of NBR 9050: 2004, which states that there must be signs not only on the door but also on the adjacent fence and these signs must meet the heights suggested by the standard. For this reason, the signs on the doors are 100% disapproved.

All visual signs on the doors of the pavilions are installed above 2.10 m in height. To reverse this situation, the college placed an improvised A4 sheet on the doors with information about the names of the subjects

and the times. Also, a student or teacher who has a visual impairment will have more difficulties in accessing the information in the classrooms, as in no pavilion there is tactile signage in Braille or embossed on the doors.

Figure 5 – Signaling at the doors
Source: UFAM (2016)

Pavilion	Visual signaling at the door	Signaling at a distance of 1.40 m from the floor	Signaling in the wall	Fence signage at a height between 0.9m and 1.1m from the floor
Engineer Nelson Ribeiro	Yes	No	No	No
Rio Tapauá	Yes	No	No	No
Rio Canumã	Yes	No	No	No

Chart 5 – Information about signage in the FT/UFAM classrooms
Source: UFAM (2016)

4.3 Urban Equipment

4.3.1 Blackboard

NBR 9050: 2004 in item 8.6.8 says that the slates must be accessible and installed at a maximum height of less than 0.90 m from the floor. Chart 6 and Figure 6 show the results of the measurements and the photo taken during data collection, respectively.

In this regard, 100% of the measurements (Chart 6) of the height of the installation of the blackboards in the classrooms of the 3 (three) pavilions are out of the standard.

Failure to comply with the height of installation of the blackboards can cause problems in the manual reach of teachers and students when they are going to use them, as a person to write will have to make a greater

effort to reach the top and also people with short stature or wheelchair users can reach only the center or bottom of the board, leaving little space for writing.

Pavilion	Height of Installation (0.90m)		
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	0,95 m	1 m	1,22 m
Rio Tapauá	0,92 m	0,93 m	0,95 m
Rio Canumã	0,92 m		

Chart 6 – Height of blackboards.
Source: Author (2016).

Figure 6 – One of the blackboards measured
Source: Author (2016)

4.4.1 Desk

Items 9.3.3.1 and 9.3.3.3 of NBR 9050: 2004 inform that the work desks must have a minimum lower height of 0.73 m and the progress must be 0.50 m. Besides, in item 9.3.1 of the standard, it says that there must be adaptable desks at accessible places and have desks available to the person in a wheelchair.

The desks analyzed concerning the lower height and advance are those used by teachers, as well as the adaptable desks available for a person in a wheelchair was, not only for teachers but also for students. Thus, it was observed that in each classroom there was only one desk for the teacher and depending on the size of the room, there could be 25 to 60 desks with attached arms for students.

The data collected were summarized in Chart 7, whose results indicate that:

a) only one (5.88%) desk for teachers met the minimum lower height of 0.73 m, required by item 9.3.3.1. The majority (15 of them = 88.24%) of them meet the minimum 0.50 m advance required by the standard in item 9.3.3.3.

b) in 100% of the rooms there are no adaptable or available desks for a person in a wheelchair.

Pavilion	Bottom Height (0,73m)			Progress (0,50m)			Adaptable desk	Available desk for person in a wheelchair
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value	Lowest Value	Medium Value	Highest Value	Não	Não
	0,66m	0,70m	0,73m	0,42m	0,53m	0,57m		
Rio Tapauá	0,65m	0,67m	0,69m	0,50m	0,52m	0,53m	Não	Não
Rio Canumã	0,67m			0,53m			Não	Não

Chart 7 - Measurements on desks in 17 classrooms.
Source: Author (2016).

Non-compliance related to the lower height of the teachers' desks can cause a relaxed posture and also

possible back pain. These problems arise from the inclination of the trunk that the teacher will have to do so that his body is closer to the desk. Another problem is the absence of adaptable or available desks for a person in a wheelchair, where this implies that if perhaps, there is a student or teacher in a wheelchair, they will have difficulties in carrying out their activities in the classroom, as there is no way for a student or teacher to support their material or equipment appropriate to carry out your activities.

4.4 Anthropometric parameters

4.4.1 Socket height.

Item 4.6.7 of NBR 9050: 2004 defines installation height for controls and controls that can be socket, doorbell, light board, heater, intercom, among others. In this case, only sockets and switches in the classroom were analyzed.

For sockets, item 4.6.7 states that the recommended installation height is at least 0.40 and at most 1 m. Figures 7 and 8 represent the sockets found and their positions.

The results in Charts 8 and 9 show that the analyzed sockets failed 100% in both vertical and horizontal measurements. It is important to note that in the Rio Canumã and Tapauá pavilions there are no sockets in the horizontal position, which is why there are no values in Chart 8 for them.

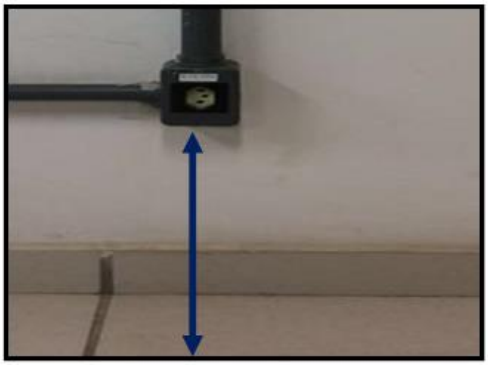


Figure 7 – Vertical socket.
Source: Author (2016).

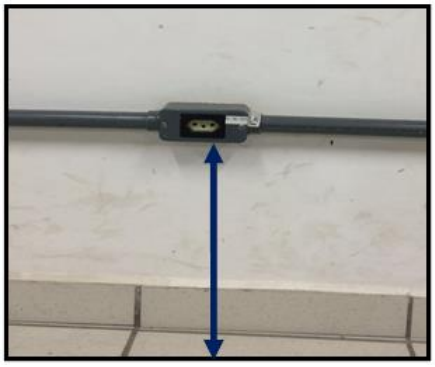


Figure 8 – Horizontal socket.
Source: Author (2016).

Pavilion	Bottom height of the vertical socket (0,40 à 1m).		
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	0,29 m	0,30 m	0,31 m
Rio Tapauá	0,22 m	0,23 m	025 m
Rio Canumã	0,22 m		

Chart 8 – Bottom height of the vertical socket
Source: Author (2016).

Pavilion	Bottom height of the horizontal socket (0,40 à 1m).		
Engineer Nelson Ribeiro	Lowest Value	Medium Value	Highest Value
	0,27 m	0,30 m	0,31 m
Rio Tapauá	-	-	-
Rio Canumã	-		

Chart 9 – Bottom height of the horizontal socket.
Source: Author (2016).

The problem caused by the non-conformity of the sockets is concerning the manual reach and effort required to reach them, as students and teachers need to bend down out of the ordinary to be able to use a simple socket.

4.4.2 Height for switches

About the item 4.6.7, the standard says that the height for installing switches is at least 0.60 and at most 1 m. Figures 9 and 10 show the height of the light and air conditioning switches.

Figure 9 – Height of the light switch.
Source: Author (2016)

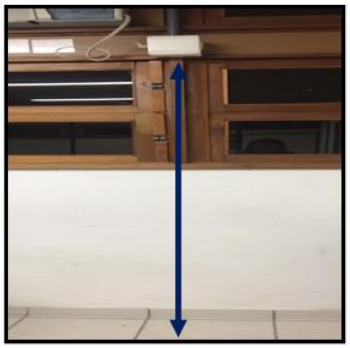


Figure 10 – Height of the air conditioning switch.
Source: Author (2016)

The values found in the data collection for the height of installation of the light and air conditioning switches are shown in Charts 10 and 11.

Pavilion	**Bottom height of the light switch (0,60 à 1m)**		
Engineer Nelson Ribeiro	**Lowest Value**	**Medium Value**	**Highest Value**
	1,06m	1,10m	1,12m
Rio Tapauá	1,08m	1,10m	1,12m
Rio Canumã	1,11m		

Chart 10 - Measurement of the light switch heights
Source: Author (2016)

Pavilion	**Bottom height of the air conditioning switch (0,60 à 1m)**		
Engineer Nelson Ribeiro	**Lowest Value**	**Medium Value**	**Highest Value**
	1,17m	1,95m	2,2m
Rio Tapauá	-	-	-
Rio Canumã	-		

Chart 11 - Height of the air conditioning switch.
Source: Author (2016)

Looking at the measurements in Charts 10 and 11, it is clear that 100% of the measurements are outside the standard required. Regarding the lower height of the light switch, it was found that the values are above the maximum limit allowed by the standard by up to 0.12 m, but the biggest difference identified was in the height of the air conditioning switch, where a value was found up to 1.2 m above the permitted limit. The problem with the switches concerning their height is the manual reach. In the classroom of the Engineer Nelson Ribeiro pavilion, for example, some students get on their chairs to turn the air conditioning on or off at the serious risk of having an accident.

The Rio Tapauá and Canumã pavilions do not have switches because they are split-model air conditioning and for this reason, no measures were taken.

5. Conclusions and recommendations

The article analyzed the problems of accessibility to the FT/UFAM classrooms based on NBR 9050: 2004, to propose suggestions for improvements for the University's managers.

The analysis consisted of verifying what was and did not comply with the requirements of the Standard, through a checklist applied in 17 rooms of the Engenheiro Nelson Ribeiro, Rio Tapauá and Rio Canumã pavilions.

The analysis concluded that most of the measured variables do not meet the requirements of NBR 9050: 2004. The most critical problems are related to a) the gap in width and height of the doors; b) the width of the corridors between the rows of chairs; c) the signs on the doors; d) the height of installation of the blackboards; e) the absence of desks adaptable and available to a person in a wheelchair; f) the height for installing sockets; g) the height of the light and air conditioning switches. All of these items were 100% disapproved, as they did not meet the minimum requirements required by the standard.

Therefore, it is recommended that:

a) to overcome non-conformities about the width and height of the doors, it is necessary that, when there are renovations in the pavilions, the FT/UFAM managers, in partnership with the construction company responsible for the work, take into account what the NBR 9050: 2004 suggests concerning the measures for the classroom doors so that all students have equal access to the place;

b) One of the alternatives to overcome the problem to the corridors between the rows of chairs is to reduce the number of students in the classrooms, redistributing classes with more students to larger rooms. This alternative will help to improve access, circulation and learning in the classroom as the students at the back are very far from the blackboard and consequently from the teacher. It is recommended that a study be made on the demand for classrooms for each course, to better dimension the size of the FT UFAM classrooms;

c) Plates installed above 2.10 m in height can be moved and installed in the center of the door at the height suggested by the standard and the improvised A4 sheet can be placed on the pavilion's corridor mural for students and teachers if they want to have more information of the rooms can consult. With the signage on the fence near the door handle, the Faculty may request the purchase of material to install the signage in Braille or embossed;

d) The non-conformity about the installation height of the blackboards can be overcome with its movement. The blackboard of Engineer Nelson Ribeiro Pavilion to reach the height required by the standard can be moved without any problem, as they are only screwed into the walls. However, the blackboards of Rio Canumã and Rio Tapauá, to be moved, need to remove the beams below them that serve as support for brushes and erasers;

e) The absence of desks adaptable and accessible to a person in a wheelchair in the rooms can be overcome with the purchase of desks for people with needs;

d) Sockets and switches to reach the minimum height required by the standard must be moved when there is a possible renovation in the Faculty, where those responsible for the work in partnership with the building maintenance coordination take into account the minimum installation height required by the standard.

6. Appendix A – Checklist

Auditoria Sala de aula. Data: __/__/____

Bloco:_____ Andar: _____

	Portas	
Vão Livre largura da porta	Largura:	Min. 0,80 m
Vão Livre altura da porta	Altura:	Min. 2,10m
Tipo de Maçaneta	Alavanca ( ) Sim ( )Não Que tipo?	Devem ser do tipo de alavancas
Altura da Maçaneta		Altura entre 0,90m e 1,10 m
Sinalização nas portas		
Sinalização Tátil na entrada da sala	( ) Possui ( ) Não Possui	Tem que ter sinalização tátil na entrada das salas
Altura de instalação da sinalização Tátil na entrada da sala.	Altura Inferior:	A altura inferior da sinalização deve ser instalada a 1,40m do chão.
Sinalização no vedo	( ) Possui ( ) Não Possui	Sinalização tátil em braile ou relevo.
Altura de instalação da sinalização no vedo.	Altura Inferior:	A altura inferior deve ser instalada a 0,90 e 1,10m do chão
Corredores		
Espaço livre entre as fileiras das cadeiras	Largura:	O corredores com exten~soa até 10m devem ter um espaço de 1,20m.
Espaço livre entre as primeiras cadeiras e a lousa	Largura:	
Tomadas e Interruptores		
Interruptor	Face Inferior: Face Superior:	Entre 0,60 m e 1,0m
Tomada	Face Inferior: Face Superior:	Entre 0,40m e 1,0m
Quadro de luz	Face Inferior: Face Superior:	Entre 0,80m e 1,20m
Equipamento		
Lousa	Face Inferior: Face Superior:	Altura Inferior Máxima 0,90 m do piso
Mobiliário		
Mesas individuais acessíveis e disponível a P.C.R	( ) Possui ( ) Não Possui	Pelo menos 1% do total deve ser acessível a P. C.R Min 1 para cada 2 salas
Mesas	Altura Avanço	As mesas ou superficies devem possuir altura livre inferior de no mínimo 0,73 m do piso. Deve ter um avanço de 0,50m.

Observações:

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Urbanization and cities of the future

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Abstract

World population is continuously and rapidly growing, urban areas representing the future. Citizens' needs and requirements are becoming the focus points of urban development strategies. Therefore, developing sustainable strategies is essential for boosting the creation and development of more inclusive communities. This paper aims to present various ways in which urbanization is changing the world as we know it, smart urban planning contributing to smart urban areas' development, formed by strong inclusive communities, giving as example different cities around the globe that have implemented successful projects. The methodology used to carry out this research is both bibliographic – opting to study and present the work of specialists in the field, authors from Romania and abroad, and empirical – formed by a case study on various smart cities around the world that have found ways to cope with the new change the world is facing today. The digital space is starting to be a very important issue in the evolution of smart cities, contributing at facilitating and improving the relationship between state and citizens. Although technology is a significant element, citizens and public institutions must be open to collaborate in order to find and implement the best solutions for solving communities' problems.

Keywords: urbanization; smart cities; sustainable development; digital change; civic engagement

1. Introduction

As the World Health Organization (WHO) states, global urbanization is a process that's changing the social and environmental setting on every continent, it meaning the migration of population from rural to urban areas, thus causing a natural urban demographic growth [WHO, (a)].

Following this idea, we can mention that in 2019 the urban population was represented by 55.7%, reaching 56.2% until this moment in 2020, thus being 4,378,993,944 individuals that currently live in urban areas [Worldometer, 2020, (b)]. The percentage of the global urban population is expected to increase to 68% by the year 2050, this meaning that urban population will almost double its size. The Organisation for Economic Co-operation and Development (OECD) has calculated that by 2100, the urban population will grow up to 9 billion, thus approximately 85% of the global population will live in cities [OECD, 2015].

Table 1. World population and world population by region

WORLD POPULATION (2020 AND HISTORICAL)								
Year (July 1)	**Population**	**Yearly change (%)**	**Yearly change**	**Median age**	**Fertility rate**	**Density (P/Km²)**	**Urban pop. (%)**	**Urban population**
2020	7,794,798,739	1.05 %	81,330,639	30.9	2.47	52	56.2 %	4,378,993,944
2019	7,713,468,100	1.08 %	82,377,060	29.8	2.51	52	55.7 %	4,299,438,618
2018	7,631,091,040	1.10 %	83,232,115	29.8	2.51	51	55.3 %	4,219,817,318
2017	7,547,858,925	1.12 %	83,836,876	29.8	2.51	51	54.9 %	4,140,188,594
2016	7,464,022,049	1.14 %	84,224,910	29.8	2.51	50	54.4 %	4,060,652,683
2015	7,379,797,139	1.19 %	84,594,707	30	2.52	50	54.0 %	3,981,497,663
2010	6,956,823,603	1.24 %	82,983,315	28	2.58	47	51.7 %	3,594,868,146
2005	6,541,907,027	1.26 %	79,682,641	27	2.65	44	49.2 %	3,215,905,863
2000	6,143,493,823	1.35 %	79,856,169	26	2.78	41	46.7 %	2,868,307,513
1995	5,744,212,979	1.52 %	83,396,384	25	3.01	39	44.8 %	2,575,505,235
1990	5,327,231,061	1.81 %	91,261,864	24	3.44	36	43.0 %	2,290,228,096

WORLD POPULATION BY REGION (2020)									
Region	**Population**	**Yearly change %**	**Density (P/Km²)**	**Land area (Km²)**	**Migrants (net)**	**Fert. rate**	**Med. age**	**Urban pop. %**	**World share**
Asia	4,641,054,775	0.92 %	150	31,033,131	-1,729,112	2.15	32.0	50.9 %	62.9 %
Africa	1,340,598,147	2.54 %	45	29,648,481	-463,024	4.44	19.7	43.8 %	18.2 %
Europe	747,636,026	0.12 %	34	22,134,900	1,361,011	1.61	42.5	74.5 %	10.1 %
Latin America and the Caribbean	653,962,331	0.94 %	32	20,139,378	-521,499	2.04	31.0	82.5 %	8.9 %
Northern America	368,869,647	0.65 %	20	18,651,660	1,196,400	1.75	38.6	82.6 %	5.0 %
Oceania	42,677,813	1.38 %	5	8,486,460	156,226	2.36	33.4	67.8 %	0.6 %

[Adapted after Worldometer, 2020, (b), (a)]

According to The World Health Organization, urban population at a global level is estimated to grow around 1.84% per year between 2015 and 2020, 1.63% per year between 2020 and 2025 and 1.44% per year between 2025 and 2030 [WHO, (b)].

We can understand that urban population is growing at a fast pace, therefore the quality of global and local ecosystems and the urban environment will play a fundamental role in urban sustainable development [WHO, (a)] and management processes.

Urban development represents a system of residential expansion activities that creates cities, taking place in vacant areas or areas that need to be modernized. These various planning activities should thus be

integrated into cities, towns and neighbourhood areas as part of the urban development process, being taken by different stakeholders, such as: architects, project managers, evaluators and environmental planners and civil and design engineers [Brooks, 2017].

In successfully addressing urban challenges, there are a few fundamental approaches that can be adopted, such as: stakeholder partnerships (cities create partnerships with the private sector, different organizations and other cities), city development strategies (based on SWOT analyses and visions for long-term periods), local cooperation (connections between rural and urban areas), cities as ecosystems (there must be found a balance between economic, social and environmental issues) and city leaders as economic managers (they need to adopt methods of entrepreneurial and economic management) [Asian Development Bank, 2019].

The European Union is focused on this topic too, helping member states by engaging in partnerships and creating initiatives for sustainable urban development. We can mention here the new *European Urban Initiative* created in order to support cities innovate, access information and understand policy and also offer support for networking and capacity building [European Commission, 2019, (a)].

Moving towards a sustainable Europe by 2030, EU is providing support for: policy foundations for a sustainable future (EU is putting in place the world's first comprehensive Plastics Strategy for circular economy, it is offering support for the transition to sustainable agriculture through a modernised Common Agricultural Policy 2021-2027, providing future-proof energy, buildings and mobility measures and ensuring a socially fair transition to ecologically sustainable economic growth and competitiveness) and horizontal enablers for the sustainability transition (education, science, technology, research, innovation and digitisation; finance, pricing, taxation and competition; responsible business conduct, corporate social responsibility and new business models; open and rules-based trade; governance and ensuring policy coherence at all levels) [European Commision, 2019, (b)].

2. Cities of the future

Computers are the ones that provide the useful technological metaphor for defining visions of smart cities [Townsend, 2014]. The Internet was another technological system that transformed the world, this industrial revolution reopening the material basis of society and introducing technologies and products that we still use today [Townsend, 2014].

We are now in a time when we have Internet components, software, protocols, languages and capabilities so that these components can be combined in ways that create new innovations [McKinsey & Company, 2009, cited by Townsend, 2014].

Through its evolution, the Internet has shown that organic evolution does not have to be slow, although it can be unpredictable. For a smart city technology combination approach to succeed, a much wider universe of ideas, technologies and innovations must be created [Townsend, 2014].

2.1 Building a sustainable future

The process of growth does not necessarily mean one of development. Regarding the evaluation of the sustainable development agenda implementation, we can see that it is mainly focused on growth indicators, this demonstrating that we are still a bit far from being able to achieve a sustainable future [Pyrkosz, 2016].

Sustainable development is a real and achievable goal, but individuals need to re-establish their priorities and re-evaluate what should lead their life, economy and society as a whole [Pyrkosz, 2016].

Social development emphasizes the importance of development based on intangible resources of various relationships, values, ethical and cultural behaviors. This approach can make a difference regarding the social-economic development, the values, the culture and the relations being able to become an additional resource in the process of obtaining a comparative advantage. Only after this approach is effectively understood and implemented will development truly become sustainable [Pyrkosz, 2016].

2.2 Promoting digital change in a smart city

At the urban level, citizens, public sector institutions and companies have certain needs and requirements within different fields of activity which are based on electronic applications, infrastructures and digital systems. Thus, smart cities must elaborate development strategies and implement solutions oriented at technological infrastructure and at developing and supporting partnerships between the public and private sectors, which focus on increasing the city‘s attractiveness, the quality of services that the public administration provides to citizens and improving prosperity at a local level [Săvulescu, Antonovici, 2017].

Digital technologies contribute at eliminating geographical obstacles, being of great importance for issues such as trade, social interaction and communication [Săvulescu, Antonovici, 2017].

The fundamental factors for a sustainable digital ecosystem refer to the following issues [Săvulescu, Antonovici, 2017]:

- **smart governance of the local digital ecosystem** – the development of this ecosystem must take into account the coordination actions that take place between the local administrations, universities, citizens and NGOs;
- **digital skills' improvement for enhancing digital change** – digital skills are fundamental contributors to gaining digital knowledge, therefore public sector authorities must provide training programs to improve such skills, being important to develop an educational strategy in this regard;
- **access to new technologies and relevant data for finding solutions for local needs** – promoting the economic environment's digitalization is important and at the same time ensuring access to data and technologies so as to contribute to increasing transparency and accountability of local public administrations, to provide citizen-centered public services and to create a favorable framework for innovation and experimentation of local enterprisess;
- **investments in technological infrastructure** – smart cities must support the process of integrating digital technologies in order to optimize the use of resources of any kind.

2.3 Virtual jobs for the development of smart urban centers

Globally, managers face an increasingly fragmented and geographically dispersed workforce [Koles, Nagy, 2014, cited by Fayomi, 2017], this leading to a large divergence of virtual jobs in organizations‘ management strategies [Fayomi, 2017]. The location of these organizations and their employees is of great importance as the tools and frameworks required for the successful implementation of the virtual workplace paradigm are not so common [Fayomi, 2017].

Social factors and those associated to the dimensional tasks (cohesion, relationship building and

coordination) that affected the effectiveness were the foundation of an effective virtual work [Lin, Standing, Liu, 2008, cited by Fayomi, 2017]. Thus, large and small urban centers propose the smart city as a new urban model, it being seen as a community of medium technological dimensions, interconnected and sustainable, which offers comfort and safety to its residents [Lazaroiu, Roscia, 2012, cited by Fayomi, 2017].

We must therefore understand the increasing importance of adding virtual jobs to the organizational strategy in order to support organizations in maintaining their competitiveness and ensuring the long-term employee well-being. This new approach benefits organizations and institutions because they can attract efficient human resources and increase productivity and competitiveness [Fayomi, 2017].

2.4 Civic engagement in the digital age

ICT and social media sites have reshaped the way citizens communicate and get involved in civic life. As a result of these actions and developments, citizens become more involved, actively participating in both online and offline communities [Zait, Andrei, Horodnic, 2017].

Education and civic engagement contribute to empowering the generations of young people, having long-term positive effects on the various issues related to the social-economic side, while contributing to personal growth and economic development [Kahne, Sporte, 2008, cited by Zait, Andrei, Horodnic, 2017]. In this context, we can thus understand that civic participation and involvement contribute to psychological and social well-being, social intelligence, supportive democracy behaviors, social innovation and happier societies [Wallace, Pichler, 2009, cited by Zait, Andrei, Horodnic, 2017].

3. Global cities – successful examples

Cities and smart technologies are fundamental elements in this new era of development and economic growth [OAV, 2019]. The actors involved in the process of developing smart cities are often asked to identify the problems the cities face, problems that, given the complexity of an area, can be individualized and solved, at least in part, by using modern technologies specific to the information era we live in. It is expected from them to write down all the ideas that appear so that, at the design stage of a smart city, these ideas can be mentioned or used also by investigating the existing infrastructure, data and technologies.

In this scope, we want to mention the first ten countries of the world with the highest population and subsequently some of their major cities that have implemented successful urban development projects.

Table 2. The first ten countries of the world by population (2020)

Country	Population (2020)	Yearly change (%)	Net change	Density (P/Km^2)	Land Area (Km^2)	Migrants (net)	Fert. rate	Med. rate	Urban pop. %	World share
China	1,439,323,776	0.39 %	5,540,090	153	9,388,211	-348,399	1.7	38	61 %	18.47 %
India	1,380,004,385	0.99 %	13,586,631	464	2,973,190	-532,687	2.2	28	35 %	17.70 %

U.S.A.	331,002,651	0.59 %	1,937,734	36	9,147,420	954,806	1.8	38	83 %	4.25 %
Indonesia	273,523,615	1.07 %	2,898,047	151	1,811,570	-98,955	2.3	30	56 %	3.51 %
Pakistan	220,892,340	2.00 %	4,327,022	287	770,880	-233,379	3.6	23	35 %	2.83 %
Brazil	212,559,417	0.72 %	1,509,890	25	8,358,140	21,200	1.7	33	88 %	2.73 %
Nigeria	206,139,589	2.58 %	5,175,990	226	910,770	-60,000	5.4	18	52 %	2.64 %
Bangladesh	164,689,383	1.01 %	1,643,222	1,265	130,170	-369,501	2.1	28	39 %	2.11 %
Russia	145,934,462	0.04 %	62,206	9	16,376,870	182,456	1.8	40	74 %	1.87 %
Mexico	128,932,753	1.06 %	1,357,224	66	1,943,950	-60,000	2.1	29	84 %	1.65 %

[Worldometer, 2020, (c)]

The first example we want to present is China and how the country is rapidly urbanizing, the economy growing continuously, thus cities becoming essential tools for delivering sustainable development [OAV, 2019]. The urban population is growing at increasing rates and by 2050 it will account for 80 percent of the country's population [OAV, 2019]. One project we want to mention in this context is *Sino-Singapore Guangzhou Knowledge City (SSGKC)* [SSGKC] that aims to be developed as a vibrant knowledge-based hub with an estimated population of 500,000 people within the next 17 years. These digital cities solutions will help Guangzhou Knowledge City (GKC) become a sustainable, eco-friendly, knowledge sharing smart city, Guangzhou being the first city to use CyAM, a cloud-based software suite that displays real-time information regarding the air quality detected by sensors spread across the city, predicting values for the next three to five days. This is only the first solution of the Green City Digital Platform project powered by MindSphere which aims to meet and solve the city's challenges in an open, interactive and holistic way, deploying future modules around issues such as: smart traffic, smart energy, smart manufacturing and intelligent buildings [OAV, 2019].

In India, smart cities and urban development projects are being developed and implemented in various cities. One of these cities is the popular tourist destination and historical trade hub, Cochin city. *Cochin Smart Mission Limited (CSML)* is seeking to build a more centralized ICT-enabled urban area, focusing on many aspects, among which urban mobility is an essential one, which is being developed through: public bicycle sharing – the system has approximately 1000 cycle spread around the city area; electric feeders – system developed to improve connectivity through various sustainable modes of transportation; elevated walkways and travel areas – local pedestrian improvement of community walkability; intelligent traffic management – integration and management of different transport ways through technology for a better traffic condition; smart bus shelters; smart bus interchanges

with commercial spaces – improvisation of major bus interchanges and commercial spaces development etc. [CSML].

Another example is offered by Mexico city, Mexico, which has carried out a number of sustainable urban development projects, including the *Neighborhood and Community Improvement Program* [Rules of operation of the Neighborhood and Community Improvement Program, 2019]. This program aims at promoting citizen participation and equity, through social infrastructure planning and rehabilitation of territorial units that have a very low and low social development index in the city's statistics. The beneficiaries of this project are residents which are facing different urban and social degradation situations that impact their quality of life [SIBISO, 2019].

In this context, we also want to mention Romania, even though the country is not present in the top ten countries of the world according to their high population level. The country is increasingly implementing new projects and developing existing ones in order to help the development and sustainability of its cities. Therefore we want to give as a successful example *Cluj IT cluster*, founded in 2012 as an innovation based network for national IT companies and organizations that aims to develop IT services and products, making them more competitive, and to create a highly effective and strong partnership between the public and the private sectors, its main goal being to improve the community's life quality. The cluster offers support to essential actions aimed at improving the collaboration between its members, helping them share knowledge and ideas and assisting further research, the results impacting the whole Romanian society [Cluj IT, (b)].

An important project developed within Cluj IT cluster is *Cluj-Napoca: Next Generation Brained City*, financed through the Sectoral Operational Program for Increasing Economic Competitiveness which aimed to generate a living area based on the innovative concept of ecological and fully computerized urban type community as an element of the networked ecological city. As part of the project's actions, 4 innovative IT products were developed up to the marketability stage and other 12 IT products were developed up to the analysis and design stage. A part of the project's budget was also intended for the organizational development of the cluster mentioned, as it contributes to supporting the IT sector which brings substantial contribution to community development [Cluj IT, (a)].

4. Conclusion

The public administration can become more efficient through the use of information and communication technology, carrying out more transparent activities to help citizens increase their confidence, thus contributing to the development of smart communities and, implicitly, cities.

The public sector plays an important role in stimulating the creation of innovations and the use of information and communication technology for the development of new projects, thus increasing productivity, stimulating the creation of public value, increasing the efficiency in the relationship between citizens and public administration, responding to the challenges that today's society raises [Matei, Săvulescu, Antonovici, 2015].

As we can easily understant, one of the modern tools that the modern world enjoys is information and

communication technology, which contributes to the implementation of democracy and the development of services offered by the public administration. Thus, we consider that the states of the world must provide access to all individuals who use digital information, in a free, equal and non-discriminatory way [Matei, Iancu, 2009].

It should be remembered, however, that although digital technologies provide important help in terms of social innovation and community development, the fundamental element in any interpersonal relationship has been and will always remain the human resource. Therefore, the interaction between individuals should not be stopped in absolute proportion, but a balance must be found between using traditional technologies and methods to perform certain actions [Tîrziu, 2016]. At the same time, the desire of individuals to adapt to the new trends and to acquire the necessary skills and knowledge is of major importance, because if this willingness is missing then the whole process of developing smart cities will be affected.

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Basal cell carcinoma - epidemiology, pathogenesis, pathology, and association with inflammation biomarkers. A review.

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Abstract

Basal cell carcinoma is the most common malignant neoplasm in humans, with low mortality, high morbidity, and exposure to solar radiation (UVB and UVA) is the most critical risk factor. Ultraviolet B rays generate mutagenic photoproducts in DNA and mutations in important genes regulating cellular functions, such as the tumor suppressor gene TP53. Ultraviolet A rays generate cytotoxic and mutagenic free radicals, potentiating the effects of UVB rays.. There is current evidence to support the role of inflammatory biomarkers related to tumorigenesis of basal cell carcinoma.

Keywords: basal cell carcinoma; epidemiology; pathology; biomarkers; inflammation.

1. Epidemiology

When included under the terminology of nonmelanoma skin cancer (NMSC), it includes basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), corresponding to ¼ of all registered malignant tumors. Its incidence is highest in Australia, where 1:2 residents develop BCC before age 70. In the USA, the incidence is 576 cases/100,000 people/year[1]. In Brazil, the estimate was 85,170 new cases of non-melanoma skin cancer (NMSC) in men and 80,410 in women in 2018. This corresponds to an estimated risk of 82.53 new cases/100,000 men and 75.84/100,000 women[2].

The male/female ratio is approximately 1.5:1.0. People with clear phototypes (Fitzpatrick I and II), positive family history of BCC (30-60%), with freckles in childhood, light eyes, and hair, are more likely to develop the neoplasm. n patients under 40 years of age, the incidence of the tumor has been increasing more in women. In high-latitude regions, the proportion of cases of BCC for each case of BCC is 4: 1. BCC globally corresponds to 70-80% of all skin cancers. In highly pigmented skin populations, it is a rare tumor, especially in parts of Africa[1].

The epidemiological profile of the disease in recent decades has shown an increase in the incidence rate of BCC, a more considerable increase in the age groups between the 4th and 5th decade of life (younger patients), a higher incidence of the superficial subtype and tumors with histological subtype of higher risk of recurrence, more significant number of BCCs in covered areas of the body and more considerable increase in cases in people of higher social class[1].

Other external risk factors for the development of BCC are tanning beds, chronic exposure to arsenic, ionizing radiation, chronic immunosuppression, especially in transplanted solid organs, and HIV infection[3,4].

Despite its high incidence, metastasis rates are from 0.0028% to 0.5%, and the estimated mortality is 0.12 cases per 100,000 inhabitants. Unpublished data from Brigham and Women's Hospital, however, suggest that the risk of metastasis and death is 6.5% in tumors greater than or equal to 2.0 cm[1].

2. Molecular pathogenesis

CBC has the highest prevalence rates of mutations of all cancers, determined by exposure to ultraviolet radiation (UV). The intracellular signaling pathway patched / hedgehog (PTCH1) plays a fundamental role in both sporadic BCC and nevoid CBC syndrome (Gorlin syndrome). Mutations in the PTCH1 gene located on chromosome 9q22.3 (58-69%) of sporadic BCCs are observed, as well as in all patients with nevoid BCC syndrome. The SHH (Sonic Hedgehog) pathway comprising the IHH, SHH, and SHH genes is crucial for development during the early stages of the embryo[5,4,6,7,8,9,10].

In the skin, the SSH pathway supports the population of stem cells and helps in the development of hair follicles and sebaceous glands. This pathway is implicated in the cell cycle, particularly in the G1-S and G2-M transitions, and in adults, this pathway is inoperative, and its activation correlates with the appearance of BCC and other tumors. Patched protein 1 (PTCH1) inhibits smoothened protein (SMO). The SHH ligand, in contact with PTCH1, forms the PTCH1-SHH complex, which then releases SMO, a signal transducer that internalizes and releases inhibition of the suppressor of fused homolog protein (SUFU) on the glioma-associated oncogene-1 (GLI1) proteins. There are also mutations of the TP53 gene on

chromosome 17p13.1 (44-65%) of BCCs. Other genetic abnormalities that predispose to the appearance of BCCs include albinism, xeroderma pigmentosum, Rombo syndrome, Bazex-Dupré-Christol syndrome, simplex bullous epidermolysis of the Dowling-Meara type, multiple hereditary infundibulocystic and sebaceous nevus[5,4,6,7,8.9,10].

There are no precursor lesions described for BCC, and the cells of origin are controversial. There is evidence of derivation from immature pluripotent cells of the interfollicular epidermis and cells of the external sheath of the hair follicle, based on experiments of activation of the Hedgehog signaling pathway in different compartments of the epidermis and in the expression of follicular pattern cytokeratins, which led to some authors call it a malignant neoplasm of follicular germ cells (trichoblasts). Additionally, there are reports of association of BCC with abnormalities of the embryonic gene of follicular development, SHH (Sonic Hedgehog), which supports the fact of the rarity of plantar spanning BCCs[4,11,12].

3. Clinical Picture

BCCs are more common in the head and neck region (in up to 80% of cases), but they can affect the trunk, shoulders, upper and lower limbs, lips, breasts, armpits, inguinal region, genital and perineal region. The clinical classification of BCC is based mainly on histological subtypes. The patterns most recognized by all are nodular, superficial, and scleraldermiform[4,13].

In a recent World Health Organization classification for skin tumors (2018), according to the National Comprehensive Cancer Network (NCCN®) Guidelines, it is recommended to stratify basal cell carcinoma for purposes of staging and prognosis in low and high-risk subtypes recurrence, based on clinical and histological parameters[3,13,14]. Figure 2 shows in an organized way the different histological subtypes of BCC, classifying them as low and high risk of recurrence.

LOW-RISK	HIGH RISK
Nodular BCC	Basal squamous carcinoma
Superficial BCC	Sclerodermiform BCC (morpheaform)
Pigmented BCC	Infiltrative BCC
nfundibulocystic BCC (A variant of BCC with adnexal differentiation)	BCC with sarcomatoid differentiation
Fibroepithelial BCC	Micronodular BCC

Figure 2. Histological subtypes of basal cell carcinoma (BCC) stratified according to the risk of recurrence.

4. Low-Risk subtypes

4.1 Nodular Basal Cell Carcinoma

It is the most common clinical form of this tumor, corresponding to 44.7%[15,16] of all BCCs. Clinically, it presents as an asymptomatic papule or nodule, with a translucent and pearly surface. It also shows superficial vascularization with an arboriform aspect, with a pink or reddish appearance. The size of the nodular CBC can vary from 1.0 mm to several centimeters. The average is between 0.5 to 2.0 cm. In

general, it is ulcerated, and in these cases, the name is nodular ulcerated BCC, which can bleed with the formation of hematic crusts. In some cases, the ulcer has more infiltrative characteristics, with the tumor adhering to deeper planes - nodular ulcer-infiltrative BCC[3,4,6,11,12, 17,18,19,20]. (Fig. 3).

Figure 3. Photo of nodular CBC. Source: Takita (2019).

Microscopically it is characterized by blocks of tumor cells in the dermis, at least not focally connected to the epidermis and involving the reticular dermis. The nodules vary in size and shape, and in general, in the nodules, there is a retraction artifact, peripheral palisade, and stroma in the surrounding dermis with mucinous alteration (fibromyxoid stroma), (Fig. 4). It may present focal melanin pigmentation in some nodules, besides Mitosis figures, areas of mature keratinization, nodule-cystic or cystic areas involving tumor islands, and adenoid areas with cribriform nests (adenoid CBC). We can also find areas of differentiation for clear cells, signet ring, granular, and pleomorphic giant cells[3,6,11,12,14,17,20].

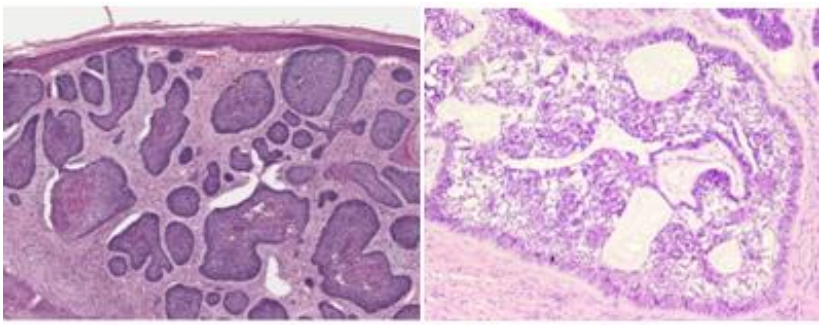

Figure 4. Histology of nodular BCC. Source: Takita (2019).

Differential diagnosis: nodular BCC can be challenging to distinguish between benign and malignant trichoblastic tumors, especially those that occur in skin damaged by sunlight (trichoblastic carcinoma/carcinosarcoma and trichoblastoma). Lesions with cystic degeneration can be challenging to distinguish from adnexal tumors, in particular, adenoid cystic carcinoma, and immunohistochemical evaluation should assist in the diagnosis. Another differential diagnosis is Merkel cell carcinoma. In this case, immunohistochemistry may show positivity for neuroendocrine markers in CBC but negativity for CK20 cytokeratin, which can be decisive in Merkel cell carcinoma[3,4,6,11,12,17,19,20,21,22].

4.2 Superficial Basal Cell Carcinoma

It is the second most common clinical form of this tumor and corresponds to about 17% of cases. Characteristically affects the trunk of male patients. Another characteristic is the greater involvement of younger patients and the presence of multiple injuries. Clinically, it appears as a centrifugal growth plate that leaves the atrophic or cicatricial center. In this form, we can also observe flaking, which is generally thin, (Fig. 5a). Histologically it is characterized by small nests of neoplastic cells in the epidermis, interspersed with healthy skin without a tumor, and the neoplasia in general exhibits retraction artifact and peripheral palisade. The surrounding stroma may have myxoid fibroid areas[3,4,6,11,17], (Fig. 5b).

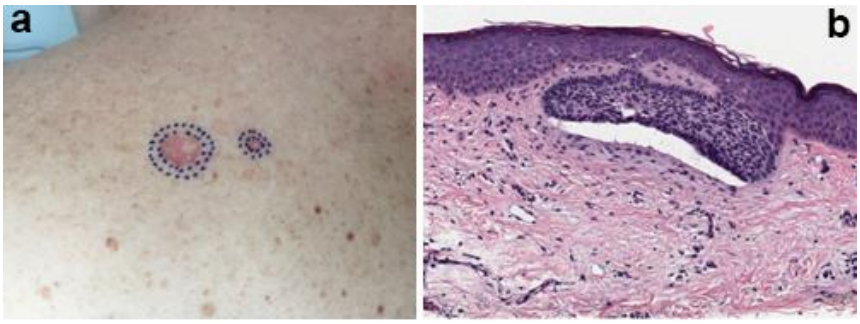

Figure 5. Photo of superficial BCC. a) skin lesion; b) histology.
Source Takita (2019).

Differential diagnosis: histologically, the differential diagnoses are with actinic keratosis, follicular infundibulum tumor, and large cell acanthoma[3,4,6,11,17].

4.3 Pigmented Basal Cell Carcinoma

It is a name that can be used in all clinical forms of BCC. Its importance derives from recognizing the melanic pigment as a component of clinical forms of any BCC, helping in the differential diagnosis of pigmented tumors[3,4,6,11,17].

It corresponds to 13.6% of the cases[23], and clinically what characterizes this variant is its color, which varies from brown to brownish brown, which can be confused with melanoma and other melanocytic or melanin-producing lesions, (Fig. 6a). Microscopically, the nodular and superficial variants of CBC can contain pigment, being categorized as pigmented CBC. Pigmented BCC includes an increased number of benign dendritic melanocytes within the neoplastic cell islands. It can also find melanin within peritumoral macrophages in the adjacent dermis[3,4,6,11,17], (Fig. 6b).

Figure 6. Pigmented Basal Cell Carcinoma. a) skin lesion; b) histology.
Source: Takita (2019).

Differential diagnosis: the histological differential diagnosis includes melanoma, pigmented squamous cell carcinoma, pigmented seborrheic keratosis, pigmented trichoblastoma, porocarcinoma, and matricomamelanocytic[3,4,6,11,17].

4.4 Infundibulocystic Basal Cell Carcinoma (and with adnexal differentiation)

It is a rare variant of BCC with adnexal differentiation, with a predilection for the periocular region. Clinically, they present as single, papular lesions, with a pearly surface, surmounted by a thin, whitish-pink scale (Fig. 7a). Microscopically, are observed infundibular structures with corneal stoppers in cystic areas, surrounded by nests of basaloid cells in the periphery. The other form would be a basal cell with areas of adnexal, sebaceous, or ductal differentiation[3,4,6,11,17]. (Fig. 7b).

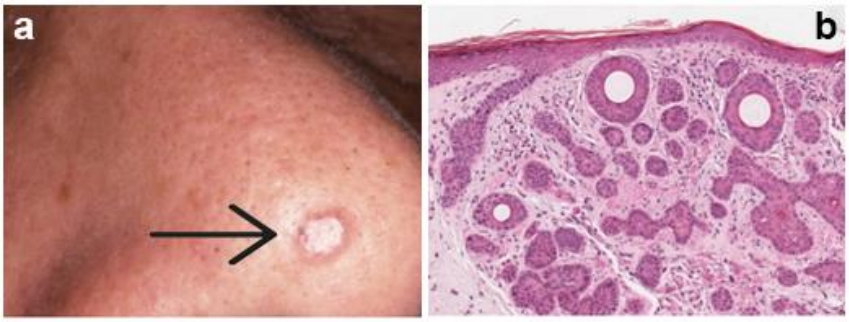

Figure 7 Infundibulocystic Basal Cell Carcinoma. a) skin lesion; b) histology.
Source: Takita (2019).

Differential diagnosis: The histological differential diagnosis of basal cell infundibulocystic carcinoma includes basaloid follicular hamartoma and trichoepithelioma. The BCC with sebaceous differentiation must be differentiated from sebaceoma, sebaceous adenoma, and sebaceous carcinoma[3,4,6,11,17].

4.5 Fibroepithelial Basal Cell Carcinoma (Pinkus Fibroepithelioma)

It is a rare variant of basal cell carcinoma, most commonly affecting the trunk, in particular, the dorsal region, and can rarely be multiple. Clinically, it usually presents as a flesh-colored nodule. Microscopically, filaments and strands of basaloid cells originate from the epidermis and form anastomosing structures into the fibrotic stroma of the dermis. Basaloid cell islands may be present[3,4,6,11,17], (Fig.8).

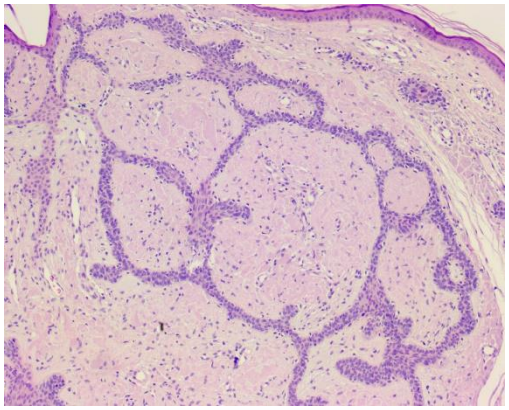

Figure 8. Histology of fibroepithelial BCC(Pinkus tumor).
Source: Takita (2019).

Differential diagnosis: histologically, it must be differentiated from the eccrine syringofibroadenoma, due to the absence of eccrine ductal epithelium and cuticle in the basaloid cell blocks and the predominance of this type of lesion in the trunk instead of the acral region in the BCC[3,4,6,11,17].

5. High-Risk subtypes:

5.1 Basal squamous cell carcinoma

Also called metatypic carcinoma, it is considered an aggressive variant of BCC, with histological findings of BCC and SCC, with transition zones between both. It usually affects older people, with light skin, in exposed areas. It corresponds to 7.4% of BCCs[15,16], and clinically presents as a slowly evolving papule or nodule that can ulcerate, present aggressive clinical behavior, with a higher possibility of recurrence and metastasis (Fig. 9a). Microscopically, it presents characteristic changes of basal cell and squamous differentiation in varying degrees[3,4,6,11,17], (Fig. 9b).

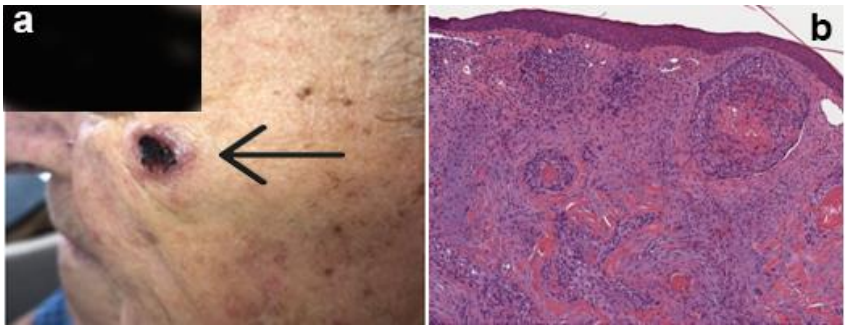

Figure 9. Basal squamous carcinoma. a) skin lesion; b) histology.
Source: Takita (2019).

Differential diagnosis: histologically, it must be distinguished from keratotic BCC (a subtype of nodular BCC) due to the presence of cytologically malignant squamous epithelium and the absence of corneal pearls in the central region of the tumoral nodules. It must also be distinguished from tumors of collision with CBC and CPB[3,4,6,11,17].

5.2 Sclerodermiform Basal Cell Carcinoma (Morpheaform)

It is an aggressive variant of basal cell carcinoma characterized by thin strands of basaloid cells of imprecise limits, without the presence of a palisade in the periphery, surrounded by an abundant fibrous stroma, sometimes desmoplastic, capable of invading the hypodermis. It corresponds to about 10% of CBCs[15,16]. Clinically, it presents as a scar pattern plate with ill-defined edges, which rarely ulcerates or bleeds, (Fig. 10a). Microscopically it reveals infiltrating filiform columns of basaloid cells with a thickness of one to five cells in a fibrosclerotic stroma, without cracks or peripheral palisade. There is often overlap or is confused with the infiltrating BCC[3,4,6,11,17], (Fig. 10b).

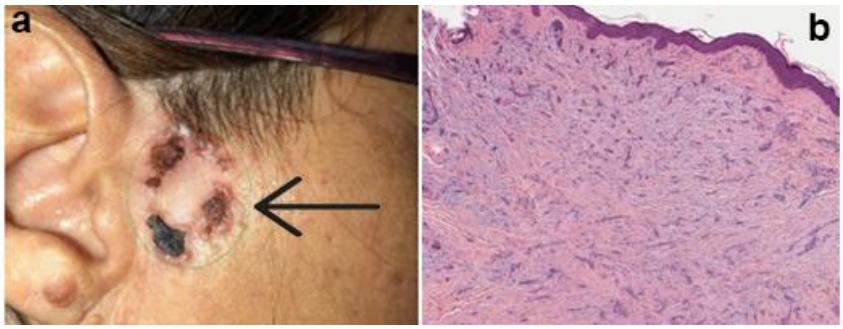

Figure 10. Sclerodermiform Basal Cell Carcinoma. a) skin lesion; b) histology.
Source: Takita (2019).

Differential diagnosis: histologically, it must be distinguished from desmoplastic trichoepithelioma and microcystic adnexal carcinoma, and immunohistochemistry facilitates this distinction. In general, is used a panel of markers where the demonstration of RA +, CK20– and PHLDA–, favors the possibility of trichoepithelioma and CEA +, CK15 +, EMA + and BerEP4–, supports the diagnosis of microscopic adnexal carcinoma[3,4,6,11,17,21,22].

5.3 Infiltrative Basal Cell Carcinoma

It is an aggressive variant of nodular basal cell carcinoma characterized by narrow strands and nests of basaloid neoplastic cells with irregular and infiltrative growth pattern and corresponds to 7% of cases. Clinically, it presents as a scar pattern lesion, more frequent in the upper trunk, head, and neck, generally more common in patients under 35 years of age. The biopsy should include the deep dermis for a correct diagnosis, (Fig. 11a). Microscopically, it presents irregular nests of basaloid cells, of varying sizes, with tentacle pattern, infiltrating the dermal stroma with a thickness of five to eight cells. Part of infiltrative BCCs, about one-third, mix with a nodular BCC component. Perineural invasion and overlap with sclerodermiform BCC can be observed[3,4,6,11,17]. (Fig. 11b).

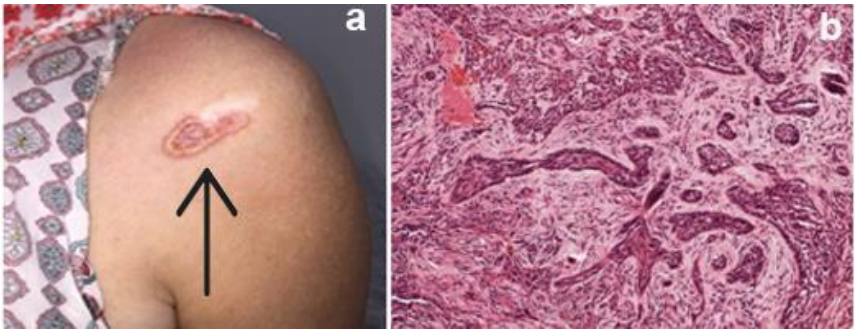

Figure 11. Infiltrative Basal Cell Carcinoma. a) skin lesion; b) histology
Source: Takita (2019).

Differential diagnosis: histologically, it can be confused with sclerodermiform basal cell carcinoma. The presence of perineural neoplastic infiltration favors the diagnosis of infiltrative BCC[3,4,6,11,17].

5.4 Basal Cell Carcinoma with Sarcomatoid Differentiation

It is a scarce aggressive variant of basal cell carcinoma, with a basaloid epithelial component and sarcomatoid stroma of variable histology. It occurs predominantly in older men, in photo exposed areas of the head and neck, chest and forearms, and the tumors are large, averaging 2.8 cm. Microscopically, it has a basal cell component, and a malignant mesenchymal component made up of undifferentiated pleomorphic cells, osteosarcoma, chondrosarcoma, leiomyosarcoma with or without rhabdomyosarcoma. It generally represents the result of a divergent mesenchymal differentiation[6,11].

Differential diagnosis: histologically, it is a biphenotypic tumor, and the correct characterization must be focused on the neoplastic mesenchymal component (e.g., undifferentiated pleomorphic, leiomyosarcoma, rhabdomyosarcoma, and others). Immunohistochemical evaluation is essential for definition[6,11].

5.5 Micronodular Basal Cell Carcinoma

It is a high-risk variant of BCC, rare in its pure form, corresponding to less than 2.6% of BCCs[24], characterized by small nests of tumor cells, generally smaller than the nodes or blocks of the nodular BCC, which deeply infiltrate the dermis, which may compromise the hypodermis. Clinically, it may present as small papules or plaques with little defined surface and extension, more common in the head and neck. As it profoundly infiltrates the dermis, it can recur after surgery; hence it is considered a high-risk variant of BCC, (Fig.11a). Microscopically, they are smaller nodules of basaloid cells (less than 0.15 mm in diameter) compared to nodular BCC. There are cracks and peripheral palisades, and the surrounding reticular dermis is fibromyxoid. It can demonstrate perineural and hypodermis infiltration with small satellite nodules in the deep dermis[3,4,11,17], (Fig. 11b).

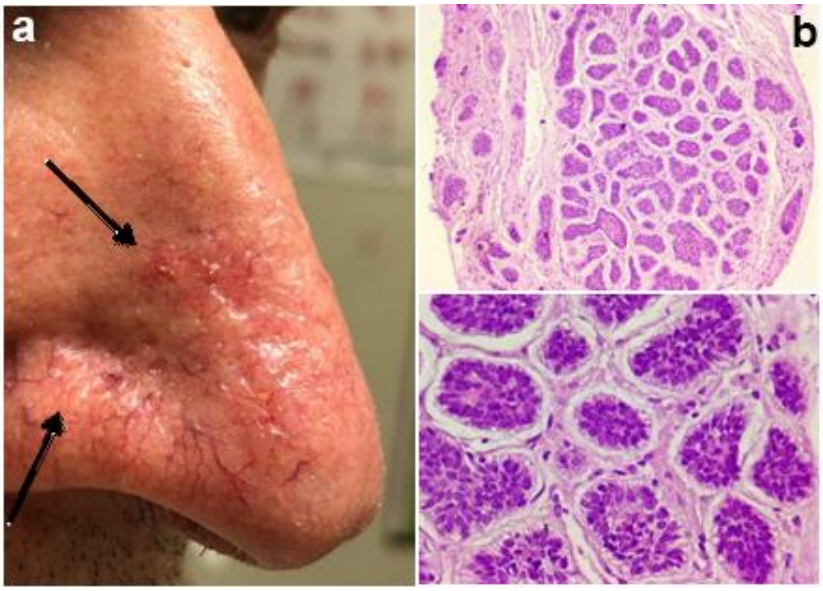

Figure 12. Photo of micronodular BCC
Source: Takita (2019).

Differential diagnosis: histologically, the differential diagnosis includes nodular BCC with focal micronodular architecture, but these tumors are surrounded by a characteristic stroma and present absence of satellite nodules in the neighborhood[3,4,11,17].

6. Evidence of Inflammation in Carcinogenesis

Inflammation is an essential component of innate immunity, allowing multicellular organisms to restore homeostasis in the face of harmful stimuli or conditions, such as infections with or similar tissue lesions. The inflammatory response depends on four components: inducers, cellular or soluble recognition molecules, inflammatory mediators, and target tissues. When this phenomenon becomes unregulated, it persists, and the cellular response starts to be characterized as chronic inflammation[25,26,27].

Depending on the origin of the inducing agents, we can divide inflammatory events associated with cancer into extrinsic (for example, chronic inflammation caused by pathogens or environmental agents) and intrinsic (for example, inflammation induced by genetic changes in pre-malignant cells or by necrosis tumor). The presence of leukocyte infiltrate, especially of macrophages associated with the tumor, represents a hallmark of practically all cancers[25,26,27].

The presence of an inflammatory microenvironment, with high concentrations of reactive oxygen species (ROS) and nitrogen, cytokines, and eicosanoids, leads to the occurrence of direct DNA damage, genetic instability, and epigenetic changes in premalignant cells, favoring the tumor initiation. The inflammatory mediators present in the tumor microenvironment initiate intracellular signaling cascades in tumor cells, culminating in the activation of transcription factors, such as NF-kB and STAT3[28,29].

These factors regulate the transcription of genes associated with the inflammatory response, such as cytokines (IL-6, IL-1β)[28,30], growth factors (CSF-1), chemokines and their receptors (IL-8, CCL2, CCL20, CXCR4)[28,31,32,333,34,35,36,37,38,39], matrix metalloproteinases (MMP-2 and MMP-9)[28,31,40,42,43,44,45],

cyclooxygenases (COX-1 and COX-2)[28,35,46] and several genes associated with carcinogenesis, representing the point of convergence between inflammation and câncer[7,25,26,27,28,47,48,49,50,51].

Some authors have reported evidence that suggests a close association between inflammation and câncer[39,50,52,53,54]. Figure 22 shows, in detail, the signaling pathways associating with inflammation and skin cancer.

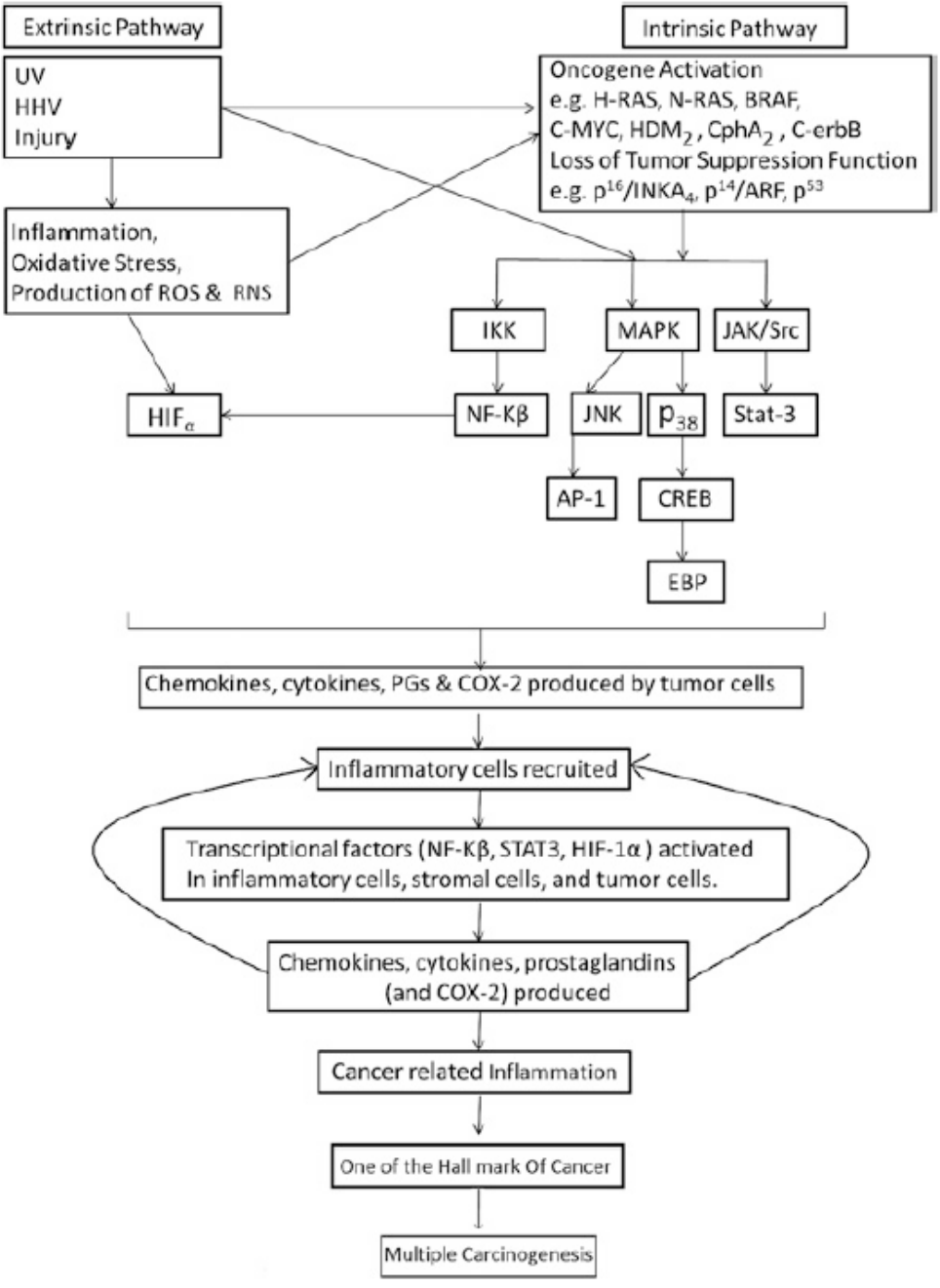

Figure 22. Signaling pathways associated with inflammation and skin cancer.

7. Evidence of inflammation in tumorigenesis of basal cell carcinomas

In the USA alone, it is estimated that 2.8 million new patients are diagnosed each year today, which is a significant public health problem[53]. One of the characteristics of BCC is the continuous activation of the Hedgehog signaling pathway due to mutations in the tumor suppressor gene patch (Ptch), which induces

inactivation or due to the Smoothened mutation that leads to activation. These mutations were considered a right candidate for a therapeutic target, with direct anti-inflammatory approaches, and clinical trials were performed with anti-inflammatory drugs such as difluoro-dimethyl ornithine, retinoids, non-steroidal anti-inflammatory drugs (NSAIDs), dinucleotide thymidine, vitamin D3, silybin and components of green and black teas[10].

Another way of signaling inflammation associated with BCC is NF-kβ, which is dependent on Ikβ kinase α (IKKα). Jia et al., Demonstrated that nuclear IKKα binds to inflammation-promoting factors; moreover, it appears that it binds to a stem cell marker, LGR5 that activates the STAT3 signaling pathway during tumorigenesis.

By eliminating IKKα, tumor growth, and the EMT process are inhibited by proving that IKKα is an oncogenic transforming factor through a loss of stem cells and activation of inflammation-related genes, this shows that BCC is directly related to the inflammatory tumor microenvironment[29].

Another pathway related to inflammation in the BCC is the transcription factor SRY pathway related to the HMG-box family (SOX9). In an animal model in rats with BCC, it was seen that SOX9 is expressed in tumor initiation and that its expression is dependent on the Wnt / β-catenin pathway. In this genetic model, the deletion of SOX9 and the constitutive activation of the Hedgehog signaling pathway suppresses the initiation of CBC highlighted by the involvement of SOX9 in the loss of stem cells, remodeling of the extracellular matrix and differentiation of tumor and metastatic development[56].

In an experimental model using SENCAR rats, in which one the inflammation was induced by UVB radiation, to study the tumor initiation into the skin, it was found that PTK6 (protein tyrosine kinase 6) expression to be increased under the action of UVB. In SENCAR Ptk6 / and Ptk6 -/- mice, exposed to UVB radiation, it was seen that in Ptk6 / mice UVB induces increased inflammation and increased expression of PTK6 in the basal epithelial cells of the epidermis. This exposure was related to a higher frequency of tumors and tumor burden compared to the SENCAR Ptk6 -/- mice. In humans with CPB (squamous cell carcinoma), the activation of PTK6 is quite marked. It appears that PTK6 contributes to inflammation dependent on UVB radiation and the subsequent increase in skin tumorigenesis[57].

In patients with BCC, there is a constant demand for immune cells related to inflammation that can predict their evolution. Such cells are neutrophils, monocytes, and lymphocytes. In a recent retrospective study of the count of white blood cells in less than 500 patients, They observed that in the group of BCCs, the count of neutrophils and monocytes was reduced in relation to the control group. The neutrophil: lymphocyte ratio was 3.24 in BCC and 3.59 in SCC when compared to 5.06 in the control group[58].

As non-melanoma skin cancers are strongly associated with excessive UV radiation, there are numerous studies on the association of the risk of skin cancer associated with vitamin D. The endocrine system and vitamin D are associated with inflammation, cell growth, and differentiation[59].

Vitamin D acts through its binding to the vitamin D receptor (VDR). In a large study reported by Lim et al. Involving about 17,000 cases of BCC compared to more than 250,000 controls, They found 2 single-nucleotide polymorphisms (SNPs) in new loci to be related to the risk of BCC. The study points out that common hereditary variations in VDR are associated with the development of BCC[60]. Another study by Kaukinenet al., Using an animal skin model, showed that mast cells expressing VDR, are involved in UV immunosuppression mediated by VDR expression of CYP24A1 (a hydroxylase) that inactivates vitamin

D3 metabolites. In healthy skin, over 2.9% of mast cells were CYP24A1+, with a high percentage of CYP24A1+ mast cells in keratoseactinics (AK), CEC, and CBC. The findings of increased CYP24A1+ mast cells in keratinocyte-derived skin cancer require further study[61]. As in other organs, we can correlate the increased expression of CYP24A1 in the skin with murine models of inflammation and progressive fibrosis[62].

The tumorigenesis process includes several additional mechanisms, such as neovascularization, tissue invasion, and metastasis. All of these processes involve tissue remodeling, where the urokinase system is highly engaged. Rubinaet al. demonstrated that BCC is associated with keratinocyte hyperproliferation, inflammatory cell migration and angiogenesis processes, and observed that the increased expression of urokinase plasminogen activating receptor (uPAR) is present in the tumor stroma surrounding BCC. Therefore, the uPAR system is a molecular network that supports proliferative aggressiveness and tumor cell invasion[63].

Another molecular system that favors inflammation and tissue remodeling in tumorigenesis is metalloproteinases (MMPs). Its activation is involved in the degradation of the basement membrane in processes such as inflammation, tissue healing, angiogenesis, and carcinogenesis. In BCC, the expression of MMP-1 and MMP-9 has been observed associated with disease progression. Low levels were detected in actinic keratosis (AK), while intense expression was found in different types of BCC[32].

Several anti-inflammatory compounds support evidence of the association of inflammation with tumorigenesis. naproxen, a known anti-inflammatory compound, shows an anti-proliferative and pro-apoptotic action. Chaudhary et al., using a rat animal model with UVB-induced skin tumorigenesis, he observed that naproxen significantly inhibited both BCC and SCC. They observed Inhibition in the number and volume of lesions, and the principal reductions were in BCC type tumors. The effects were associated with decreased expression of PCNA and cyclin D1, increased apoptosis, and inflammation-related molecules (e.g., iNOS, COX-2, nuclear NF-kBe p65). Even residual tumors, after naproxen therapy, had a lower aggressive potential, expression of EMT markers (epithelial-mesenchymal transition, such as N-cadherin, vimentin, Snail, and Twist) and increased expression of E-cadherin[64].

Regarding therapeutic strategies, we have available Imiquimod, which is a TLR7 agonist (TollLike Receptor-7), which addresses an inflammatory-derived receptor, and which has been approved for the treatment of CPB in situ, and more recently, has been used for treatment superficial BCC with positive clinical results. These results show the success of a therapeutic strategy that reduces inflammation and reduces tumorigenesis[65].

Currently has been tested in BCC other classic anti-inflammatory compounds such as aspirin and other non-steroidal anti-inflammatory drugs (NSAIDs). Collectively, data from 11 clinical studies showed a 10% risk reduction for BCCs of patients using NSAIDs, while aspirin use had a lesser reduction in risk. This report highlights that in humans, the use of NSAIDs can be used in a high-risk population to reduce the initiation of BCCs[66].

8. Conclusion

BCC is cancer with multiple clinical and histological facets and can be challenging to differentiate from other cancers and other skin diseases. Therefore, the use of tumor and inflammatory immunohistochemical markers plays an essential role in the differential diagnosis and is necessary for the adoption of the correct therapy in many cases.

Clinical data related to CPNM (non-melanoma skin cancer) show that anti-inflammatory therapeutic approaches can significantly reduce skin carcinogenesis induced by UVB (ultraviolet radiation B).

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Plant stand failures effect in genetic parameters estimation procedure in *Eucalyptus* sp.

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Abstract

The objective of this work was to verify the influence of the percentage of failures in a forest genetics experiment in the estimation of genetic parameters. The study consisted in the evaluation of two

experiments of full-sib families under randomized complete block design with three replicates conducted in the state of Minas Gerais, Brazil. The experiment I was evaluated in January 2002, with approximately 60 months of age. The experiment II was evaluated in January 2003, with 45 months of age. In both experiments, the evaluations consisted of the measurement of the diameter at breast height and plant height. For all the investigated genetic parameters, an increase in the amplitude of the estimates was verified due to the increase in the number of experimental failures. Variances and negative heritabilities were detected, from 35% of failure, indicating that in such cases, this proportion of failure may be problematic to estimate genetic values, to estimate the gain with the selective process and for make decision.

Keywords: Eucalypt, biometric statistics, plant genetics, genetic statistics, genetic parameters.

1. Introduction

The economic importance of eucalypt culture in Brazil and worldwide is due to its rapid growth, wood productivity, and the multiplicity of uses of its different species. According to [12], the area covered by planted forests in Brazil corresponds to approximately 7.84 million hectares, of which 5.7 million hectares of eucalypt, 1.6 million hectares of pine trees and 590 thousand hectares with other species, *Acacia* sp., *Hevea brasiliensis*, *Schizolobium amazonicum*, *Tectona grandis*, *Araucaria angustifolia*, among others. Most of these areas are in the states of Minas Gerais (24%), São Paulo (17%) and Mato Grosso do Sul (15%).

Eucalyptus is currently the most widely exotic planted species in Brazil due to its adaptation to climatic and edaphic conditions and to its high productivity and short production cycles compared to native species. With the establishment of the plantations, various research and breeding programs were initiated in order to provide superior individuals. In this sense, obtaining genetic parameters is of great importance, since it allows the estimation of genetic gains with the selection process, as well as the identification of individuals or families more adapted to different environments.

Genetic gain is defined by [9] as the improvement of the average genetic value in a population. Among the main procedures for its estimation, we highlight the analysis of variance (ANOVA) and the REML/BLUP (Restricted Maximum Likelihood Estimation / Best Linear Unbiased Prediction) procedure. In ANOVA, the variance components are obtained from mean square expected values [3], considering the experimental and genetic design. Heritability and other genetic parameters are estimated from the genetic variance components. REML/BLUP, widely used in forest genetics, allows dealing with unbalanced data and treatments with any kinship, being considered a generalization of ANOVA for more complex situations. However, for simple situations, both procedures are equivalent [30].

Although the experiments are conducted in as judicious as possible way, in *eucalyptus* trials, the existence of failures in the parcel is due to various effects (pests, management etc.) that are accentuated due to their period of evaluation in the field. Experiments with failures, or unbalanced, are worrying in the genetic context, because it means that the plants are under different competition conditions, which in the analytical context require appropriate methods to obtain reliable estimates. If they are not considered, the existence of failures in the experiment is able to provide mean estimates and variances unbiased, which may lead to

incorrect decision-making by plant breeders. In this sense, the objective of this work was to verify the influence of the percentage of failures in a forest genetics experiments on the estimation of genetic parameters, that will allow to accurately estimate the gain with the selection process.

2. Material and Methods

The study consisted in the evaluation of two experiments of full-sib families. The experiment I was installed in the municipality of Belo Oriente, MG, Brazil, in December 1996 and evaluated in January 2002, with approximately 60 months of age. It was used a randomized complete block design with three replicates and linear parcel of 10 plants. The treatments consisted of 32 full-sib families whose parents were elite genetic material previously selected for trait of wood yield. In both experiments, the evaluations consisted of the measurement of the diameter at breast height (DBH) and plant height (PH). The two experiments were taken because they presented low percentage of failures (<3.80, 2%) in the plant stand. Prior to the statistical analysis, the plant stand correction method was applied according to [1].

The variables were analyzed using the statistical model [6]:

$$Y_{ijk} = \mu + G_i + B_j + \varepsilon_{ij} + \delta_{ijk} \quad (1)$$

Where Y_{ijk} is the observation obtained in the k^{th} individual of the i^{th} family evaluated in the j^{th} block; μ is the overall mean of the experiment; G_i is the random effect of the i^{th} family; B_j is the random effect of the j^{th} block; ε_{ij} is the random effect of the variation between families; and δ_{ijk} is the random effect of the variation between plants, within the family.

Based on the analysis of variance, the estimates of the following parameters were calculated:

Phenotypic variance within family:

$$\sigma_d^2 = MSE_{within} \quad (2)$$

Genotypic variance between and within families:

$$\sigma_g^2 = \frac{MS_{family} - MSE_{between}}{nb} \quad (3)$$

Environmental variance between family means:

$$\sigma_e^2 = \frac{MSE_{between} - MSE_{within}}{n} \quad (4)$$

Broad-sense heritability between family:

$$h_b^2 = \frac{\hat{\sigma}_g^2}{\hat{\sigma}_f^2} \quad (5)$$

Broad-sense heritability within family:

$$h_w^2 = \frac{\hat{\sigma}_g^2}{\hat{\sigma}_d^2} \quad (6)$$

Broad-sense heritability at the level of individual in the block:

$$h_{ib}^2 = \frac{2\hat{\sigma}_g^2}{\hat{\sigma}_g^2 + \hat{\sigma}_e^2 + \hat{\sigma}_d^2} \quad (7)$$

Broad-sense heritability at the level of the individual in the experiment:

$$h_{ie}^2 = \frac{\widehat{2\sigma}_g^2}{\hat{\sigma}_g^2 + \hat{\sigma}_e^2 + \hat{\sigma}_d^2 + \hat{\sigma}_b^2} \quad (8)$$

Experimental coefficient of variation:

$$CV_e(\%) = \frac{100.\hat{\sigma}_e}{\bar{X}} \quad (9)$$

Genetic coefficient of variation:

$$CV_g(\%) = \frac{100.\hat{\sigma}_g}{\bar{X}} \quad (10)$$

CV_g/CV_e relation; in which MS_{family} is the mean square of families, $MSE_{between}$ is the mean square of error between the families, n is the number of individuals in a family and b is the number of families. For scenarios with unbalance due to loss of information in the parcel, it was considered the value of $\bar{n}$, taken by:

$$\frac{1}{\bar{n}} = \frac{1}{gr}\sum_{i=1}^{g}\sum_{j=1}^{r}\left(\frac{1}{n_{ij}}\right) \quad (11)$$

to obtain the estimates.

Estimates of the genetic and phenotypic parameters were considered the true values of the parameter, since the data set studied was considered as the known population. Once full-sib families were used, there is only one genotypic variance estimate, since the estimates of the genotypic variance between and within families, for this family structure, have the same estimator, without considering the effects of dominance deviations. To evaluate the influence loss of experimental data, were simulated failure percentages: 5%, 10%, 15%, 20%, 25%, 30%, 35% and 40%. For each percentage, 20000 resamplings were evaluated, generated from the original data set. Analytic algorithms were developed using the R programming language [23] integrated to GENES software [4] [5] to automate the simulation procedures, analysis and estimation of the parameters presented, and also to apply the method proposed, and design the graphs.

3. Results and Discussion

In the variance analysis, it was noticed that the progeny effect was significant (p<0.05) for traits of diameter at breast height (DBH) and plant height (PH), for both experiments (Table 1). This implies the existence of genetic variability between and within progenies, and the possibility of obtaining genetic gains by selecting the most productive progenies for these traits [29], or by selecting the most productive individuals within the best progenies.

Table 1. Summary of variance analysis of experiments assessed at mean level of plot. Mean squares, coefficient of experimental (CV_e) and genetic (CV_g) variation, corrected mean, genetic parameters are showed.

		(I) Mean Square			(II) – Mean Square	
FV	gl	DBH	PH	gl	DBH	PH
Blocks	2	80.93***	84.22**	3	6.06	1.76
Progeny	31	76.43***	145.67***	27	66.05***	62.98***
Between	62	43.24***	81.35***	81	9.15*	10.24***
Within	864	9.49	12.45	560	6.72	6.23
$CV_e(\%)$		22.3867	20.1468		5.9780	5.4563
$\bar{X}$		14.9845	23.7870		13.0458	18.3648
$\hat{\sigma}_g^2$		1.1061	2.1439		2.3709	2.1973

$\hat{\sigma}_d^2$	9.4862	12.4536	6.7153	6.2306
$\hat{\sigma}_e^2$	11.2529	22.9664	0.6082	1.0035
$\hat{h}_b^2$	0.4342	0.4415	0.8615	0.8373
$\hat{h}_w^2$	0.1166	0.1722	0.3531	0.3527
$\hat{h}_{ib}^2$	0.1013	0.1141	0.4891	0.4660
$\hat{h}_{ie}^2$	0.1007	0.1141	0.4901	0.4685
CV_g	7.0188	6.1555	11.8030	8.0716
CV_e	22.3867	20.1468	5.978	5.4546
CV_g/CV_e	0.3135	0.3055	1.9744	1.4798

According to [13], *Eucalyptus* breeding programs in Brazil are based mainly on the selection between and within half-sibling progenies, based on phenotypic measures such as family averages. Regardless of the selection strategy, whose discussion is beyond the scope of this paper, it will depend on the accurate estimation of genetic parameters, which in turn is dependent on the integrity of the experiment. In this sense, an experiment with fewer failures should lead to more accurate estimates of genetic values, and consequently, gains from the selection process.

Estimators for population-genetic parameters of a same trait usually differ between experiments. They depend on the population, but also reflect the environment in which the experiment was conducted. Estimates of variances showed that the two characters under study had similar but not identical genetic control, with estimates of h_b^2, h_w^2, h_{ib}^2 and h_{ie}^2 varying for the same trait between experiments.

Heritability estimates for DBH and PH in experiment II were higher than those found in experiment I in all selection units. In both cases, the highest estimates obtained were for broad-sense heritability between family (h_b^2). These results indicate that selection based on progeny means should be more efficient than selection within progenies, considering the same selection intensity. These findings are consistent and similar to those obtained by [19], [27] and [2]. Higher estimates of h_w^2 would indicate a selection within families, as highlighted by [20] and [22].

The experimental coefficient of variation (CV_e) was higher than 20% for DBH and PH in experiment I, being considered high. In the experiment II, both traits showed CV_e below 10%, which denotes high experimental precision (11). The coefficient of genetic variation CV_g is a commonly used parameter to compare genetic variability [26]. According to the authors, estimates of CV_g higher than CV_e lead to favorable conditions for selection among and within families, that should provide higher genetic gains than selection only between families. Also, according to [32] and [18], when the ratio CV_g/CV_e tends to 1.0 or higher values, there is a favorable situation for obtaining gains with the selection. In this context, experiment II should provide greater gains than experiment I by presenting higher CV_g/CV_e, of the order of 1.97 and 1.47, for DBH and PH respectively.

A factor that affects the performance of the experiments and is often outside the control of the researcher is the loss of plants or experimental units. This can happen due to insect attack, pests, mechanical damage caused by animals, competition with weeds or by simple competition with other plants of the experiment itself. These facts are more aggravating in perennial crops that pass through the long period in the experimental units. This loss of plants is usually random and leads to differences in the plant stand, which contributes to the reduction of experimental precision [34] and the correct interpretation of the results [1].

In relation to cultivated annual species, [8] and [28], working respectively with beans and corn, reported stand effect and methods for correcting such effect. However, in perennial species in which the experimental plots usually involve fewer individuals and the losses of some plants may have the most expressive effect, the information is scarce, and the correction methods involve the inclusion of number of failures adjacent to the plant as a covariate for correcting its genotypic value [25]. In such species, according to [1], this factor is further exacerbated by the fact that errors can be cumulative and perpetuate throughout the conduction of the experiment, which can take decades.

Tables 2 to 5 show the results of the mean estimates with standard deviation of the genetic-population parameters for the two characteristics of experiments I and II, complete and with simulated failures that ranged from 5% to 40% in 20000 resamplings. The analysis of the genetic parameters of the experiments when subjected to simulated failures presented distinct and peculiar behaviors, evidenced by the graphic analysis presented in the boxplots of figure 1.

Table 2. Estimates of the genetic and phenotypic parameters in *Eucaliptus* full-sib families for trait diameter at breast height, considering the original experiment (I) and 8 scenarios with different percentages of lost data (5 to 40%), in 20000 simulated experiments.

	(I)	5%	10%	15%	20%	25%	30%	35%	40%
σ_d^2	9.4862	9.4865 ± 0.15	9.4876 ± 0.2192	9.4843 ± 0.2754	9.4822 ± 0.3292	9.4916 ± 0.3822	9.4839 ± 0.4347	9.4888 ± 0.4904	9.493 ± 0.5457
σ_g^2	1.1061	1.0566 ± 0.0876	1.0074 ± 0.121	0.9571 ± 0.1444	0.9076 ± 0.1628	0.8585 ± 0.1764	0.8067 ± 0.1881	0.7576 ± 0.1974	0.7059 ± 0.2022
σ_e^2	11.2529	10.6693 ± 0.3654	10.0826 ± 0.5074	9.5052 ± 0.6106	8.9177 ± 0.6856	8.3257 ± 0.7495	7.7538 ± 0.8037	7.1695 ± 0.8454	6.5827 ± 0.8758
h_b^2	0.4342	0.4325 ± 0.024	0.4307 ± 0.0348	0.4284 ± 0.044	0.4262 ± 0.0523	0.424 ± 0.0601	0.4202 ± 0.0683	0.4171 ± 0.0763	0.413 ± 0.0841
h_w^2	0.1166	0.1114 ± 0.0096	0.1063 ± 0.0132	0.101 ± 0.0158	0.0959 ± 0.0178	0.0906 ± 0.0193	0.0853 ± 0.0206	0.0801 ± 0.0216	0.0747 ± 0.0222
h_{ib}^2	0.1013	0.0997 ± 0.0088	0.098 ± 0.0125	0.0961 ± 0.0154	0.0942 ± 0.018	0.0922 ± 0.0201	0.0898 ± 0.0221	0.0874 ± 0.0241	0.0846 ± 0.0256
h_{ie}^2	0.1007	0.0991 ± 0.0087	0.0975 ± 0.0124	0.0956 ± 0.0153	0.0938 ± 0.0178	0.0918 ± 0.02	0.0893 ± 0.022	0.087 ± 0.0239	0.0842 ± 0.0254
CV_e	22.3867	21.7955 ± 0.3799	21.1841 ± 0.5422	20.5638 ± 0.6725	19.9145 ± 0.7806	19.2373 ± 0.8833	18.5593 ± 0.9815	17.8375 ± 1.0736	17.0856 ± 1.162
CV_g	7.0188	6.8539 ± 0.2839	6.6858 ± 0.4025	6.5096 ± 0.4956	6.3312 ± 0.5754	6.1494 ± 0.6438	5.9512 ± 0.7139	5.7559 ± 0.7748	5.5455 ± 0.8282
CV_g/CV_e	0.3135	0.3147 ± 0.0162	0.316 ± 0.0238	0.3172 ± 0.0302	0.3189 ± 0.0364	0.3211 ± 0.0424	0.3225 ± 0.0487	0.3251 ± 0.0553	0.3276 ± 0.0620

σ_d^2 phenotypic variance within family; σ_g^2 genotypic variance between and within families; σ_e^2 environmental variance between family means; h_b^2 broad-sense heritability between family; h_w^2 broad-sense heritability within family; h_{ib}^2 broad-sense heritability of the individual in the block; h_{ie}^2 broad-sense heritability in the level of the individual in the experiment; CV_e experimental coefficient of variation; CV_g genetic coefficient of variation; CV_g/CV_e genetic and experimental variation coefficient relation.

Table 3. Estimates of the genetic and phenotypic parameters in *Eucaliptus* full-sib families for trait plant height, considering the original experiment (I) and 8 scenarios with different percentages of lost data (5 to 40%), in 20000 simulated experiments.

	(I)	5%	10%	15%	20%	25%	30%	35%	40%
σ_d^2	12.4536	12.4532 ± 0.2414	12.453 ± 0.351	12.4532 ± 0.4446	12.4638 ± 0.529	12.4524 ± 0.6173	12.4507 ± 0.7049	12.463 ± 0.7881	12.4574 ± 0.874
σ_g^2	2.1439	2.0473 ± 0.1526	1.9503 ± 0.2109	1.8524 ± 0.2479	1.7571 ± 0.2846	1.6622 ± 0.3055	1.57 ± 0.3238	1.476 ± 0.3399	1.3757 ± 0.3494
σ_e^2	22.9664	21.7703 ± 0.6459	20.5926 ± 0.895	19.3937 ± 1.0599	18.2065 ± 1.2039	17.0191 ± 1.3012	15.8253 ± 1.3812	14.6131 ± 1.4567	13.4535 ± 1.4945
h_b^2	0.4415	0.4408 ± 0.0217	0.4397 ± 0.0316	0.4387 ± 0.0393	0.4376 ± 0.0476	0.4368 ± 0.0542	0.4362 ± 0.0612	0.4354 ± 0.0684	0.4328 ± 0.0759
h_w^2	0.1722	0.1645 ± 0.0131	0.1568 ± 0.0181	0.149 ± 0.0213	0.1413 ± 0.0245	0.134 ± 0.0265	0.1267 ± 0.0281	0.1191 ± 0.0296	0.1112 ± 0.0304
h_{ib}^2	0.1141	0.113 ± 0.009	0.1116 ± 0.013	0.1101 ± 0.0158	0.1086 ± 0.0189	0.1071 ± 0.0211	0.1056 ± 0.0234	0.1039 ± 0.0257	0.1015 ± 0.0277
h_{ie}^2	0.1141	0.1129 ± 0.009	0.1115 ± 0.0129	0.1101 ± 0.0158	0.1086 ± 0.0189	0.1071 ± 0.0211	0.1056 ± 0.0233	0.1038 ± 0.0256	0.1014 ± 0.0276
CV_e	20.1468	19.6131 ± 0.2971	19.0732 ± 0.4231	18.5066 ± 0.5165	17.9291 ± 0.6049	17.3313 ± 0.6761	16.7083 ± 0.7437	16.0515 ± 0.8185	15.3969 ± 0.8755
CV_g	6.1555	6.0111 ± 0.2254	5.8626 ± 0.3198	5.7087 ± 0.3867	5.5542 ± 0.4577	5.3967 ± 0.5064	5.2386 ± 0.5548	5.0724 ± 0.6015	4.8896 ± 0.6448
CV_g/CV_e	0.3055	0.3066 ± 0.014	0.3077 ± 0.0204	0.3089 ± 0.0256	0.3105 ± 0.0313	0.3123 ± 0.0358	0.3148 ± 0.041	0.3176 ± 0.0465	0.3196 ± 0.0522

σ_d^2 phenotypic variance within family; σ_g^2 genotypic variance between and within families; σ_e^2 environmental variance between family means; h_b^2 broad-sense heritability between family; h_w^2 broad-sense heritability within family; h_{ib}^2 broad-sense heritability of the individual in the block; h_{ie}^2 broad-sense heritability in the level of the individual in the experiment; CV_e experimental coefficient of variation; CV_g genetic coefficient of variation; CV_g/CV_e genetic and experimental variation coefficient relation.

Table 4. Estimates of the genetic and phenotypic parameters in *Eucaliptus* full-sib families for trait diameter at breast height, considering the original experiment (II) and 8 scenarios with different percentages of lost data (5 to 40%), in 20000 simulated experiments.

	(II)	5%	10%	15%	20%	25%	30%	35%	40%
σ_d^2	6.7153	6.7155 ± 0.1164	6.7159 ± 0.1712	6.7194 ± 0.2151	6.7194 ± 0.2562	6.7208 ± 0.3016	6.7176 ± 0.3499	6.7241 ± 0.3953	6.7208 ± 0.4409
σ_g^2	2.3709	2.2548 ± 0.0785	2.1346 ± 0.1107	2.0194 ± 0.1311	1.8977 ± 0.1472	1.7796 ± 0.1586	1.6613 ± 0.1684	1.5429 ± 0.1774	1.4262 ± 0.1834
σ_e^2	0.6082	0.5772 ± 0.106	0.544 ± 0.1485	0.5101 ± 0.1796	0.4776 ± 0.205	0.4446 ± 0.229	0.413 ± 0.2501	0.3808 ± 0.2685	0.3491 ± 0.2824
h_b^2	0.8615	0.8569 ± 0.0075	0.8518 ± 0.0112	0.8464 ± 0.0143	0.84 ± 0.0174	0.8331 ± 0.0205	0.8253 ± 0.0238	0.8162 ± 0.0277	0.8062 ± 0.0316
h_w^2	0.3531	0.3359 ± 0.0139	0.3181 ± 0.0197	0.3009 ± 0.0233	0.283 ± 0.026	0.2655 ± 0.0282	0.2482 ± 0.0302	0.2305 ± 0.032	0.2134 ± 0.0329

h_{ib}^2	0.4891	0.4723 ± 0.0154	0.4544 ± 0.0223	0.4367 ± 0.027	0.4173 ± 0.0309	0.398 ± 0.0344	0.378 ± 0.0376	0.357 ± 0.0408	0.336 ± 0.0432
h_{ie}^2	0.4901	0.4732 ± 0.0154	0.4552 ± 0.0223	0.4373 ± 0.027	0.4179 ± 0.0309	0.3984 ± 0.0344	0.3784 ± 0.0375	0.3573 ± 0.0408	0.3362 ± 0.0432
CV_e	5.978	5.7987 ± 0.5404	5.5974 ± 0.7966	5.3859 ± 1.0079	5.1821 ± 1.1936	5.0064 ± 1.3287	4.8522 ± 1.4447	4.7327 ± 1.52	4.6231 ± 1.5621
CV_g	11.803	11.5086 ± 0.2034	11.1953 ± 0.2947	10.8876 ± 0.3593	10.5518 ± 0.4162	10.2162 ± 0.4633	9.8674 ± 0.5084	9.5063 ± 0.5561	9.1352 ± 0.5984
CV_g/CV_e	1.9744	2.0033 ± 0.2057	2.0484 ± 0.3587	2.1249 ± 0.8993	2.2274 ± 1.5277	2.3202 ± 1.961	2.414 ± 2.458	2.4503 ± 2.5065	2.4662 ± 2.7838

σ_d^2 phenotypic variance within family; σ_g^2 genotypic variance between and within families; σ_e^2 environmental variance between family means; h_b^2 broad-sense heritability between family; h_w^2 broad-sense heritability within family; h_{ib}^2 broad-sense heritability of the individual in the block; h_{ie}^2 broad-sense heritability in the level of the individual in the experiment; CV_e experimental coefficient of variation; CV_g genetic coefficient of variation; CV_g/CV_e genetic and experimental variation coefficient relation.

Table 5. Estimates of the genetic and phenotypic parameters in *Eucaliptus* full-sib families for trait plant height, considering the original experiment (II) and 8 scenarios with different percentages of lost data (5 to 40%), in 20000 simulated experiments.

	(II)	5%	10%	15%	20%	25%	30%	35%	40%
σ_d^2	6.2306	6.23 ± 0.1744	6.2332 ± 0.2562	6.2259 ± 0.3255	6.231 ± 0.3865	6.2388 ± 0.4521	6.2336 ± 0.5109	6.2273 ± 0.5801	6.2293 ± 0.6531
σ_g^2	2.1973	2.0901 ± 0.0841	1.9802 ± 0.1171	1.8706 ± 0.1408	1.7619 ± 0.1562	1.652 ± 0.17	1.5419 ± 0.181	1.4324 ± 0.1914	1.3253 ± 0.1969
σ_e^2	1.0035	0.9509 ± 0.1057	0.8986 ± 0.1484	0.8491 ± 0.1806	0.7937 ± 0.2072	0.74 ± 0.2332	0.6908 ± 0.256	0.6398 ± 0.2776	0.59 ± 0.2989
h_b^2	0.8373	0.8331 ± 0.0086	0.8282 ± 0.0128	0.8228 ± 0.0165	0.8171 ± 0.0199	0.8104 ± 0.0237	0.8027 ± 0.0278	0.7942 ± 0.0324	0.7846 ± 0.037
h_w^2	0.3527	0.3358 ± 0.0172	0.3183 ± 0.0239	0.3014 ± 0.0289	0.284 ± 0.032	0.2664 ± 0.0352	0.2492 ± 0.0374	0.2323 ± 0.0397	0.2153 ± 0.0407
h_{ib}^2	0.466	0.451 ± 0.0175	0.4348 ± 0.025	0.4184 ± 0.031	0.4014 ± 0.0352	0.3833 ± 0.0397	0.3649 ± 0.0435	0.346 ± 0.0475	0.3265 ± 0.0501
h_{ie}^2	0.4685	0.4533 ± 0.0176	0.4369 ± 0.025	0.4203 ± 0.031	0.403 ± 0.0353	0.3848 ± 0.0398	0.3662 ± 0.0436	0.3471 ± 0.0476	0.3275 ± 0.0501
CV_e	5.4546	5.3014 ± 0.2983	5.1438 ± 0.4325	4.9879 ± 0.5446	4.8073 ± 0.6508	4.622 ± 0.768	4.4469 ± 0.8727	4.2619 ± 0.9801	4.0863 ± 1.0755
CV_g	8.0716	7.8708 ± 0.1624	7.6594 ± 0.2326	7.4422 ± 0.2874	7.2207 ± 0.3288	6.9901 ± 0.3693	6.7503 ± 0.4075	6.5031 ± 0.4469	6.2521 ± 0.4787
CV_g/CV_e	1.4798	1.4897 ± 0.0962	1.5007 ± 0.1473	1.5124 ± 0.1983	1.5346 ± 0.2578	1.5681 ± 0.4078	1.6021 ± 0.5312	1.6581 ± 0.7737	1.7369 ± 1.4438

σ_d^2 phenotypic variance within family; σ_g^2 genotypic variance between and within families; σ_e^2 environmental variance between family means; h_b^2 broad-sense heritability between family; h_w^2 broad-sense heritability within family; h_{ib}^2 broad-sense heritability of the individual in the block; h_{ie}^2 broad-sense heritability in the level of the individual in the experiment; CV_e experimental coefficient of variation; CV_g genetic coefficient of variation;

CV_g/CV_e genetic and experimental variation coefficient relation.

In experiment I, for the characteristic DBH, the increase in the number of failures in the experiment did not alter the mean of h_b^2 (Figure 1A) and led to a large increase in the amplitude of the estimates. In experiment II, the increase in the number of failures resulted in a slight decrease in h_b^2 and similar increase in the amplitude of estimates.

According to [29], heritability is one of the most important genetic-population parameters for the genetic study of quantitative character, and whose role is to express the confidence of the phenotypic value as a guide to the genetic value or degree of phenotypic value and genetic value. According to [7] heritability is a property not only of a character but also of the population, of the environmental circumstance to which the individuals are subjected, and of the way in which the phenotype is measured, and since its value depends on the magnitude of all the components of variance, a change in any one of these will affect it. According to [2], variations in this genetic parameter are common and may be associated with the age of evaluation, the site and experimental precision of the experiment.

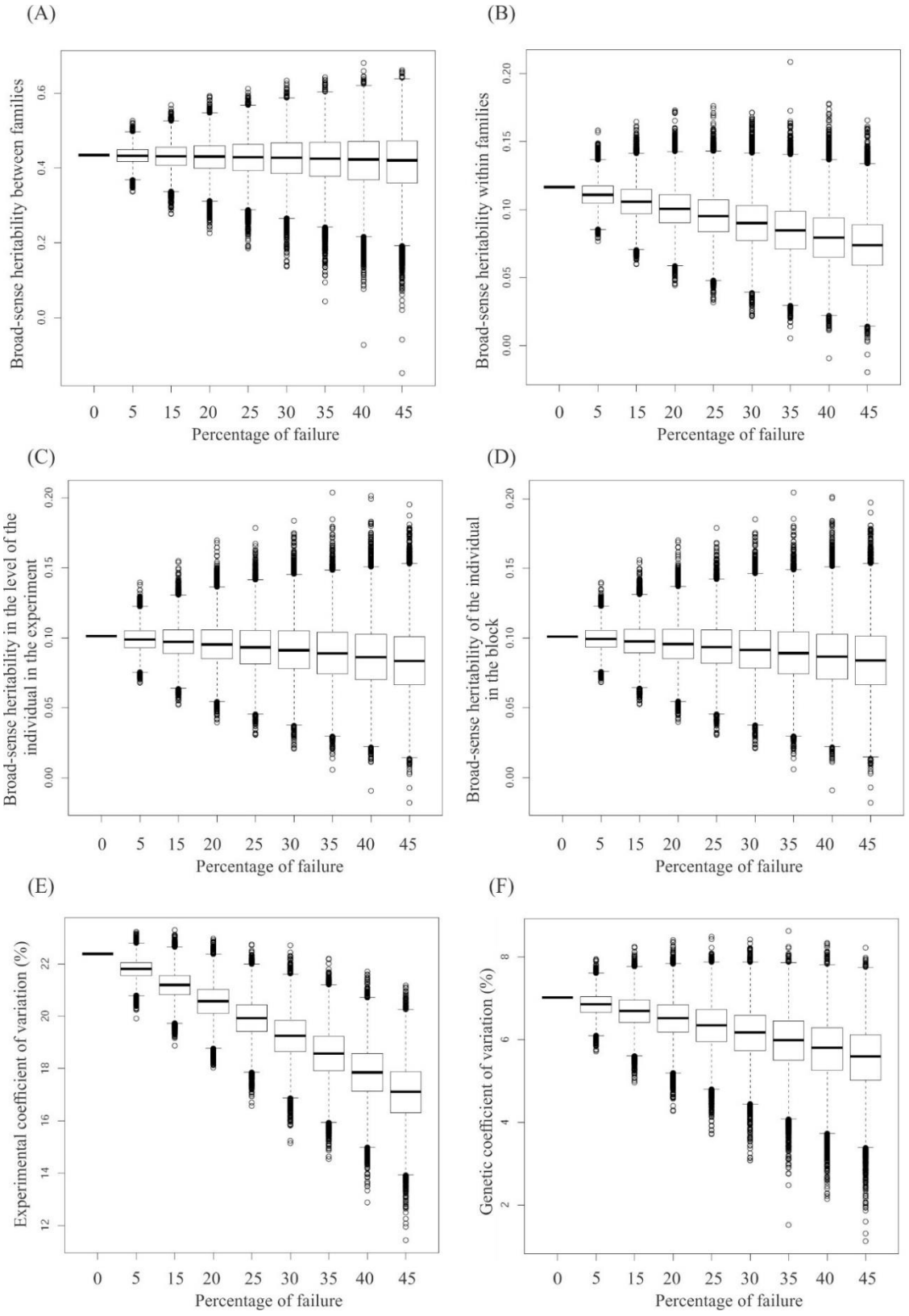

Figure 1. Dispersion of the 20000 parameters estimates of (A) broad-sense heritability between families, (B) broad-sense heritability within families, (C) broad-sense heritability in the level of the individual in the experiment, (D) broad-sense heritability of the individual in the block, (E) experimental coefficient of variation (F) and genetic coefficient of variation.

For all the investigated genetic parameters, an increase in the amplitude of the estimates was verified. Also in the boxplots (Figure 1), the increase of simulated failures caused even an increase in the amount of outliers. In extreme cases, negative variances and heritabilities were detected, indicating that in such cases, this proportion of failure may be extremely harmful for estimating genetic values, to estimate the gain with the selective process and for decision making. The obtaining of negative variances stems from the method used, and its obtaining an indicative of problems in the estimation process. These results, together with those of [1] corroborate the fact that, at the very least, failures in the plant stand impair the identification of the best materials, and that of large amounts of failures are able to make experimentation impossible to breeding purposes and selection of superior genetic materials.

For the estimates of h_w^2, in all cases, it decreased with the increase in the number of failures in the experiment. Furthermore, they presented estimates lower than those of heritability at the level of family mean, which according to [19], implies that the selection in this selection unit should provide greater genetic gains. In Figures 1-4, 1-F are also presented the behavior for parameter estimates h_{ib}^2, h_{ie}^2, CV_e and CV_g, which were similar to h_w^2.

The results indicated that, in general, the increase of failures in the experiment led to a variety of estimates of genetic parameters, sometimes higher, sometimes inferior, or innocuous. The experiment's behavior with experimental failures should be investigated on a case-by-case basis, since each experiment has a genetic structure unknown to a priori, usually with intricate kinship relationships among the genotypes. A possible criticism that could be raised, is that in the scenarios evaluated, it was not considered that the development of plants adjacent to experimental failures, which should stand out to others. We emphasize that this was not the focus of the work, given the intense work of computational modeling necessary, but that will certainly be investigated in the future.

4. Conclusions

The increase in the number of experimental failures led to an increase in the amplitude of the estimates of genetic parameters.

Experimental failures equal to or greater than 35% of the experiment provided unrealistic estimates of heritabilities. Similar percentage experiments are potentially problematic to estimate genetic parameters and gain with selection.

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School Climate in the Brazilian school context: an integrative literature review

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Abstract

The school establishes its educational practices through historical and social biases, existing outside and inside it. The present study demonstrated the continuous debate about the school context, its organization, management and dynamism, through an integrative literature review. The purpose of the research is to learn a little more about the school climate in the Brazilian educational context and what the scientific literature has been producing on the subject. The school climate has been studied for a few years, but only in recent years, through practical perspectives found in the studies, has is become possible to analyze the "reality" of the school climate in a more subjective way, exploring the concept from the perception of students as protagonists of their education. The school climate, therefore, is understood as a complex and comprehensive variable of affective, social and cognitive aspects that influence a school pedagogical practice. Notably, the articles mentioned in this study corroborate that the educational results are strongly influenced by the school climate. The positive or negative impact, depending on the climate that is established, has as a consequence the academic performance referenced by the teaching and learning process.

Keywords: school climate; school; definition; integrative review.

1. Introduction

The school is much more than an agglomeration of people who relate to each other in search of a common goal, or a physical structure capable of receiving individuals with different experiences and knowledge. It is necessary to have a broad view of it, while allowing functional cuts of how the school is constituted. For, there is no possibility of pointing out successes and failures solely due to the structure and functioning of basic education. It is necessary to envision the school, the classrooms and the protagonists of the system as a universe, constituted by ideals, actions and reflections relevant to the development of the participants in the process.

For Falsarella (2018, p. 623), "schools are historical and cultural institutions that are similar in architecture and organizational structure. At the same time, each school is a different terrain, in which social subgroups with different interests define each other, characterizing their culture, within a certain time, space and place ".

The way in which each school establishes its educational practices is based on historical and social biases. Therefore a naive view that each sphere works based on its own principles is not conceivable. The school is immersed in a rich historical and social dynamism existing outside and inside it. For the authors

Pereira and Mouraz (2015), this immersion brings a certain tension, as a consequence. For what used to be a unit of principles and values, today presents a diversity of principles, focused on actions and norms of justice.

The analyses of the selected studies show that the debates about the school context, its organization, management and dynamics, have increased considerably since the 1990s. Falsarella (2018) highlights, however, that most studies analyze education based on results obtained in institutionalized and official exams instead of the intellectual enrichment, properly speaking, of the students. Reis (2012), on the other hand, argues that the students' school experience does not allow the understanding of specific aspects related to the appropriation of knowledge. Participants in their research report that the practice of many teachers is restricted to the exposure of concepts already systematized, which, makes little sense to most students. According to them, most teachers do not establish a dialogue between the subject and its interpretations, leading students to perceive reality as dichotomous. On the one hand, they perceive the experience familiar to them and, on the other what is taught by the teacher.

The research results also indicate that there is no evidence of teachers' concern with certain knowledge, such as study techniques and practical instructions for carrying out work (REIS, 2012). In this context, school failure has multiple causes, whether internal or external to the school walls.

> The inequalities that occur in schooling are due not only to the structure and functioning of the educational system, but also to the influence of school variables and internal processes in schools. (NÓVOA, 1999, p. 15).

Although it is difficult to conceptualize quality education, due to the complexity of the school world, it can be said that it consists of promoting comprehensive education, which contains physical, cognitive, affective and socio-moral aspects in its core, in order to contribute to the education of honest, fair and respectful citizens, while including the necessary learning and knowledge for a productive and satisfying life in a democratic society (MORO; VINHA; MORAIS, 2019).

The school climate is seen as one of the constitutive elements of the school and of the schooling processes, and can be understood as a set of elements, perceptible or not, by the actors that compose it, unifying them in school culture values and practices (FALSARELLA, 2018; PETRUCCI et al., 2016).

The school climate is related to the quality of life in the educational institution and reflects the perception of students, teachers, administrators and other employees and families about the school's daily work, shared values, established and agreed rules, proposed objectives, the development of teaching and learning, interpersonal relationships and organizational structures (COHEN, 2006, 2010, 2012 apud MORO; VINHA; MORAIS, 2019).

Falsarella (2018) establishes the “emotional tone” as the most characteristic link in the school climate. A feeling attuned to institutional functioning and even more so, to the existing relationships within the school environment.

The quality of the relationships, understood here by the authors as inherent to the school climate, between students, teachers and the entire academic community, plays an important role in the integral

development of children and adolescents, including the influence of school results (CORNELL, SHUKLA, KONOLD, 2016 apud AMARAL; CUNHA; SANTO, 2019).

There is evidence, based on the studies found, that the school climate helps academic performance (AMARAL; CUNHA; SANTO, 2019) and promotes school adjustment and satisfaction with life, based on the improvement of mental health (PETRUCCI et al., 2016).

These interactions, however, can also lead to negative results, such as violent behavior and depression (PETRUCCI et al., 2016) and the victimization of peers (AMARAL; CUNHA; SANTO, 2019).

Despite the advance of studies on the school climate theme, there is still no consensus regarding its dimensions. The authors suggest, in their studies, different contributing factors in the perception of the school climate. Among them, the following characteristics are mentioned: gender and race, size of school, number of students with behavioral problems, interpersonal relationships between teachers and students, and between peers, institutional norms and objectives, and teaching and learning practices (PETRUCCI et al., 2016).

2. Methodology

2.1 Study objective

This study was carried out in order to know a little more about the school climate in the Brazilian educational context and what the scientific literature has been producing on the subject.

2.2 Design

It is an integrative literature review (WHITTEMORE, 2005) on the school climate in a Brazilian school context. The research was carried out between the months of January and September of 2019. All articles published up to this time period were previously included in the research, and filters were subsequently delimited in order to elect the pertinent studies for the composition of this research, which will be described below.

The school climate has been studied for a few years. According to Cunha (2014), the studies on the subject began in the late 1950s, however in a more macro-social view of research. In the first studies, it was not considered to interfere with students' school performance. Only in recent years has the scientific literature investigated the school climate as a contextual part of a unit of analysis, represented by the term ethos, "which would represent the totality of the referred process variables acting together". (CUNHA, 2014, p.1080-1081).

The present study is justified by the need to establish perceptions about the relationships experienced within school institutions and which have an impact on the academic, social and cultural construction of participants in the educational process and in family settings.

Literature review is a research procedure that, according to Sampieri, Collado and Lucio (2013), consists of finding, consulting and selecting bibliographies on a given topic. The integrative review, from its broad methodological approach, allows the compilation of relevant information and understanding of the state of the art on the school climate, using publications of experimental and non-experimental, theoretical and empirical studies for this purpose (WHITTEMORE, 2005) . Also according to the author, the integrative

review makes it possible to find studies that portray the same theme, but with different conceptions, approaches and analyses, providing a wide understanding of the problem in question.

The method adopted in the integrative review will be presented next.

2.3 Procedures

The procedure performed for the application of the integrative review in the present study occurred through the use of associated key terms, described in Portuguese and English, respectively, namely: (1) clima escolar; (2) school climate.

The studies considered here were searched in the databases Scielo (Scientific Electronic Library Online) and BHS (Biblioteca Virtual de Saúde - Virtual Health Library), electronic libraries that cover national and international journals. However, in order to converge with the objective of the study, which was to seek studies on the school climate in a Brazilian educational context, the following selection filters were used: (1) Full text available, (2) Type of document - article and (3) Country / Region as a subject - Brazil.

The terms used were considered the central axis of the research in question. The search criterion included the presence of this term - school climate, in the title, in the summary of the article or in the keywords presented by the authors. The exclusion criteria for studies were: (1) studies that were not scientific articles, (2) complete texts not available, (3) studies not related to the proposed theme (school climate) and (4) researches that have not been carried out in Brazil.

The abstracts of the studies found throughout the research were systematically read and evaluated by the authors of the present study, verifying their adequacy to the inclusion and exclusion criteria adopted.

2.4 Results

The initial search with descriptors in Portuguese and English, without the use of filters and exclusion criteria, resulted in 14,385 studies, 14,060 of those being from the BVS database and 325 from SciELO.

Due to the large number of studies, there was an impossibility of reading all of them, therefore the search was narrowed using the filters: (1) Full text available, (2) Type of document - article and (3) Country / Region as subject - Brazil.

The second search resulted in 307 studies from BVS and 84 from SciELO. Systematic readings of the titles and abstracts of the articles found were necessary to decide which ones were relevant to the topic in question. When just reading the title and abstract was not enough, the studies were read in its entirety, and evaluated for incorporation into the research, as shown in Chart 1.

Chart 1 - Descriptors used in the respective search sites and the number of articles selected in the second search.

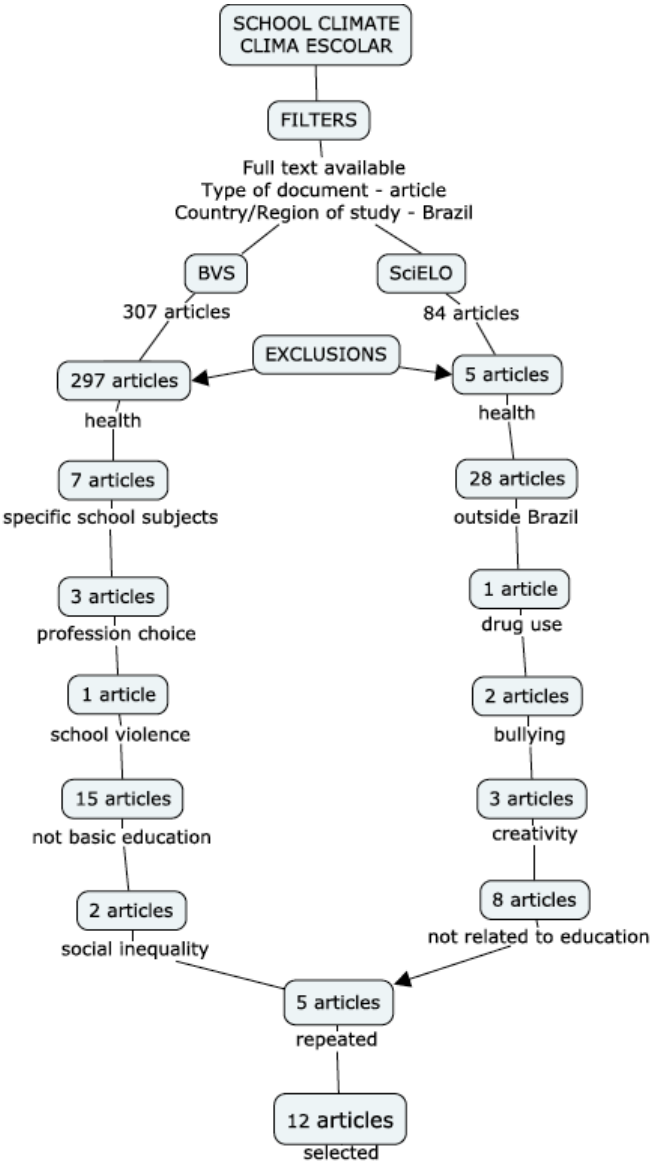
Association between key terms	**BVS**	**SciELO**
Clima escolar	0	9
School climate	1	2

Source: Authors (2019)

Of the total of 391 (three hundred and ninety-one) articles found in the searches using the key terms associated in both platforms - BVS and SciELO, the prevalence of studies related to the health area was observed (n = 302), having their distributions between epidemiologies and childhood illnesses. The high number of studies in the health field is understandable, considering that the vast majority (n = 297) was found on the BVS platform, which aims to converge information on health and other areas.

Other articles were not included in the study due to factors such as: studies outside the Brazilian context (n = 28); specific school subjects (n = 7); choice of profession (n = 3); drug use at school (n= 1); school violence, such as homophobia (n = 1) and bullying (n = 2); studies outside basic education (n = 15), related to creativity (n = 3), social inequality within the school walls (n = 2), not related to the area of education (n = 8) and repeated (n = 5). These numbers are reported, for a better view, in figure 1.

Figure 1. Identification and selection of articles in the BVS and SciELO databases, including reasons for their exclusion.



Source: Authors (2019)

According to the selected studies (n = 12), they propose to carry out a panoramic analysis of the school climate and are referenced throughout the study and elucidated in their most basic characteristics in table 1.

Chart 1. Description of the selected studies.

	Article	Year of publication	Place of publication	Field of the study	Nature of research	Autho(s) of research
1	Os estudos sobre a cultura da escola: forma, tradições, comunidade, clima, participação, poder (Studies on school culture: form, traditions, community, climate, participation, power)	2018	Educ. Soc., Campinas	Education	Theoretical	FALSARELA, A. M.
2	Estética diária das escolas: a partir do que você vê em direção ao sentido da escola (Daily aesthetics of schools: from what you see towards the direction of the school)	2018	Educação e Sociedade	Education	Theoretical	MARINI, G.; MERCHAN, J. D. R.; AGUAYO, M. S.
3	Liderança do diretor, clima escolar e desempenho dos alunos: qual a relação? (Principal leadership, school climate and student performance: what is the relationship?)	2016	Ensaio: aval. pol. públ. Educ.	Education	Empirical	OLIVEIRA, A. C. P. de; WALDHELM, A. P. S.
4	Crise da educação escolar e percepções dos professores sobre o seu trabalho:	2015	Educação em Revista	Education	Empirical	PEREIRA, F.; MOURAZ, A,

	identidade profissional e clima de escola em análise (Crisis of school education and teachers' perceptions of their work: professional identity and school climate in analysis)					
5	Possíveis relações entre percepções de violência dos alunos, clima escolar e eficácia coletiva (Possible relationships between students' perceptions of violence, school climate and collective effectiveness)	2014	Educ. Pesqui.	Education / Sociology	Empirical	CUNHA, M. B.
6	Práticas e percepções docentes e suas relações com o prestígio e clima escolar das escolas públicas do município do Rio de Janeiro (Teaching practices and perceptions, and their relationship with the prestige and school climate of public schools in the city of Rio de Janeiro)	2010	Revista Brasileira de Educação	Education	Empirical	BRITO, M. de S.; COSTA, M. da.

7	A escola como lócus de formação docente: uma gestão bem-sucedida (The school as a locus of teacher training: successful management)	2010	Cadernos de Pesquisa	Education	Empirical	GRIGOLI, J.; LIMA, C. M.; TEIXEIRA, L. R. M.; VASCONCELLOS, M.
8	A escola de qualidade para todos: abrindo as camadas da cebola (The quality school for all: opening the onion layers)	2005	Ensaio: aval. Pol. Públ. Educ.	Education / Sociology	Theoretical	GOMES, C. A.
9	School climate evaluation: Designing and validating measurement instruments (School climate evaluation: Designing and validating measurement instruments)	2019	Cadernos de Pesquisa	Education	Empirical	MORO, A.; VINHA, T. P.; MORAIS, A.
10	Authoritative school climate and peer victimization among Brazilian students	2019	Psico	Education	Empirical	AMARAL, H. T.; CUNHA, J. M. da; SANTO, J. B.
11	Experiência escolar de jovens/alunos do ensino médio: os sentidos atribuídos à escola e aos estudos (Experiência escolar de jovens/alunos do ensino médio: os	2012	Educação e Pesquisa	Education	Empirical	REIS, R.

	sentidos atribuídos à escola e aos estudos)					
12	Adaptation and preliminary validation evidences of the school climate questionnaire – revised, elementary and middle school version (SCS-MS)	2016	Psicologia: Reflexão e Crítica	Psychology	Empirical	PETRUCCI, G. W.; BORSA, J. C.; DAMÁSIO, B. F.; KOLLER, S. H.

Source: Authors (2019)

2.5 Discussion

One may observe that the school climate theme is studied mainly by professionals in the Education area (n = 11) with a bias towards the school environment, among which are some studies in the area of Sociology related to studies focused on Education (n = 2) and Psychology (n = 1).

In view of the facts presented in the table, the prevalence of empirical studies (n = 9) is clear, using tools such as interviews and questionnaires conducted with teachers and students from Basic Education schools, in context with the findings in scientific literature.

Through the practical perspective of the studies it becomes possible to analyze a more subjective "reality", exploring the concept of school climate from the perception of the protagonists of education.

In observance of the studies, the recurrence on the theme in the last ten years is evident (n = 11), even though the school climate started in the scientific literature in the mid-1970s. For Cunha (2014), the school institution is considered as an integrated unit of interfering aspects only in more recent studies, and should be analyzed based on its internal processes.

Next, the study presents a brief synthesis of the articles described in the table, organized into two topics: (1) characterization of the school climate and (2) school climate and educational results, aspects considered by the authors as essential for the educational area under which the present study writes, aiming to show how the school climate theme was treated by the consulted literature.

3. Characterization of the school climate

Despite being a topic of great relevance in the school environment and object of scientific studies for a few years, there is no consensus on the definition of the term "school climate". According to Moro, Vinha and Morais (2019), there is semantic equivalence to the terms: school ethics, atmosphere, ideology, community, personality, health or social environment.

However, the authors classify the school climate as a set of perceptions and expectations shared by members of the school community, resulting from their experiences in that context. This definition allows us to understand that the school climate, despite its difficult conceptualization, is defined as the image perceived by the individuals who integrate it (CUNHA, 2014).

The study by Marini, Merchaán and Aguayo (2018) also establishes aesthetics as a characteristic of the school climate. This aesthetic can be perceived through visual, olfactory and tactile senses. Physical aesthetics make up the subjective understanding of the school climate, that is, the "state of common spaces, such as walls, stairs, bathrooms and patios, has an impact on the morale of teachers and students and, therefore, on the school climate, and may even establish what the normative cultural, social and political trends that a school institution is based on are" (DEBARBIEUX et al., 2012 apud MARINI, MERCHAÁN, AGUAYO, 2018, p. 371).

The revision of the bonds established by the students, both with their teachers and with their peers, together with the way they relate to the institution as a whole, are part of what several authors conceptualize as a school social climate (ARÓN; MILICIC, 1999 apud MILIC et al., 2013, p. 648).

To analyze the concept of school climate, studies vary in terms of how individuals feel in the institution, how they perceive institutional and organizational spaces and how relationships between school actors occur, along with their educational experiences (GANGI, 2010 ; JANOSZ; GERGES; PARENT, 1998; THIÉBAUD, 2005; HOY; HANNUM, 1997 apud MORO; VINHA; MORAIS, 2019).

In the study by Oliveira and Waldhelm (2016), for example, multilevel analysis was used in order to ascertain the school climate, using the teachers' perception of leadership to do so. The authors point to the multiplicity of factors that make up the school climate, with leadership being exercised and perceived by teachers as a central element, alongside factors such as: violence, discipline, cohesion and collaboration among the team.

Socio-emotional and academic adjustment, the relationship between school experience, and behavioral, anxious or depressive problems and social adaptation are also defined as constituent elements of the school climate (KUPERMINC et al., 2001; KORNBLIT et al., 2008; LOUKAS; ROBINSON, 2004 apud MILIC et al., 2013, p. 648).

The school climate, therefore, influences the dynamics of the school, and, on the other hand, is influenced by it. The quality of life and the quality of the teaching and learning process is sustained under a positive school climate (VINHA; MORAES; MORO, 2017), integrating the socio-emotional well-being of students and the development of socio-emotional skills (MILIC et al., 2013, p. 648).

For Brunet (1992 apud MORO; VINHA; MORAIS, 2019), the literature delimits three broad and distinct definitions of school climate: one based on the characteristics of the institution, its organizational attributes; another, in which the climate is defined according to the satisfaction of individual needs, based on their emotions, according to the principles of subjective perception; and a third, measured through the understanding of the organizational characteristics existing in a space and how they are established in relation to the members and the neighboring society.

Brunet (1999 apud FALSARELLA, 2018, p. 626) still classifies the organizational climate into categories, with exploitative authoritarianism being the one that creates a hostile environment, where members belonging to a lower hierarchy have no voice, are controlled by the top of the organization, who, many times, act with indifference and threats; benevolent authoritarianism becomes a softening of the first category, allowing some rare decisions to be made by members belonging to the organization, however, with the members of the hierarchical top still having the greatest decision-making power; in the third category, named as a participatory type of consultative character, the level of trust between members is

increased, allowing for greater participation and decision-making power in collective actions; finally, the fourth category recognizes the group's participation for the good progress organization.

The study by Moro, Vinha and Morais (2019) brings a reference structure, containing eight dimensions for the school climate: 1. relationship with teaching and learning; 2. social relations and conflicts at school; 3. rules, sanctions and safety at school; 4. situations of intimidation between students; 5. family, school and community; 6. school infrastructure and physical environment; 7. work relations and 8. administration and participation. The authors also argue that the understanding and analysis of the school climate may reveal essential elements for the identification of positive aspects of the school's dynamics, as well as aspects that deserve further investigation and interventions to improve the quality of this environment.

The work by Petrucci et al. (2016) uses a six-dimensional definition of school climate: justice, order and discipline, parental involvement, resource sharing, student interpersonal relationships and student-teacher relationships (EMMONS et al., 2012 apud PETRUCCI et al., 2016). The authors cite THAPA et al. (2013 apud PETRUCCI et al., 2016), for whom the school climate is a complex and multidimensional construct that refers to different aspects of school life.

To compare the dimensions created by the authors of the two works, a table was created, which will assist in visualizing the similarities and differences.

Table 2 - Comparison of the School Climate dimensions mentioned in the two articles

DIMENSIONS OF THE SCHOOL CLIMATE			
	Moro, Vinha and Morais (2019)	**Petrucci et al. (2016)**	**Comparison**
1	Relationship with teaching and learning		Dimension mentioned only in one of the articles, despite its centrality to the educational theme
2	Social relations and conflicts at school	Student interpersonal relationships / Student-teacher relationships	This dimension was subdivided into two in one of the articles, differentiating relationships between students from those involving the teacher
3	School rules, sanctions and safety	Order and discipline	Although both refer to school order, safety is taken into account in the first article, absent in the second
4	Bullying situations among students		This dimension, absent in the second article, could be encompassed by the dimension “Interpersonal relationships of students”

5	Family, school and community	Parental involvement	The first article includes the community, while in the second, only the family
6	School infrastructure and physical environment	Resource sharing	While the first article summarizes the analysis of the physical environment, in the second, all resources are analyzed, not only the physical ones
7	Relations with work		These two dimensions are analyzed only in the first article, despite their centrality to the perception of the school climate by teachers and students
8	Administration and participation		
9		Justice	Essential dimension for the perception of a positive school climate, it appears only in the analysis of the second article

Source: The authors (2019)

Despite the similarity in some dimensions, mentioned by the authors of the two articles, the absence of some essential factors in both is perceivable. We consider that the relationship with teaching and learning, as well as administration and participation, in addition to justice are extremely important dimensions in determining the perception of School Climate by those involved. Therefore, it would be promising to carry out an analysis based on the lists of dimensions cited in both works, in order to consider all the factors interfering in the process, a description that has not yet been carried out in the articles found in this integrative review.

Issues related to school management / leadership and the academic climate appear as important factors associated with the school effect (BROOKE; SOARES, 2008, p. 10 apud OLIVEIRA; WALDHELM, 2016, p. 839). It is important to highlight that the present study does not highlight the school climate as a variable related only to the students' cognitive performance, but rather, through a comprehensive view of the term, looking at affective and social aspects that interfere, in a certain way, in the students' school performance, and in the lives of teachers. As stated by Cunha (2014, p. 1081): “schools with a positive school climate tend to have more satisfied and motivated students and staff, reducing dropout rates, insecurity and violence”.

The relationship between a positive school climate and higher performance is found in several studies (MELO, 2017; CASASSUS, 2008; WARNER; HEINDEL, 2017; REYNOLDS et al. 2017 apud MORO; VINHA; MORAIS, 2019). Debarbieux et al. (2012 apud MORO; VINHA; MORAIS, 2019) also emphasizes that the quality of the school climate is a direct variable for the prevention of violence.

Cunha (2014) demonstrates an association between school climate and violence. According to the author, institutions with a higher rate of violence have a school climate that is negatively assessed by the participants. However, understanding violence as the only negative source of the school climate is hasty, since the school is a multifaceted space, which receives historical, cultural and socioeconomic interference from the individuals who participate in it (CUNHA, 2014).

3.1 School climate and educational results

The school climate is implicit in the existing relationships between participants in the school environment and its notoriety is found in the scientific literature, demonstrating its relevance to the educational process.

> The physical environment and the intersubjective relations of its members could be viewed as concomitant expressions that would contribute to the development of a school experience of greater lucidity and critical potential. (MARINI, MERCHAÁN, AGUAYO, 2018, p. 372).

Many authors corroborate the fact that the school is a heterogeneous place in its complexity, that is, multiple factors are interrelated so that there is success in its main objective, to carry out pedagogical practices that promote the development of the teaching and learning process.

The climate is noticeable in many aspects within an organization. In schools, it influences students' academic performance, team cohesion, strengthening goals, clarity of objectives and achievement (CUNHA, 2014).

However, Brooke and Soares (2008 apud CUNHA, 2014, p. 1083) affirm that the existence of good relations alone does not characterize a positive school climate. Gomes (2005, p. 292) highlights components of effectiveness in the face of the school climate, such as: educational leadership, consensus and team cohesion, potential for evaluation and involvement of the protagonists involved in the process.

For Gomes (2005) the success of a school goes beyond the parameters evaluated in national exams. A quality school is one where students like to learn and where teachers, parents and students treat each other well.

For Grigoli et al. (2010) among the verifiable factors of a quality school, the school climate stands out, which is closely linked to school management, its organization and form of leadership.

> Elements like an atmosphere of encouragement; leadership of the director and faculty; high levels of demand; positive expectations for students; personality and cordiality in the treatment; widespread discipline and exercised as a value; strong and authentic interest in students; focus on educational activities; constant monitoring and evaluation; closer relationships with families have been identified in research (Abramovay et al., 2003; Gomes, 2005) as factors that may be at the basis of the differences between successful schools and others. (GRIGOLI et al., 2010, p. 243).

There is a continuous effort over the years to try and find out which elements influence school pedagogical practice and which are the attributes of quality teaching. For this reason, studies on school climate are deepened. Several studies indicate the relationship between the quality of the climate and the well-being of school actors, especially in relation to students, showing the relationship with academic performance, motivation for learning, behaviors, sense of belonging and justice, satisfaction with school, appreciation of knowledge and individual development (FAN; WILLIAMS; CORKIN, 2011; CUNHA; COSTA, 2009; GOMES, 2005; GAZIEL, 1987; LOUKAS, 2007; COHEN; PICKERAL, MCCLOSKEY, 2008; COHNE, 2010 apud MORO; VINHA ; MORAIS, 2019).

Schools with a positive climate have good interpersonal relationships, an environment of care and trust, quality of the teaching-learning process, spaces for participation and conflict resolution in a dialogical way, proximity to parents and the community, good communication, sense of justice with compliance to rules and fair sanctions, a stimulating and supportive environment, centered on the student, in which individuals feel safe, supported, belonging and involved in the school and respectfully challenged (FREIBERG, 1998, 2005; BRUNET, 2001; COHEN, 2009; DEBARBIEUX et al., 2012; SHERBLOM; MARSHALL; SHERBLOM, 2006; VINHA; MORAIS; MORO, 2017 apud MORO; VINHA; MORAIS, 2019).).

The climate can influence the behavior of people who coexist in a given space, on the other hand it can affect interpersonal relationships, characterizing the environment inside the school (GAZIEL, 1987 apud MORO; VINHA; MORAIS, 2019).

What the different definitions have in common is the idea of school climate as a perception that the school actors have about the environment and the relationships established there. These perceptions are collective and can significantly influence the behavior of the group, thus suggesting its relation to the quality of the teaching-learning process, as well as interpersonal relationships at school (MORO; VINHA; MORAIS, 2019).

In the studies by Wentzel and Wigfield (2009 apud AMARAL, CUNHA and SANTO, 2019) students reported that emotionally closest and most reliable teachers can be more effective in their school contexts, in addition to helping to reduce school violence, ensuring greater security for students and teachers. Therefore, the school climate is linked to the quality of social interactions - between teachers, students, parents, principals, and others - and the school structure, justice, rules, etc. (BEAR et al., 2016 apud AMARAL; CUNHA; SANTO, 2019).

4. Final Considerations

Based on the objective of the study, of knowing a little more about the school climate in the Brazilian educational context, we sought to indicate two axes of analysis from the articles found: characterization of the school climate and school climate and the educational results.

It emerges from the topic of characterization of the school climate that the school participants, the context analyzed, perceives the school climate as an aesthetic and perceptual characteristic. Through what you see and hear, physical attributes allow the recognition of social, political and cultural components established by the institution (DEBARBIEUX et al., 2012 apud MARINI, MERCHAÁN, AGUAYO, 2018).

The studies mentioned here sought to integrate the concept of school climate from the perceptible analysis that individuals had of the institutions to which they belonged. In this analysis, listed as characteristics belonging to the school climate were: the physical spaces, the relationships of organization and hierarchy between teachers and between students, individual experiences, leadership, violence, discipline, team cohesion and collaboration, behavioral problems, socioemotional adjustment, academic results, justice and parental involvement.

The school climate, therefore, is understood as a complex and comprehensive variable of affective, social and cognitive aspects that influence school pedagogical practice.

Notably, the articles mentioned in this study corroborate that educational results are strongly influenced by the school climate. This is because, in the school climate, basic attributes belong to school pedagogical interventions, such as: trust between parents, teachers and students, strengthening educational goals and objectives, innovative and motivating practices and the sense of belonging of the participants to the context and the established social group.

The positive or negative impact, depending on the climate that is established, has as a consequence the academic performance referenced by the teaching and learning process.

It is clear that the definition of the term school climate is somewhat complex, as it is composed of intrinsic and extrinsic aspects to the school and the subjects. The climate allows to transmit and perpetuate a particular vision of a given reality (CHANG; CHUANG; BENNINGTON, 2011 apud PEREIRA; MOURAZ, 2015) influencing the teachers' professional experience and the quality of the students' educational experiences (PEREIRA; MOURAZ, 2015, p. 121).

In Brazil, the study of the school climate and its impact on students has recently increased (OLIVEIRA et al., 2013 apud AMARAL; CUNHA; SANTO, 2019), and despite the absence of a universal definition for this construct (THAPA, COHEN, GUFFEY, HIGGINS-D'ALESSANDR, 2013 apud AMARAL; CUNHA; SANTO, 2019), fairer environments have been indicated as the main aspect of a positive school climate in Brazilian schools.

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Biomechanical Behavior of Zirconia Post and Core *In vitro*: a Systematic Review

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Abstract

Restoration of endodontically treated teeth is a common clinical practice which is being improved constantly. One piece zirconia post and cores are being introduced to dental treatments routine and offers aesthetic approach in restoring severely damaged teeth. However the biomechanical properties of such restorations remain unclear. The purpose of this systematic review was to describe biomechanical properties of zirconia post and cores and put them in a perspective with more conventional restorations. An electronic search was conducted in PubMed, Cochrane Library and Clinical Key databases for in vitro studies dating up to October 2019. Clinical studies and case reports were excluded.

Results: a total of 8 articles were included in a systematic review, consisting of 4 in vitro studies and 4 finite element analysis (FEA). Several evaluation parameters were set: zirconia post and core fractural resistance comparison with metal and prefabricated post systems, stress distribution in teeth restored with zirconia post and cores.

Conclusions: zirconia post and core could be a promising restoration for anterior teeth where aesthetic demand is high. It showed similar in vitro biomechanical behavior and fractural resistance to gold alloy restorations, although such findings only show a tendency and further clinical investigation is needed.

Keywords: *zirconia post and core, prosthetic dentistry, biomechanical behavior.*

Introduction

Restoration of endodontically treated teeth is a common clinical practice. Such cases have a prevalent algorithm of firstly restoring tooth with post and core and then, after abutment is created, finishing the work with a crown (1). But as the all-ceramic restorations are highly translucent, esthetic demand for post and

core material also arises to reach an overall esthetic final result. Usual cast metal post and cores tend to have negative impact on light transmission (2) making them an undesirable choice for anterior teeth restoration. In pursuance of esthetics, milled zirconia post and cores were introduced. It could be described as a novel alternative to more usual tooth rehabilitation systems, since clinical trials are lacking, even though first insights were made back in 1999 (3). Such restorations are low-time consuming and are made relatively simply using a CAD/CAM system (4,5).

But milled zirconium dioxide post and core is not the only choice for esthetic restoration as there are prefabricated zirconia or glass fiber posts that offer similiar esthetic results. Since there are so many options to choose from, and the only variable that may differ between the groups is biomechanics, it is important to put a zirconia post and cores in a perspective with more common restorations as it would make it easier for clinicians to decide, whether they should consider a different treatment method. The purpose of this study was to review a biomechanical *in vitro* behaviour of custom-made zirconia post and cores and compare them to more conventional restoration types.

1. Methods

A reviewing process was in line with the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analysis) guidelines. An electronic search was conducted in PubMed, Cochrane Library and Clinical Key databases of articles dating up to October 2019 by using a combination of following terms: 'zirconia' AND 'post' AND 'core'. In all data bases search builder was used and key words were set to be searched in all fields of publication in order to extend the results. After initial search article screening and full-text analysis was executed by two independent authors. All disagreements were solved by consulting a third supervising author. Before including, articles were checked with eligibility criteria that were set during the process of study (Table 1). Data extraction was performed independently by dividing articles into groups based on testing method that was used.

Table 1. Eligibility criteria

Inclusion criteria	Exclusion criteria
Studies evaluating one-piece zirconia post and cores	No comparison performed
Studies in English	Primary teeth
In vitro studies	Animal teeth
Finite Element Analysis (FEA) studies	Case report
Objective: fracture load comparison	
Objective: stress distribution	

2. Results

Using established key words electronic search conducted a total of 655 articles. After reviewing articles only by titles 144 were registered for screening, during which 108 articles were excluded. 25 full-text articles were assessed and after exclusion of 17 studies that did not fit the eligibility criteria, 8 articles were

included in qualitative synthesis. No studies met the criteria for quantitative analysis. Then articles were divided into two groups according to testing methods: group 1 – *in vitro* studies that used extracted human teeth (n = 4) and group 2 – studies that performed Finite Element Analysis using 3D models of human teeth (n = 4).

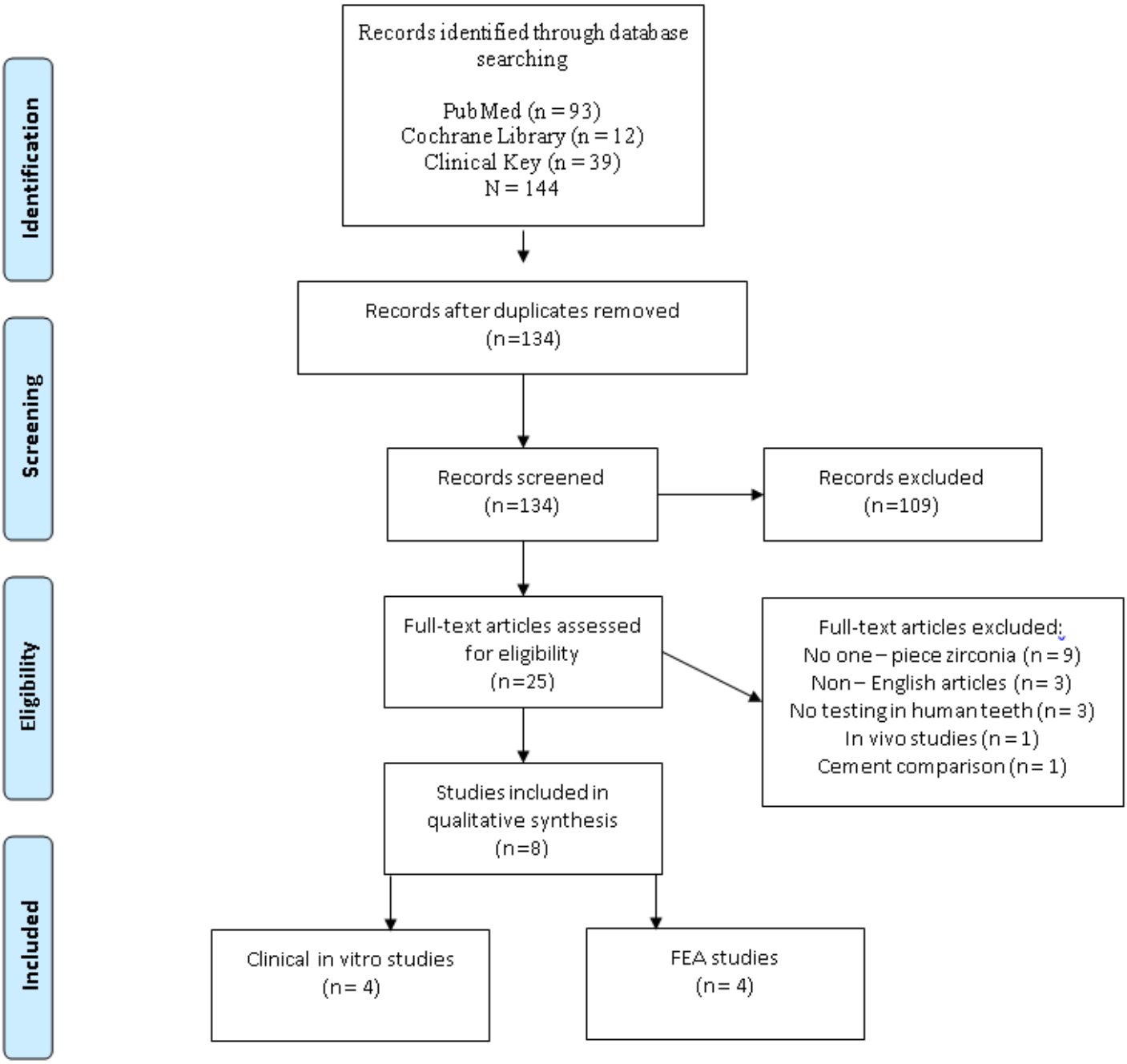

Figure 1. PRISMA flow diagram, showing the inclusion proccess of selected studies.

2.1. In vitro studies

Table 2. In vitro studies' methodical comparison and results

Author	Tooth type	Number of teeth	Post length (h)	Ferrule	Specimens	Coronal restoration	Load application	Results
Soundar et al. (2014)	Upper central incisor	48	h = 11 d =1.4/1.7	Yes, 2 mm	Post and core system: cast metal (Ni-Cr) (CM), pressable ceramic (PC), prefabricated zirconia (PZ), milled zirconia (MZ)	Yes, cast metal crown	130° to longitudinal axis, 1 mm/min	PC1.4<CM1.7<**MZ1.4**<PZ1.4<PC1.7<**MZ1.7**<CM1.4<PZ1.7 **MZ1.4** had significant difference from CM1.4, CM1.7, PC1.4, PC1.7, PZ1.4, PZ1.7.
Kalyoncuoğlu et al. (2015)	Single rooted premolar	40	h =10 d =1.25±0.5	No	Post and core system: cast metal (Cr-Co) (CM), milled metal (MM), laser sintered metal alloy (LSM), milled zirconia (MZ)	No	130° to longitudinal axis, 1 mm/min	CM<LSM<MM<**MZ** **MZ** had significant difference from all other groups ($p<0.05$)
Habibzadeh et al. (2017)	Lower first premolar	36	Not specified	Yes, 2 mm	Post and core system: cast metal (Ni-Cr) (CM), milled zirconia (MZ), glass fiber post and composite core (GFP)	Yes, milled zirconia crown	45° to longitudinal axis, 0.5 mm/min	**MZ**<CM<GFP MZ had significant difference from all other groups ($p<0.05$)
Bittner et al. (2010)	Upper central incisors and canines	85	h =10 d =1.25	Yes, 2 mm	Post and core system: cast gold (CG), milled zirconia (MZ), prefabricated zirconia (PZ), titanium with composite core (TC), combined fiber/zirconia post and composite core (FZ)	Yes, milled zirconia crown	135° to longitudinal axis, 0.5 mm/min	PZ<**MZ**<CG<TC<FZ **MZ** had significant difference from TC and FZ groups. No significant difference from PZ and CG

2.1.1 Milled zirconia vs metal restorations

Results of Soundar et al. (4) showed a significantly ($p<0.05$) lower fracture loads of teeth restored with 1.7 mm or 1.4 mm diameter zirconia post and cores compared with teeth restored with cast metal post of 1.4 mm, accompanying Habibzadeh et al. (6) results which also showed significantly lower fracture resistance of milled zirconia post and cores compared to cast metal restorations. However teeth restored with either 1.7 mm or 1.4 mm diameter zirconia post and cores had a significantly higher fracture resistance compared to teeth restored with 1.7 mm cast metal restoration (4), following Kalyoncuoğlu et al. (5) which also registered a significantly higher fracture resistance among zirconia post and cores when compared with cast, milled or laser sintered metal post-cores. Prefabricated titanium posts were also compared with zirconia, showing a results of significantly higher fracture resistance for a titanium post (7). Only Bittner et al. (7) compared milled zirconia and cast gold post in which teeth restored with zirconia or cast gold post and cores had the same fracture load limits.

2.1.1 Milled zirconia vs prefabricated posts

Soundar et al. (4) compared milled zirconia with prefabricated zirconia, which showed a significantly lower fracture resistance at milled zirconia group when corresponding diameters were compared. Although Bittner et al. (7) showed results of higher fracture resistance for milled zirconia than prefabricated but results had no significant difference ($p>0.05$). Habibzadeh et al. (6) stated that glass fiber posts had a significantly higher load toleration compared to milled zirconia, surpassing it in mean fracture loads more than twice. Bittner et al. (7) used zirconia-reinforced glass fiber posts which also had significantly higher fracture resistance when compared with milled zirconia.

2.2. Finite element analysis (FEA)

Table 3. FEA studies. Methodical comparison and main findings

Author	Tooth type	Restoration type	Variables	Load value (N)	Main findings
Chen D. et al. 2019	Maxillary incisor	Post and core system: One-piece zirconia Coronal restoration - heat-pressed glass ceramic	Ferrule heights (mm) of 0.0, 1.0, 2.0 and 3.0 Post diameters (mm) of 2.5, 2.0 Post heights (mm) of 12.9, 11.9, 10.9	300	- Stress decreases with increasing ferrule height; 3,0 mm ferrule had significantly lower von Mises stress than 0,0 mm. - Increased ferrule heights causes von Mises stress to shift to the root neck. - Lowering post length decreases von Mises stress in dentin, post, and their interface
Chen A. et al. 2015	Maxillary canine	Post and core system: one-piece zirconia, one-piece glass fiber, cast titanium, cast gold.	Dentin wall thickness (mm) of 1.0, 1.5, 2.0, 2.5.	100	- Decreasing alveolar bone height increases von Mises stress in dentin.

		Coronal restoration – not specified	Alveolar bone loss of 1/3, ½ and 2/3 bone level		- Von Mises stress in dentin for zirconia specimens was lower than with other materials at constant bone levels and dentin wall thickness. - No significantly different stress distribution between different dentin wall thickness although more favorable results were in thicker dentin wall specimens.
Nokar S. et al. 2018	Maxillary central incisor	1 group – Ni-Cr / gold post and core, restored with metal-ceramic (MC) crown 2 group – stainless steel, titanium, carbon fiber, glass fiber, quartz fiber posts and composite cores restored with MC's 3 group – zirconia post and core, zirconia post, carbon fiber post, glass fiber post, quartz fiber post with composite cores, restored with all-ceramic crowns	None	100	- Zirconia post and core specimens showed higher stress at gingival border. - Zirconia post and cores showed lowest Von Mises stress between the middle and cervical thirds of the root; results were similar to Ni-Cr specimens. - Zirconia post and cores may be alternative to metallic posts.
Marghalani T. et al. 2012	Maxillary canine	Post and core system: one – piece zirconia, cast gold Coronal restoration – all-ceramic crown	None	100	- No significant differences between stress in teeth restored with wither post and core material. - Zirconia post and core von Mises stress was 4.81 % lower than in gold post andcore. - Zirconia post and core could be aesthetic alternative for cast metal restorations.

Zirconia post and core showed a significantly lower von Mises stresses in dentin compared with glass fiber posts at all tested bone levels (1/3, ½, 2/3, no bone loss) (8), following another study which concluded that one piece zirconia post and cores have more favorable stress distribution than pre-fabricated glass fiber posts (9) (Table 3). Besides that zirconia post and core shows very similar performance when compared to cast gold, Ti or Ni-Cr post and cores, leaving no significant differences between mentioned materials

(8,10), although metal restorations resulted in less stress concentration at either gingival border or between the middle and cervical thirds of the root (9).

Zirconia post and cores showed an inverse stress distribution with different dentin thickness (1.0 mm, 1.5 mm, 2.0 mm, 2.5 mm residual root dentin walls were compared), as more stress concentrate in dentin than post when dentin wall is left thinner contrary to thicker dentin walls, which lead to stress accumulation on the post itself (8). Although it has to be mentioned, that one-piece zirconia specimens are tend to absorb most of the generated stress as they are stiffer due to higher elastic modulus than dentin, hence less stress accumulate in dentin itself (8). Additionally another study came to similar results as decreasing the length and diameter of zirconia post and cores showed less von Mises stress accumulation in dentin, post and their interface, leaving with a conclusion that smaller post dimensions should be considered for more favorable clinical results (11). Furthermore, FEA results showed, that stress zones appear to be in a root at a level of residual bone, in which tension gradually increases when bone level is decreasing (8).

Different ferrule heights for zirconia post and cores showed an influence on stress distribution, as maximum von Mises stresses in radicular dentin, post and post-dentin interface gradually decreases when ferrule is left higher, leaving a significant difference between 0 mm and 3 mm ferrules (11). Also stress location shifting is monitored, as changing ferrule heights from 0 mm to 1, 2 and 3 mm results in stress ascension from mid – root towards the cervical part of the root. (11).

3. Discussion

Zirconium dioxide is a considerable material for dental restorations as it has a similiar Young‘s modulus to stainless steel and a comparable flexural strenght to titanium or cast gold (12). What makes a difference is a high elastic modulus in zirconia, considerably surpassing a dentin, leaving with an implication that more stress is transferred to dentin, which could result in fractures of dental tissue (12,13).

All reviewed studies differed in methodical execution of testing, therefore, in results too. Although some matching results are observed. But when it comes to biomechanics, one should consider that human masticatory system is a complex combination of structures that function together (14). Therefore, *in vitro* studies which only rely on one-way load application can only show a tendency of various restorations performance in vivo, but not a general conclusion.

Firstly, custom made dowels consisted a major part of all subjects. Only one *in vitro* study, that used natural teeth, showed a superior fracure resistance of milled zirconia when compared to metal restorations (5). Furthermore, it was highly heterogenous from all other studies as it was the only one which did not performed a coronal restoration and a ferrule effect for its‘ specimens (5), leaving with an assumption that major influencing variables of biomechanics such as ferrule effect were left behind (15).

But what favors the milled zirconia restorations are FEA studies. All studies has shown more favorable stress distribution in custom made zirconia restoration when compared to prefabricated dowels (8,9). Also, no significantly different von Mises stresses were observed in either milled zirconia or cast metal specimens (8,10). Ultimately, FEA studies could be considered as a relatively closer to *in vivo* biomechanics as periodontal ligament, cortical and cancellous bone was took into account. Moreover, comparison of cast

gold and milled zirconia has given similar results in both in vitro and FEA, suggesting that both treatment methods could have same clinical performance (7,8,10).

When comparing with prefabricated dowels, milled zirconia showed lower fracture resistance in many *in vitro* studies (4,6,7).

Tooth-colored post and core is considerable restoration when aesthetic demand is high, for example when restoring defected anterior teeth. Although fractural loads of teeth restored with milled zirconia where lower in many studies, this might not be relevant as fractural loads highly surpass average biting loads in adults, which, according to one study, is 284,9 N on average (16), proposing that registered fracture resistance is enough for human bite (Table 4).

Table 4. Fractural load of teeth restored with zirconia post and core.

Author	Fracture load (N)
Bittner et al. (2010)	442.71
Soundar et al. (2014)	312.00 (415.00)
Habibzadeh et al. (2017)	435.34
Kalyoncuoğlu et al. (2015)	315.4

One of the main criteria, influencing endodontically treated teeth fractural resistance is residual root dentin wall thickness. Clinicians are strongly advised to maximize the preservation of natural healthy dentin in order achieve more successful results (17) – this can be reached by decreasing post diameter. Increasing the residual wall thickness not only leads to more favorable stress distribution (less Von Mises stresses in root) (8,11), but also significantly increases bearable occlusal load (17) and may increase the possibility of root fracture (18). However it still not fully clarified what dentin thickness – post diameter ratio should be considered as the most beneficial, since particular dimensions may not be suitable for every clinical case, as teeth measurements vary for each patient.

Ferrule has been a hot topic for a long time and it should be considered when preparing a space for zirconia post and core. Many studies accompany the results of our selected studies. Two *in vitro* studies revealed that presence of the ferrule promotes more satisfactory stress distribution in a root, also increasing maximum fracture load (19,20) and decreases stress at the interface of restoration and dentin (11). Ultimately, Yang et al. (21) have shown that absence of the ferrule might compromise the clinical success of the restoration. Mamoun et al. (22) explains, that post helps to retain the core as it extends the restorations' bond strength by increasing surface area, but the main biomechanical variable that determines the clinical outcome is the ferrule, leaving with an implication, that a teeth-restoration complex, where only post retains the core, is a generally bio-mechanically unstable.

When talking about zirconia post and core performance in vivo, only one prospective clinical trial was made, where 72 defective teeth in 47 patients were restored with one piece zirconia post and core. After an average follow up of 65.0±4.8 months no incidence of teeth nor restoration failure was registered, implying that CAD/CAM zirconia post and cores could be a good choice for restoration of defective teeth (23).

4. Conclusions

Based on the findings of systematic review, the following conclusions were formed:

1. Teeth restored with zirconia post and cores tend to have lower fractural resistance compared to teeth restored with cast metal post and cores.
2. Zirconia post and core showed more favorable stress distribution in radicular dentin during occlusal loading than prefabricated posts.
3. Milled zirconia post and cores could be a clinical alternative to similiar gold restorations.
4. As fractural loading surpasses average human biting load, zirconia post and cores could be considered as esthetic restoration for anterior teeth.
5. Excessive preparation of root dentin should be avoided when preparing space for a post in order to achieve higher fractural resistance.
6. In order to achieve bio-mechanically stable teeth-restoration complex, ferrule should be prepared when restoring teeth with zirconia post and core.

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Early selection efficiency for recommendation of *Eucalyptus* sp.

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Abstract

This paper aims to estimate genetic and phenotypical parameters to assess the viability of early selection in progeny tests of Eucalyptus sp. We analyzed data from experiments conducted in the state of Minas Gerais, Brazil. The evaluated traits were diameter at breast height and plant height in 482 progenies of

full sibs under randomized block design, into nine experiments: four of which were assessed at progenies mean level, and five assessed at individuals mean level. It were evaluated the predicted gains with combined selection index under 5, 10 and 20% of selection; the coincidence among selected families in juvenile and adult ages, and the efficiency of early selection. Results indicated that the procedures were efficient in most of the scenarios, and the gains comparable to the direct selection on tree harvest age.
Keywords: eucalipt; biometry; statistics; selection method; genetic parameters.

1. Introduction

Brazil has the second largest area of *Eucalyptus* planted forests, worldwide, being consolidated as the largest producer of hardwood pulp [7]. The use of clones in commercial plantations of *Eucalyptus* is a common practice in most of forestry sector companies. Thus, the identification of superior clones has been constituted as the primary objective of breeding programs. However, the main obstacle for the process is the delay in the assessment step, in such way that the early selection constitutes an alternative for lessen this problem [10].

Concerning perennial plants, the number of years to complete a selection cycle is the major limitation for recurrent selection programs. In forestry species of temperate climates, usually rotations can reach 50 years or more, whereas for subtropical species this age ranges from 25 to 30 years. Still, in conducting a recurrent selection program with *Eucalyptus* in Brazil, the assessment step lasts about seven years, which is the harvesting age of plants in commercial plantations [1]; [10].

Thus, the contribution of the number of years to complete a selection cycle is expressive. Therefore, alternatives aiming at decreasing the necessary time to complete a selection cycle must be used in order to efficiently promote the selection as younger as possible. Some methodologies have been proposed with the goal of assessing the efficacy of early selection, such as: the study of fluctuation of genetic and phenotypical parameters throughout ages [13] and the estimation of the genetic correlation in different ages [9]; [8].

Using data of experiments conducted by CENIBRA NIPO-BRASILEIRA SA, this research was performed aiming at estimating genetic and phenotypical parameters and at assessing the viability of early selection.

2. Material and Methods

For the experiments were used 517 full sibs progenies, divided into nine experiments: four of which were assessed in level of mean progeny, and five assessed in individual level within their linear plot. Experiments considered are presented in Table 1. The experiments were installed in a randomized block design between years 1995 and 2000 in the cities of Antônio Dias, Belo Oriente, Pingo D'água, Sabinópolis and Santa Bárbara, in the State of Minas Gerais, Brazil. The number of replications varied according each experiment, as well as the size of linear plot (Table 1). The spacing used was 3.0 x 2.75 m in experiments TPH 80 and 81, and 3.00 x 2.00 m in the other experiments.

Table 1. Ratio of assessed experiments, locations, year of installation, ages, and number of assessed progeny.

Experiment	Locations	Installation (month/year)	Evaluation ages (years)	Number of progenies	Plant row plot arrangement	Replications
Progeny mean estimates						
80	Sabinópolis	11/1995	3.7 / 4.5	56	-	5
81	Belo Oriente	12/1996	3.5 / 5	42	-	3
84	Antônio Dias	12/1996	3 / 5	43	-	3
88	Sta. Bárbara	12/1996	3.5 / 5	37	-	3
Individual plant estimates						
110	Belo Oriente	12/1997	4 / 6	10	10	4
111	Belo Oriente	12/1997	4 / 5	24	12	3
115	Sabinópolis	04/1999	2.6 / 3.7	28	6	4
123E	Pingo D'água	11/2000	2 / 3	121	5	5
123B	Pingo D'água	11/2000	2 / 3	121	6	5

Diameter at breast height (DBH), in centimeters, and plant height (PH), in meters, were collected in all experiments, assessed in several ages (Table 1). Individual variance analyses were performed per location for each age. Estimations of genetic and phenotypical parameters were obtained from mean squares expected of variance analyses. Four experiments were assessed at level of mean family following the model: $Y_{ij} = \mu + G_i + B_j + \varepsilon_{ij}$. And five experiments at individual level within the plot following the model: $Y_{ijk} = \mu + G_i + B_j + \varepsilon_{ij} + \delta_{ijk}$, where, Y_{ij} and Y_{ijk} respectively correspond to the observation of the i-th progeny of j-th block; and to the observation of the i-th progeny of the j-th block in the k-th plant. μ correspond to the general mean; G_i to the effect of the i-th progeny; B_j to the effect of the j-th block; ε_{ij} to the experimental error among progenies; and δ_{ijk} to the experimental error within progenies. Estimations of heritability for the experiment at level of progeny mean was calculated following the expression: $h_P^2 = \dfrac{\hat{\sigma}_g^2}{\dfrac{\hat{\sigma}^2}{r} + \hat{\sigma}_g^2}$ where, $\hat{\sigma}_g^2$ and $\hat{\sigma}^2$, constitute the genetic variance and environment estimators, respectively; and r, number of replications.

For experiments at individual level within the plot, heritability at progeny and individual levels was estimated, respectively given by: $h_P^2 = \dfrac{\hat{\sigma}_g^2}{\dfrac{\hat{\sigma}_d^2}{nr} + \dfrac{\hat{\sigma}_e^2}{r} + \hat{\sigma}_g^2}$ and $h_{Ind.}^2 = \dfrac{\left(\dfrac{1}{\theta_e}\right)\hat{\sigma}_g^2}{\dfrac{gn(r-1)}{gnr-1}\hat{\sigma}_b^2 + \dfrac{n(gr-1)}{gnr-1}\hat{\sigma}_e^2 + \dfrac{rn(g-1)}{gnr-1}\hat{\sigma}_g^2 + \hat{\sigma}_d^2}$

where, θ_e constitutes the genetic variance fraction explored among families; $\hat{\sigma}_g^2$, the estimator of

genotypic variance among means of family; $\hat{\sigma}_d^2$, estimator of phenotypic variance among plants within the plot; $\hat{\sigma}_e^2$, estimator of environmental variance among plots; $\hat{\sigma}_b^2$, estimator of environmental variance provided by difference between blocks; g, number of families; r, number of blocks; n, number of plants within plot. The selection and estimation of genetic gains of the experiments assessed at mean level were performed according method proposed by [4]: $\Delta M_e = c.SD.h^2$ where, c is the parental control, SD is the selection differential and h^2 is the trait heritability.

In the experiments assessed at individual level within the plot, the procedure of combined selection for selection and estimation of genetic gains was considered for each characteristic. The model below was followed: $I = \beta_1(Y_{ijk} - Y_{ij.}) + \beta_2(Y_{i..} - Y_{...})$ where, Y_{ijk} corresponds to the observation of the i-th progeny of the j-th block in the k-th plant; $Y_{ij.}$ corresponds to the mean value in the i-th progeny of the j-th block, and $Y_{...}$ is the general mean. Predicted gains under the selection percentages of 5%, 10% and 20% were assessed.

With the purpose of assessing the efficiency of selection, the following methodologies were used: a) correlated response with the selection between early and mature age [6]; b) percentage of coincidence among selected families in juvenile and adult ages [15]; and c) efficiency of early selection quantified by the expression: $E = \frac{R_j / T_j}{R_m / T_m}$ where, R_j is the response of the mature trait after juvenile selection, and R_m is the direct response on selection in the adult age; T_j and T_m are the juvenile and mature ages, respectively [5]. The program GENES [2]; [3] was used for statistics analysis.

3. Results and Discussion

In the variance analysis, it was noticed that the progeny effect was significant ($p<0.05$) for characteristics of DBH and PH, in juvenile and adult ages, excepting for the PH in the experiment 111 (Table 2-3).

The coefficients of experimental variation (CV_E) were ranging from 7.51% and 17.21% (Tables 2 and 3), agreeing with the findings of other authors for the eucalyptus crop — [18]; [17]; [16] —, indicating a good experimental accuracy. [14] and [11], evaluating experiments of *E. camaldulensis* and *E. grandis*, respectively, obtained results that corroborate this information. In the results found, despite only the experiments 80, 84, 110 and 115 provided estimates of CVg/CVe higher than 1.0, all the experiments provided genetic gains with the selective process. Moreover, in all experiments, both early and mature selection were efficient.

An increase in estimations of genetic ($\hat{\sigma}_G^2$) and environmental variance ($\hat{\sigma}_E^2$) was seen with increase of age in the experiments in mean progeny level. In principle, one can infer that a greater release of genetic

variability over the years has occurred. However, estimations of heritability, which is a relative measure, practically do not change among different ages (Tables 2-3). Thus, it can be argued that the genetic variability released among clones was the same in the different ages, because CV_E was maintained in similar levels. These results allow us to infer that, at least in principle, selection in juvenile ages is viable. Such results are confirmed by [16] and [15].

In experiments at individual level, within the plot, generally, variances increased throughout the years, but there were estimations of variances that decreased: $\hat{\sigma}_G^2$ and $\hat{\sigma}_E^2$ of experiment 110 (in PH); $\hat{\sigma}_E^2$ of experiment 111 (DBH); $\hat{\sigma}_E^2$ of experiment 123B (in DBH and PH); $\hat{\sigma}_E^2$ of experiment 123E (in DBH and PH). These results are showed in Table 2. There were also situations where the variance was negative: TPH 111 (PH at 5 years); TPH 123E (DBH at 2 and 3 years; and PH at 3 years). These results, unlike what was expected, might be explained by the effect of competition between plants, which is common in the eucalyptus crop [20]; [14]. It should be stressed that heritabilities ($\hat{h}_P^2$ or $\hat{h}_{Ind.}^2$) were similar in the different ages. Thus, along with good experimental accuracy, it might be said (at least a priori) that selection in early ages is viable.

Table 2. Summary of variance analysis of experiments assessed at mean level of plot. Mean Squares (MS), coefficient of experimental (CV_E) and genetic (CV_G) variation, corrected mean, estimations of genetic and environmental variance, and estimation of heritability at progeny level were presented.

DBH								
Experiment	80		81		84		88	
	3.7 year	4.5 year	3.7 year	4.5 year	3 year	5 year	3.5 year	5 year
	MS	MS	MS	MS	MS	MS	MS	MS
Blocks	0.98	0.69	1.02	0.52	5.16	5.94	3.22	2.90
Progeny	12.80**	17.05**	5.32**	6.79**	6.53**	10.51**	3.40*	5.50*
Residual	1.31	1.74	1.88	2.28	1.43	2.11	1.96	2.96
CV_E (%)	9.46	10.26	10.96	11.26	9.08	9.76	12.87	12.72
Mean	12.09	12.86	12.51	13.40	13.16	14.57	10.88	13.52
CV_G (%)	12.54	13.61	8.56	9.16	9.90	11.25	6.37	6.82
$\hat{\sigma}_G^2$	2.2980	3.0619	1.1467	1.1561	1.7014	2.8004	0.4803	0.8496
$\hat{\sigma}_E^2$	0.2618	0.3480	0.6269	0.7588	0.4762	0.7022	0.6535	0.9853
$\hat{h}_P^2$ (%)	89.77	89.79	64.65	66.50	78.13	79.75	42.34	46.30
PH								
Experiment	80		81		84		88	
	3.7 year	4.5 year	3.7 year	4.5 year	3 year	5 year	3.5 year	5 year
	MS	MS	MS	MS	MS	MS	MS	MS

Blocks	4.95	22.66	26.47	1.27	12.03	8.16	3.64	16.99
Progeny	16.88**	32.88**	7.74**	13.43**	10.62**	24.49**	4.20*	7.78*
Residual	1.84	3.43	2.73	4.98	2.24	4.01	2.67	4.41
CV_E (%)	7.79	8.96	8.37	9.85	7.51	8.23	10.09	9.47
Mean	17.40	20.67	19.73	22.64	19.93	24.36	16.21	22.16
CV_G (%)	9.97	11.58	6.55	7.42	8.38	10.72	4.40	4.79
$\hat{\sigma}_G^2$	3.0079	5.7298	1.6697	2.8185	2.7922	6.8238	0.5086	1.1260
$\hat{\sigma}_E^2$	0.3676	0.6856	0.9095	1.6585	0.7467	1.3394	0.8908	1.4686
$\hat{h}_P^2$ (%)	89.11	89.31	64.74	62.96	78.90	83.59	36.34	43.40

$^{*}\ p < 0.05$; $^{**}\ p < 0.01$

TABLE 3. Summary of variance analysis of experiments assessed at individual level of plot. There are showed Mean Squares for Variation Sources, experimental coefficient (CV_E) and genetic coefficient (CV_G) of variation, estimation of mean ($\hat{\mu}$), estimations of genetic and environmental variance between-plots, and estimation of heritability at progeny and individual levels in the experiment.

DBH										
Experiment	110		111		115		123B		123E	
	4 years	6 years	4 years	5 years	2.6 years	33.7 years	2 years	3 years	2 years	3 years
Blocks	27.42	23.87	57.39	71.74	1.89	2.85	2.84	10.24	5.07	30.73
Progeny	54.81**	69.89**	26.98**	36.49**	19.24**	58.91**	9.79**	24.98**	7.36**	18.84**
Between Plot	10.94	12.99	11.23	12.27	3.13	8.25	5.41	11.68	2.48	6.72
Within Plot	10.70	12.51	10.41	14.01	2.90	7.78	3.74	10.72	2.99	7.66
CV_E (%)	10.14	10.19	9.18	8.60	8.22	9.90	14.35	17.21	9.71	13.33
$\hat{\mu}$	12.25	13.33	11.93	13.31	9.67	13.19	8.52	10.31	8.57	10.12
CV_G (%)	10.16	10.66	6.28	6.97	9.32	12.26	5.78	8.21	6.09	8.01
$\hat{\sigma}_G^2$	1.5469	2.0203	0.5620	0.8628	0.8141	2.6176	0.2431	0.7172	0.2729	0.6562
$\hat{\sigma}_E^2$	0.0346	0.0679	0.0879	-0.186	0.0465	0.0985	0.4609	0.2585	-0.1415	-0.2561
$\hat{h}_P^2$ (%)	80.04	81.41	58.37	66.36	8374	85.99	44.79	53.25	66.26	64.34
$\hat{h}_{Ind}^2$ (%)	25.09	27.61	9.98	11.54	43.41	50.07	10.95	12.27	17.47	16.17
PH										
Experiment	110		111		115		123B		123E	
	4 years	6 years	4 years	5 years	2.6 years	33.7 years	2 years	3 years	2 years	3 years
Blocks	20.20	87.76	540.05	263.15	2.12	2.29	77.92	97.76	15.50	197.39
Progeny	111.81**	105.78**	52.49^{ns}	53.53^{ns}	26.93**	56.50**	23.80**	38.73**	12**	35.32**

Between Plot	20.51	18.74	54.72	42.29	5.10	9.90	10.60	17.77	5.67	13.27
Within Plot	17.31	17.52	21.26	22.64	2.84	7.5	5.43	13.71	4.58	24.87
CV_E (%)	8.01	8.16	11.73	10.13	8.36	7.73	13.71	15.53	9.75	12.22
$\hat{\mu}$	21.24	19.98	20.62	20.98	12.57	18.50	12.49	14.09	12.91	15.51
CV_G (%)	8.45	8.80	-	-	8.36	8.39	6.84	7.55	4.61	7.04
$\hat{\sigma}_G^2$	3.2197	3.0909	-	-	1.1029	2.4084	0.7313	1.1297	0.3548	1.1934
$\hat{\sigma}_E^2$	0.4506	0.1734	-	-	0.4544	0.4948	1.4341	1.0944	0.3045	-0.4324
$\hat{h}_P^2$ (%)	81.66	82.29	-	-	81.08	82.48	55.45	54.11	52.79	62.42
$\hat{h}_{Ind}^2$ (%)	30.69	29.44	-	-	50.38	46.54	18.88	14.02	13.49	14.88

$^{*}\ p < 0.05$; $^{**}\ p < 0.01$

Three percentages of selection were assessed; 5%, 10% and 20% (Table 4-6). The use of higher intensities of selection conducted to predicted gains of higher magnitude; what was expected. However, despite the genetic gains being higher in short term, such strategy is not efficient when associated to procedures of recurrent selection which tends to deplete genetic variability more rapidly [15]; [11].

Aiming at clearing what occurs with the genetic gain when early selection is performed, scenarios where selection was performed in a juvenile age with measurement of the genetic gain in the adult age of the tree were assessed. In all scenarios evaluated, early selection proved to be efficient due to $\hat{E} > 1.0$ ou $\hat{E}$ (%) > 100%. However, this does not necessarily imply that the gain from early selection is necessarily higher than the genetic gain with selection being performed in mature age. This is because direct comparison does not take into account into account how long the genetic material is at the field until it is evaluated, and consequently its breeding cycle, which in the case of perennials species such as eucalypt can be considerably large.

The percentage of coincidence of selected individuals quantified by the percentage of genotypes that had the best performance in early age, and that presented in mature age, was always superior to 57.00%, a scenario obtained for experiment 115 for DBH (Table 4) with selection intensity of 5%. For the other intensities of selection, the percentage of coincidence was similar; 59.93 for selection intensity of 10% (Table 5), and 62.50 for 20% (Table 6). Another indicator of the early selection viability was provided by the analysis of correlation between genetic values of family/individual means for DBH in early and mature ages (data not shown). The existence of high genetic correlation (≥0.78) suggests that selection in early age will also conduct to selection of individuals that will also present significant performance in mature age.

In forestry breeding, early selection has been shown as viable for presenting advantages in relation to selection only in the mature age of the tree. The main one is the decrease of interval of progenies generation, and consequently in the decrease of the breeding cycle [9]; [12]. In this sense, early selection must be desirable when allowing an expressive genetic gain, associated to significant decrease of generation time. Theoretical studies developed by [19] indicate that both genetic information obtained by selection of the

tree in early ages and molecular information – genealogy, and data of markers linked to characteristics of interest – might be used to increase the efficiency of selection in mature age.

Table 4. Gain with selection in early and mature ages with selection intensity of 5%, and efficiency of early selection in relation to the selection in mature age. I_i corresponds to the age of measurement of the trait, and I_j is the age in which the individuals classified as the best were selected. Values prior to parenthesis in Genetic gain indicate the value of gain with selection in the measurement of the trait, and values within parentheses are the percentage gain.

Experiment	Age of selection (I_i/I_j)	Genetic gain (%)		Selection Efficiency (%)		Coincidence of selected	
		DBH	PH	DBH	PH	DBH	PH
80	3.7 / 3.7	2.42 (20.00)	2.42 (13.88)				
	4.5 / 4.5	2.96 (23.00)	3.22 (15.57)				
	3.7 / 4.5	2.66 (20.68)	3.18 (15.36)	109.30	120.11	66.67	66.67
81	3.5 / 3.5	1.71 (13.69)	1.72 (7.74)				
	5 / 5	1.83 (13.71)	1.76 (7.81)				
	3.5 / 5	1.61 (12.00)	1.75 (7.74)	125.68	142.045	100.00	100.00
84	3 / 3	1.88 (14.27)	1.01 (5.06)				
	5 / 5	2.55 (17.14)	2.23 (13.25)				
	3 / 5	2.54 (17.11)	3.23 (13.24)	166.01	241.41	100.00	100.00
88	3.5 / 3.5	0.91 (8.39)	0.86 (5.32)				
	5 / 5	1.23 (9.09)	1.19 (5.38)				
	3.5 / 5	1.23 (9.09)	1.19 (5.38)	142.86	142.86	100.00	100.00
110	4 / 4	2.47 (20.23)	3.16 (14.86)				
	6 / 6	2.89 (21.71)	3.04 (15.20)				
	4 / 6	2.81 (21.08)	2.86 (14.30)	145.85	141.12	79.54	79.54
111	4 / 4	1.02 (8.56)	-				
	5 / 5	1.44 (10.86)	-				
	4 / 5	1.39 (13.45)	-	120.66	-	75.00	-
115	2.6 / 2.6	1.66 (17.19)	1.99 (15.82)				
	3.7 / 3.7	2.69 (20.42)	2.47 (13.36)				
	2.6 / 3.7	2.40 (18.19)	2.32 (12.51)	126.97	133.67	57.00	67.86
123E	2 / 2	1.07 (12.49)	1.10 (8.53)				
	3 / 3	1.68 (16.65)	2.26 (14.55)				
	2 / 3	1.64 (16.22)	2.19 (14.13)	146.43	145.35	80.13	83.44
123B	2 / 2	0.71 (8.30)	1.39 (11.17)				
	3 / 3	1.48 (14.38)	1.95 (13.86)				
	2 / 3	1.34 (13.09)	1.74 (12.32)	135.81	133.85	66.89	60.93

Table 5. Gain with selection in early and mature ages with selection intensity of 10%, and efficiency of early selection in relation to the selection in mature age. I_i corresponds to the age of measurement of the trait, and I_j is the age in which the individuals classified as the best were selected. Values prior to parenthesis in Genetic gain indicate the value of gain with selection in the measurement of the trait, and values within parentheses are the percentage gain.

Experiment	Age of selection (I_i/I_j)	Genetic gain (%)		Selection Efficiency (%)		Coincidence of selected	
		DBH	PH	DBH	PH	DBH	PH
80	3.7 / 3.7	2.09 (17.25)	2.15 (12.38)				
	4.5 / 4.5	2.46 (19.06)	2.78 (13.43)				
	3.7 / 4.5	2.32 (18.02)	2.72 (13.16)	114.7	119.00	66.67	66.67
81	3.5 / 3.5	1.29 (10.29)	1.45 (7.27)				
	5 / 5	1.59 (11.90)	1.54 (6.85)				
	3.5 / 5	1.47 (11.00)	1.64 (7.26)	132.08	152.13	75.00	75.00
84	3 / 3	1.50 (11.38)	1.22 (6.10)				
	5 / 5	2.04 (13.71)	2.85 (11.68)				
	3 / 5	2.00 (13.43)	2.65 (10.88)	163.40	154.97	75.00	75.00
88	3.5 / 3.5	0.77 (7.08)	0.70 (4.30)				
	5 / 5	0.99 (7.30)	1.05 (4.73)				
	3.5 / 5	0.78 (5.77)	0.77 (3.46)	112.55	104.76	75.00	75.00
110	4 / 4	1.86 (15.21)	2.43 (11.46)				
	6 / 6	2.21 (16.62)	2.39 (11.95)				
	4 / 6	2.16 (16.17)	2.15 (10.76)	146.61	134.94	75.00	58.89
111	4 / 4	0.83 (6.93)	-				
	5 / 5	1.17 (8.81)	-				
	4 / 5	1.06 (8.00)	-	113.25	-	60.4651	-
115	2.6 / 2.6	1.41 (14.56)	1.64 (13.07)				
	3.7 / 3.7	2.26 (17.13)	2.05 (11.08)				
	2.6 / 3.7	2.08 (15.78)	1.86 (10.02)	130.97	129.12	65.67	67.16
123E	2 / 2	0.85 (9.88)	0.86 (6.70)				
	3 / 3	1.33 (13.20)	1.79 (11.57)				
	2 / 3	1.31 (13.02)	1.66 (10.74	147.74	139.12	81.79	75.83
123B	2 / 2	0.55 (6.45)	1.09 (8.71)				
	3 / 3	1.19 (11.58)	1.53 (10.90)				
	2 / 3	1.08 (10.49)	1.33 (9.47)	136.13	130.39	65.56	59.93

Table 6. Gain with selection in early and mature ages with selection intensity of 20%, and efficiency of early selection in relation to the selection in mature age. I_i corresponds to the age of measurement of the trait, and I_j is the age in which the individuals classified as the best were selected. Values prior to parenthesis in Genetic gain indicate the value of gain with selection in the measurement of the trait, and values within parentheses are the percentage gain.

Experiment	Age of selection (I_i/I_j)	Genetic gain (%)		Selection Efficiency (%)		Coincidence of selected	
		DBH	PH	DBH	PH	DBH	PH
80	3.7 / 3.7	1.94 (16.01)	2.20 (12.66)				
	4.5 / 4.5	2.24 (17.47)	3.07 (14.86)				
	3.7 / 4.5	2.01 (15.68)	2.47 (11.93)	109.13	97.85	83.33	83.33
81	3.5 / 3.5	1.16 (9.14)	1.40 (6.99)				
	5 / 5	1.32 (9.77)	1.78 (7.75)				
	3.5 / 5	1.10 (8.18)	1.47 (6.49)	119.04	117.98	75.00	75.00
84	3 / 3	1.65 (12.52)	2.12 (10.65)				
	5 / 5	2.18 (14.64)	3.44 (14.13)				
	3 / 5	1.65 (11.12)	2.26 (9.28)	126.15	109.50	87.50	87.50
88	3.5 / 3.5	0.61 (5.56)	0.57 (3.49)				
	5 / 5	0.84 (6.24)	0.94 (4.24)				
	3.5 / 5	0.66 (4.87)	0.70 (3.14)	112.25	106.38	62.50	62.50
110	4 / 4	1.30 (10.62)	1.73 (8.13)				
	6 / 6	1.54 (11.58)	1.77 (8.84)				
	4 / 6	1.57 (11.78)	1.68 (8.41)	152.92	142.37	74.44	65.28
111	4 / 4	0.63 (5.30)	-				
	5 / 5	0.88 (6.65)	-				
	4 / 5	0.83 (6.26)	-	117.90	-	75.58	-
115	2.6 / 2.6	1.14 (11.83)	1.31 (10.47)				
	3.7 / 3.7	1.85 (14.01)	1.67 (9.04)				
	2.6 / 3.7	1.66 (12.60)	1.47 (7.93)	127.69	125.26	74.63	75.37
123E	2 / 2	0.60 (7.01)	0.61 (4.70)				
	3 / 3	0.97 (9.59)	1.27 (8.24)				
	2 / 3	0.96 (9.50)	1.26 (8.14)	148.45	148.82	84.63	78.18
123B	2 / 2	0.41 (4.77)	0.80 (6.42)				
	3 / 3	0.88 (8.52)	1.10 (7.84)				
	2 / 3	0.83 (8.11)	1.05 (7.42)	141.48	143.18	74.38	67.27

4. Conclusion

Traits evaluated had moderate magnitude heritability in the assessed experiments, showing good responses to selection. Early selection procedure was efficient in all of the assessed scenarios, providing similar responses to the direct selection in mature age, allowing expressive genetic gain associated to significant decrease of breeding cycle in eucalypt culture.

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Supervisory System for Monitoring, Control and Estimating Thermal Comfort for Broiler and Laying Hens Production Sheds

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Abstract

This research aims to promote the project for the construction of software, firmware, and micro-controlled hardware, which together allow the automatic control of the temperature and humidity index (THI) in real-time the intensive production environment in poultry and laying hens production houses, thus avoiding productive losses due to the stress to which the birds are subjected. This system aims, from the information from a set of sensors, connected to a microcontroller acquisition and control board, to infer the temperature and humidity index from the measured climatic variables, to enable the corresponding activation of electronic interfaces with electric actuators, for the automatic activation of ventilation devices, humidification and curtain actuation and the lighting of production houses, keeping the environmental conditions of the house within a convenient range of temperature and relative humidity to ensure thermal comfort and thus avoiding bird stress. Thus, helping to mitigate production losses and facilitating managers real-time monitoring of the shed to achieve greater productivity and competitiveness.

Keywords: Automatic Control, Broiler Production, Competitiveness, Decision Support Software, Productivity.

1. INTRODUCTION

Whereas poultry and laying hens production are currently negatively affected by the possible rise in temperatures, limiting the areas where production can be established and renewing the search for means to alleviate the sudden changes in the external environment within the premises, poultry and laying hens production. In Brazil, which is one of the most coordinated animal production chains, it must continue to invest in innovation in order to maintain its current position among the largest producers in Latin America.

According to [1], temperature maintenance is essential for the welfare of laying hens. The thermal factors that can be represented by air temperature, humidity, thermal radiation and air movement cause several physiological changes in the birds, compromising the homeothermy. Outside the comfort zone, there is a decrease in productivity, reproductive and immunity performance, and temperature extremes can be lethal.

As the consumption of chicken meat in the world has increased in recent years, consumers have

become more demanding about poultry welfare [2], and regarding the quality and safety of this product [3], a fact that generates more motivation for the technological contribution.

In this scenario, a factor that stands out as a problem to be solved or mitigated through technological support is thermal stress, a factor that directly affects the productivity of breeders and, in addition, can expose them to high mortality rates, thus reducing the production performance by several genetic lines [4].

Adult breeding birds raised in temperature in the so-called thermal neutral or thermoneutral zone tend to produce more in the welfare state [5].

According to [6] the global meat industry has seen significant changes in the methods used to create, harvest and process fresh meat over the past century. The increased use of automation has led to significant increases in the speed of production processes for beef, pork, sheep, poultry and fish operations. The same author in another publication highlights the fact that in general greater automation has been introduced in the poultry industry due to the smaller size and more uniform nature of broilers compared to red meat animals [7].

The researchers [8] worked on an evaluation of the thermal comfort and performance of broilers and concluded that the meteorological variables and the environmental thermal comfort indices, under favorable conditions, point to a better natural thermal conditioning for the birds. This fact favors the improvement of the productive indices, even when the results are evaluated under the differentiated farming regime.

This is reinforced by the work of [9], who highlights that heat waves cause losses in animal production due to their exposure to heat stress increasing mortality, and consequently, economic losses. These hot flashes are recurrent in southeastern Brazil.

Given this research and its conclusions, it is justified to present this research with the purpose of mitigating these impacts on production, in order to support producers to evaluate and monitor the characteristics of broiler breeding and laying hens environments, seeking to automatically reduce heat stress and thus better support their decisions, or set them to be automatically made through automated systems focusing on scaling results with less human interference, thereby enhancing productivity, competitiveness and reducing losses.

This is achieved through the development of a computational tool focused on the automatic control and monitoring of the utilities and sensors of the sheds, helping to keep the thermal environment controlled, avoiding the thermal stress for birds as pointed out by [10], together with information from of a sensor system and a microcontroller device that can generate sufficient information for the automatic activation of devices that promote temperature control and thus prevent productive losses in the broiler chicken and laying hens production sheds.

Thus, the objective is the development of the design and construction of a prototype with embedded intelligence, based on microcontroller, acting in real-time, with a set of sensors for the measurement of dry bulb temperature, atmospheric pressure and humidity using discrete components and actuators that allow data exchange with a personal computer-based supervision and control system for the automatic comfort control of the poultry rearing and laying hens environment to maintain the temperature and humidity index (THI), within the limits of thermal comfort, evaluating its response characteristics in simulated environment.

2. LITERATURE REVIEW

In the classic work by [11], the authors carry out an important review on the application of integrated monitoring systems techniques, in which sensors of environmental variables, databases, mathematical models and previously formed knowledge bases are combined and interpreted, thus allowing the maximum potential of this generated information can be utilized so that the farmer/keeper can maximize the efficiency of his production system by monitoring all its critical steps and goals and ensuring that they are kept close to ideal.

These considerations make it possible to infer that technological innovations, through technological support in intensive broiler and laying hens production environments, can increase competitiveness and increase producers' profitability.

It is observed that in this animal production market, there is a growing use of automation, which leads to significant increases in the speed of operations with birds, where procedures such as maturation, stimulation, cooling, sensing and actuation of electrical systems are now common. for poultry processing resulting in high-quality end products [6].

The same author points out that this is a constant challenge because the equipment requires the development of unique sensors and control systems that replace traditional manual operations and assisting the equipment in automatic operation.

In this field of knowledge emerges precision agriculture, which can be defined as in the work of [12], as is the art and science that uses advanced technology to improve agricultural production. The authors point to sensor technologies that are the major causes of the development of precision agriculture. Further, the fact that recent advances in communications and electronics have enabled the development and production of low-cost, low-power multifunction sensors that are small in size and can communicate intelligently and cheaply, and can be deployed. in large numbers, providing enormous opportunities for environmental monitoring and control [13].

Monitored data, according to [12], are used to obtain the best decision for the control and adjustment of environmental parameters in order to obtain a better production yield, optimizing the use of resources. As the project is closely related to climate variables, it will also have sensors that will collect data to monitor the excursion of climate variables. Given these considerations, choosing the right hardware that makes up the sensor nodes is an important decision for any precision farming system deployment.

Comparison between different hardware architectures can be made according to the general parameters, processor and memory, communication capacity, sensor support, and power consumption. One of the main characteristics in node selection (hardware/microcontroller/sensor/actuator) is its physical parameters, weight, size and price [14].

According to the work of [15], we currently find in the market equipment produced by large electronics companies that adapt the PC for the most diverse functions ranging from data acquisition to the control of complex production lines in the industry. These products include data acquisition boards that, together with a huge assortment of transducers, allow you to use the PC to measure and record the most diverse physical variables. According to the same authors, one of these devices is the Arduino development learning board, which is based on a very versatile AVR family AVR microcontroller, which enhances its functions beyond

a simple passive data acquisition interface and can operate alone controlling various devices and thus having applications in embedded instrumentation and robotics.

They add that the whole electronic project, including the platform for the development of the control programs, is public and free, with an extensive international community and on the Web, you can find a lot of application documentation.

Other works using this hardware platform in different applications and knowledge areas have already been done by [16]; [17] and with other microcontrollers as in the works of [18] and [19] who worked with PIC, as well as the authors [20] who worked with Basic Step M8.

In this context the present research presents the development of the project of an intelligent prototype-based microcontroller acting in real-time, with a set of sensors for the measurement of dry bulb temperature, atmospheric pressure and relative humidity, which uses discrete components and actuators, exchanging data with a personal computer-based supervision and control system for the comfort control of the poultry and laying hens environment automatically maintaining the temperature and humidity index (ITU) within comfort limits thermal stress and avoid heat stress. This will help companies reduce the production losses caused by sudden temperature fluctuations and increase their market share, thus gaining greater competitiveness and productivity.

3. MATERIAL AND METHODS

For the design of the system hardware, are used open-source, free software Fritzing version 0.9.3b, which is a software tool for prototype documentation [21]. After the software-supported prototype was completed, the hardware was built with its components - an Arduino Mega 2560 R3 acquisition and control development board, a BMP 180 atmospheric pressure sensor, two relative humidity, and dry bulb temperature sensors DHT22 for measurement of the internal and external shed temperatures, a block of 4 Relays (1 inverter each for 110/220 Vac power loads), and an L298N H-Bridge for two DC and 12V dc motors.

The entire system was powered by a 12 Vdc power supply and a unique 9Vdc power supply for the data acquisition board to eliminate the possibility of improper restarting of the data acquisition card due to the switching of system interfaces added controls.

As the variables to be monitored by the system are the dry bulb temperature, relative air humidity and atmospheric pressure, the methodology proposed by [22] were applied for the temperature range of $0 < t < 50$ ºC and, the sensors and actuators adapted for project development will be those listed in Table 1.This table also shows the specifications of the drive modules listed in the design for driving curtain motors, fans and humidifiers.

Table 1. Sensors and actuators listed for development.

Sensor	Manufacturer	Reading range	Resolution	Accuracy
Pressure BMP180	Bosch Sensortec	300-1100 hPa	0,02hPa; 0,17m	+- 1hPa
Humidity and	Aosong Electronics Co.,Ltd	0 to 100%RH; - 40 to + 80°C	0.1%RH; 0.1°C	+- 2,0%RH; +- 0,5°C

Temperature DHT22		
Actuator	**Manufacturer**	**Features**
H bridge L298N	STMicroelectronics	Interface Board - Control of 2 DC motors; Max Operating Current: 2A per channel or 4A max; Logic voltage: 5v; Logic current: 0 ~ 36mA; Temperature Limits: -20 to + 135 ° C; Max Power: 25W
Multiple Relay Block	New Brand	Interface Board 5V - 8 Channels 10A Relays DC30V AC250V 10A, with Optimal Couplers for 15-20mA Input

The developed system has the function of collecting, through sensors, the environmental variables corresponding to the dry-bulb temperature, atmospheric pressure and relative humidity inside the building that simulates poultry and laying hens installation, in which actuators are also installed (Opto relay blocks). which controls the actuation of two sets of motorized curtains, the lighting system, a fan and a humidifier.

These relays in the actual production environment will be responsible for sending the drive signals to the electrical control units of the lighting, ventilation, humidification and curtain control systems, thus forming a unit adaptable to any type of shed and any legacy equipment.

These actuators will be controlled by the Arduino microcontroller board on which firmware is embedded to automatically seek to maintain the temperature and humidity index (THI) within the limits of thermal comfort and to avoid heat stress.

Figure 1 presents the block diagram of the proposed system built with Bizagi process modeling software [23].

For the evaluation of the binomial relative humidity and room temperature, according to [24], we use the index developed in [25] classic work that proposed the calculation for the Temperature and Humidity Index (UTI) using equation 1, which has been widely used for involving only meteorological information normally available in weather stations and databases from satellite images:

$$THI = Dbt + 0{,}36\ Dpt + 41{,}5 \qquad \text{Eq.1}$$

wherein:

THI - temperature and humidity index; Dbt - dry bulb temperature, (ºC); Dpt - dew point temperature, (ºC).

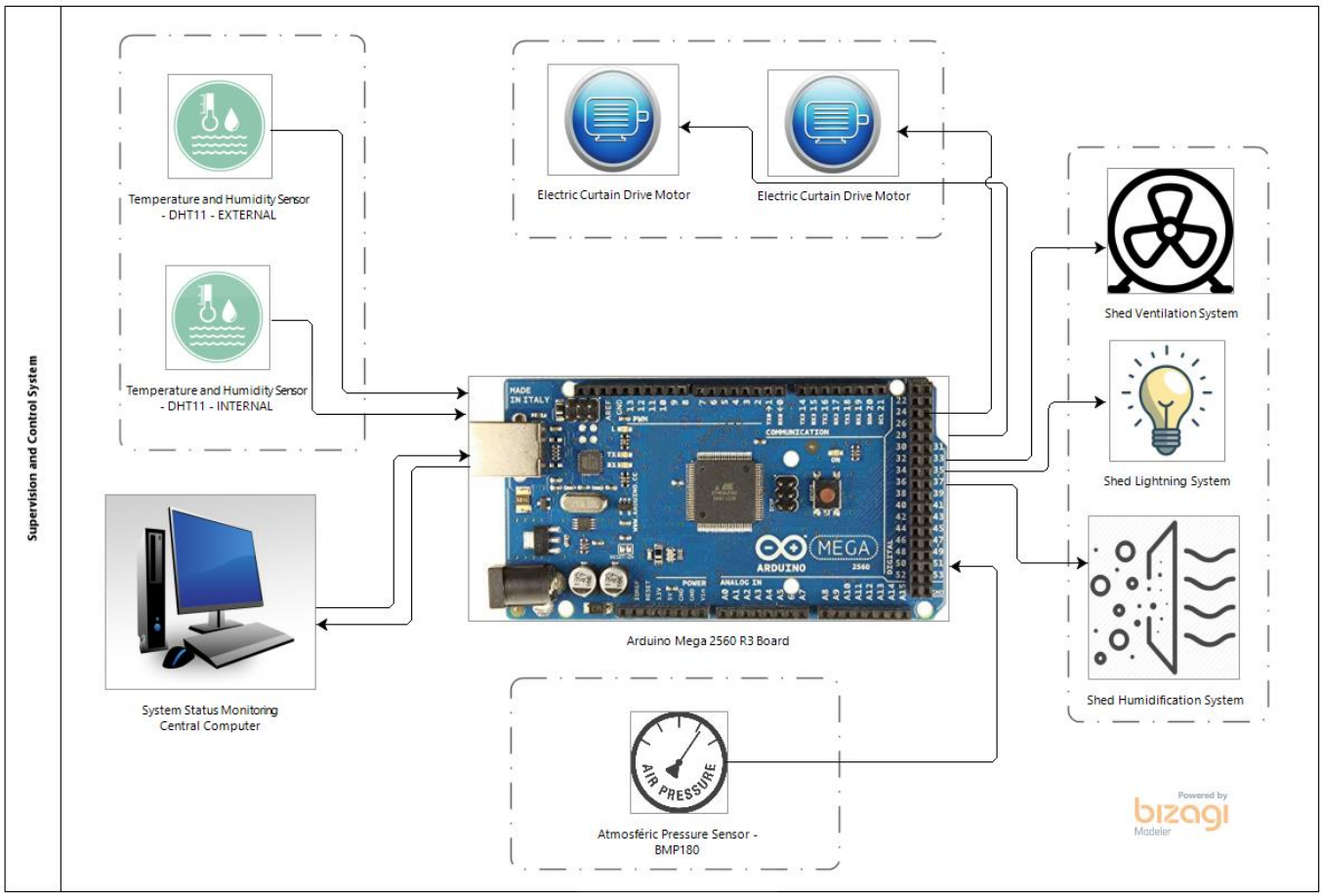

Figure 1. Block diagram of the proposed supervision and control system.

The air temperature (dry-bulb temperature - Dbt) can be obtained by means of common thermometers and, in the case of the proposal of this work, by means of the DHT22 electronic sensor.

As for the dew point temperature (Dpt), it is considered, according to [26], the result of the night cooling, due to the losses of longwave radiation that reduces the temperature until reaching the temperature. dew, when saturation occurs and, consequently, the steam condensation process begins. Therefore, it was necessary to obtain Tpo through indirect means.

To this end, the methodology proposed by [22] was applied to the temperature range of 0 <t <50 ºC (Eq. 2) due to the humid temperate climate with dry winter and hot summer in the city of Tupã / SP. located in the southeastern region of Brazil according to the Köppen-Geiger Cwa climate type classification:

$$Dpt = 6{,}983 + 14{,}38 * a + 1{,}079 * a2 \quad \text{Eq. 2}$$

wherein: $a = \ln(pw)$

In this equation, pw is the saturation pressure, which was obtained from the same study by [22] using Equation 3:

$$W = 0{,}62198 * (pw/(p-pw)) \quad \text{Eq.3}$$

wherein:
W - Relative Air Humidity, (%);
p - local atmospheric pressure (Pa).

With the application of these equations, with the proper algebraic manipulations, it was possible to obtain the value of the THI since the values of relative humidity and atmospheric pressure which are also obtained through the electronic sensors. These calculations have all been transferred to the firmware and to the PC software.

THI values between 71 and 78 are characterized as critical, from 79 to 83, indicate danger and above 83 is already an emergency [27]. Also according to the same author, THI values ranging from 71 to 83, would be valid for domestic animals globally, thus applying to broiler chickens, an object of this research.

A few years later, [28] constructed an adjusted table to indicate the THI indices for animals according to the impact it represents globally, allowing them to determine the four important classes adopted for the present study.

Table 2 presents the thermal comfort status ranges adapted from this study:

Table 2. Site Characteristics x Temperature and Humidity Index (THI)

Location Status	THI
Normal	< 74
Alert	> 74 < 79
Danger	> 79 < 84
Emergency	> 84

Source: Adapted from [28].

The system firmware was built based on the Arduino community-available web application [29] in version 1.6.5 and was adjusted to collect climate variables by inferring THI index values, and the control algorithm is based on climatic variables and THI values for the performance of each output device.

The THI values are calculated in the embedded system and in the PC application, automatically after each collection and the algorithm, based on the rules defined for the performance, based on the table proposed by [28] and will fire individually or together, all indoor environment control devices to keep the environment, as close as possible, within the thermal comfort conditions for the birds by serially sending the data to the supervisory developed in Microsoft® Visual Studio .Net 2017 Rapid Application Development (RAD) tool with VB.Net programming language.

This supervision will allow the System User to interact with the acquisition and control hardware installed, allowing automatic or manual activation of the shed curtains or the fans and humidifiers.

4. RESULTS AND DISCUSSION

4.1 Hardware design and connections diagram

The design of the system hardware, to meet the data collection characteristics described in the materials and methods section, consisted of the application of open-source, free software Fritzing version 0.9.3b, [21]

and resulted in the diagram of links between the modules shown in Figure 2.The system is based on the application of commercially available, low-cost commercial modules and sensors.

The developed hardware had its peripheral processing and control base defined by the Arduino Mega 2560 R3 board which allows, besides meeting the connections required by the project, the provision of a good number of spare I / Os for future expansions, as well as a good programming memory space, which guarantees good stability considering the amount of variables and peripheral devices adopted for development.

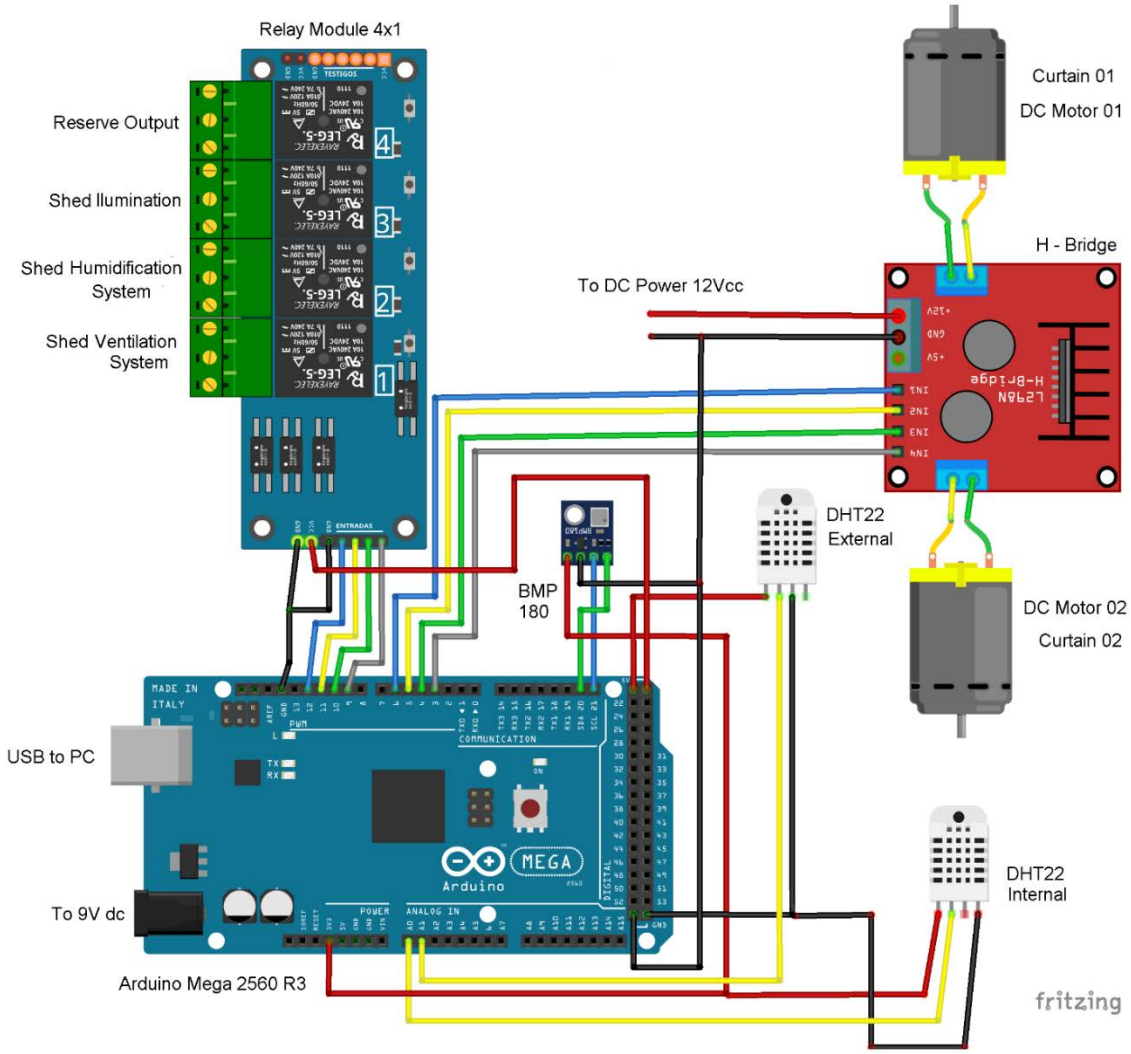

Figure 2. Design of supervisory and control hardware components.

4.2 Firmware design

The system firmware built on the application made available by the Arduino web-community [29] in version 1.6.5.

The coding was done in C ++ language using subroutines. The configuration libraries provided by the manufacturers of the sensors and H-bridge selected for the project were also used.

The coding of this firmware was developed based on the creation of a proprietary communication protocol that makes the acquisition card standby waiting for the USB serial communication channel to arrive from the PC (from the developed supervisory application) of a string or numeric code so that it can

then respond as requested.

The generated algorithm causes a focused interrogation loop for the USB serial channel input to identify which function is being requested and thus determines the action to be performed (Sensor Read or Power Interface Trigger).

Sensors are interrogated by the PC application individually (using different numeric codes) and, upon receiving the code, the firmware executes the subroutine corresponding to the reading of the value of the given sensor and sends it to PC through the USB serial communication channel of the data acquisition board.

The acquisition board also in its firmware is prepared to receive from the PC, control strings, which depending on their configuration, will trigger the corresponding relay block digital outputs, thus allowing the control of external loads.

4.1 Supervisory Software Design and Description of the Main Functionalities

The supervisory was developed in Microsoft® Rapid Application Development (RAD) tool called Visual Studio .Net 2017 with a visual basic programming language (VB.Net).

Immediately after clicking on the application icon on the computer desktop with the Windows 10 operating system, the application starts by displaying a splash form with the system presentation.

The generated application splash screen can be seen in Figure 3.

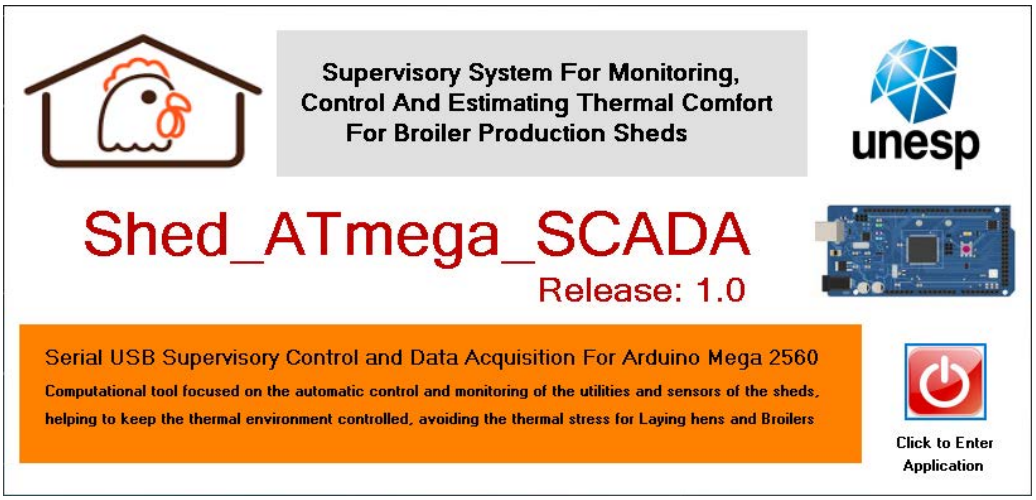

Figure 3. Splash Screen form.

When the Form Splash discharged after the user press the command button with the message “Click to Enter Application”, the Form Splash loads a message box with instructions to the user, recommending the correct setup of the serial port communication and the correct hardware connection to the PC USB port. The message box can be seen in Figure 4.

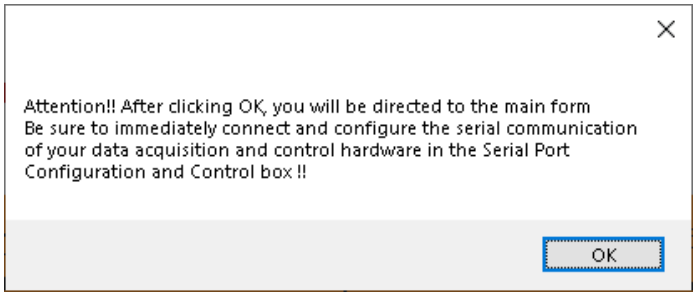

Figure 4. Configuration Allert MessageBox.

After clicking the command Button "OK" the MessageBox, there is a discharge of Form Splash and MessageBox, opening for the user to the MainForm of application. The main form of the application has a set of features that can be divided into some important sections.

On the left side, in the upper corner of MainForm, there is a container that allows the user to configure the serial communication between the PC and the Arduino Hardware with an ATmega microcontroller.

In this container a DropBox allows the selection of the available serial port, that is, the system captures all the serial port drivers installed in the operating system and allows selection.

Just below, there is another DropBox with the possibility for the user to select BitRate, that is, data that is transmitted in a certain period of time, so that the PC can establish communication correctly with the Arduino hardware. The default is 9600 bps, a value also defined in the firmware developed for the ATmega board. With these two configurations made, the user will be able to click on the CommandButton to open the serial port and enable bidirectional communication (PC / Hardware) of the system.

When performing this task, the icon of the USB port, which is animated, changes its color to green, indicating the new status of the port. Right below, there is the CommandButton to close the port and the USB port icon turns red again and the bidirectional communication is stopped.

For the system to act in conjunction with the hardware, the door must be open, otherwise, the system will send MsgBoxes with error messages about the serial port being closed.

Once the communication is established, below the container of the serial port configuration, there is a new container that allows the user to manually access the hardware drives, starting by accessing the led of the card that is physically connected to pin 13.

Thus, the user can make sure the card is properly connected and configured. There is also an icon with the word LED which, depending on the command, is animated in black or white, following the operation of the LED on the board.

LED between the icon and the image with the thumbnail of the board, there is a lively text that indicates the status of the board's response on the confirmation of the drive.

Below we also have the CommandButtons that allow us to connect or disconnect four digital output ports, one dedicated to the activation of the fans, one dedicated to the activation of the humidifiers, one dedicated to the activation of the shed lighting system and finally one dedicated to an extra user equipment. , here called "reserve".

In the sequence are two sets for driving an H bridge for two direct current electric motors, which allow, depending on the CommandButton that is activated, to make the motor turn clockwise, brake or turn counterclockwise. These commands were inserted to actuate the shed curtain systems. Below each set of these controls is an animated text with the status of the outputs.

In the central range of MainForm, there is a defined area for reading the sensors installed in the hardware. The user can, by clicking the CommandButton that enables the automatic reading of the sensors, see start scanning through a green icon that moves between the lines by filling in the values read in red and above, there is a lively text that shows the status of scan, which is green when triggered and displays text "scanning" and when the user clicks the CommandButton that Disables the sensor reading scan, the green

icon to your traffic and animated text turns red inscription "scan Stopped".

When the readings are enabled, the round icon with the text “Off” in red, changes to see with the inscription “On”.

When using the sensor scanning system, in the system, below, there is a checkbox that enables the automatic control of the fans and humidifiers, automatically turning them on or off based on the status of the shed's internal thermal environment. There is also a set of two square icons that show the status of the outputs controlled automatically by changing colors from red to green and using animated text on the right side. Just below there is a new container box that allows the user, when clicking on the CommandButton, to access a new Form with extra information about the issues involving the birds' thermal stress and a table with the indices that are calculated in the application. Figure 5 shows this form.

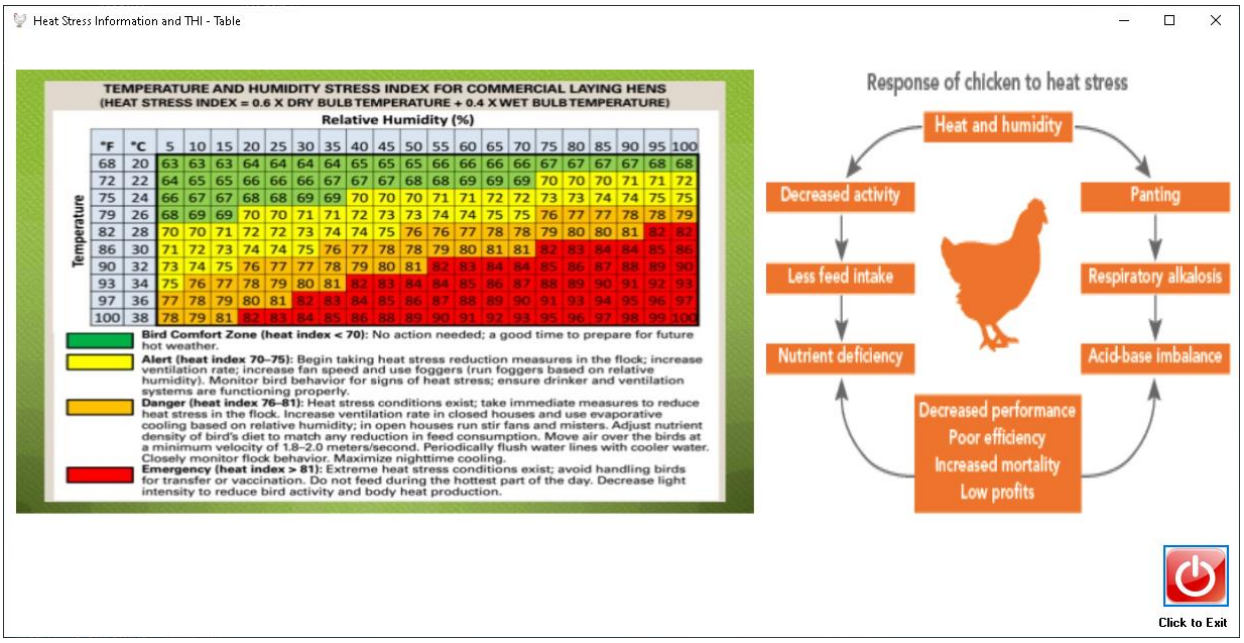

Figure 5. Auxiliary form to support users with indications about the THI index and the effects of thermal stress on birds.

In the third section of MainForm, the THI index calculations are displayed for the interior and exterior of the shed, using animated text and progress bars that show the result of the calculations obtained for each sensor scanning interaction, as well as the green animated icons that travel between the readings in the central assignment and go through the index calculations, they update the results.

Below is a new container box with two blocks, each with a set of animated icons that show the installation status for the interior and exterior of the shed.

These icons show two stylized thermometers and emoji faces indicating the thermal comfort condition, as well as an animated text with the status condition determined by the calculation of the indices.

Continuing in the sequence, in the next container box, we have access for the user to fill in two text boxes, the desired times for the shed lighting to switch on and off.

This allows the user to have more effective control of the light time schedule to which the birds must be exposed.

Right below, still in this section, we have a container with the date and time-synchronized with the

PC's operating system.

Finally, the user finds in the last container in the lower right corner of the MainForm, a Command Button that allows to close the application.

Figure 6 shows the MainForm in the condition of "Serial Port Closed" awaiting user commands.

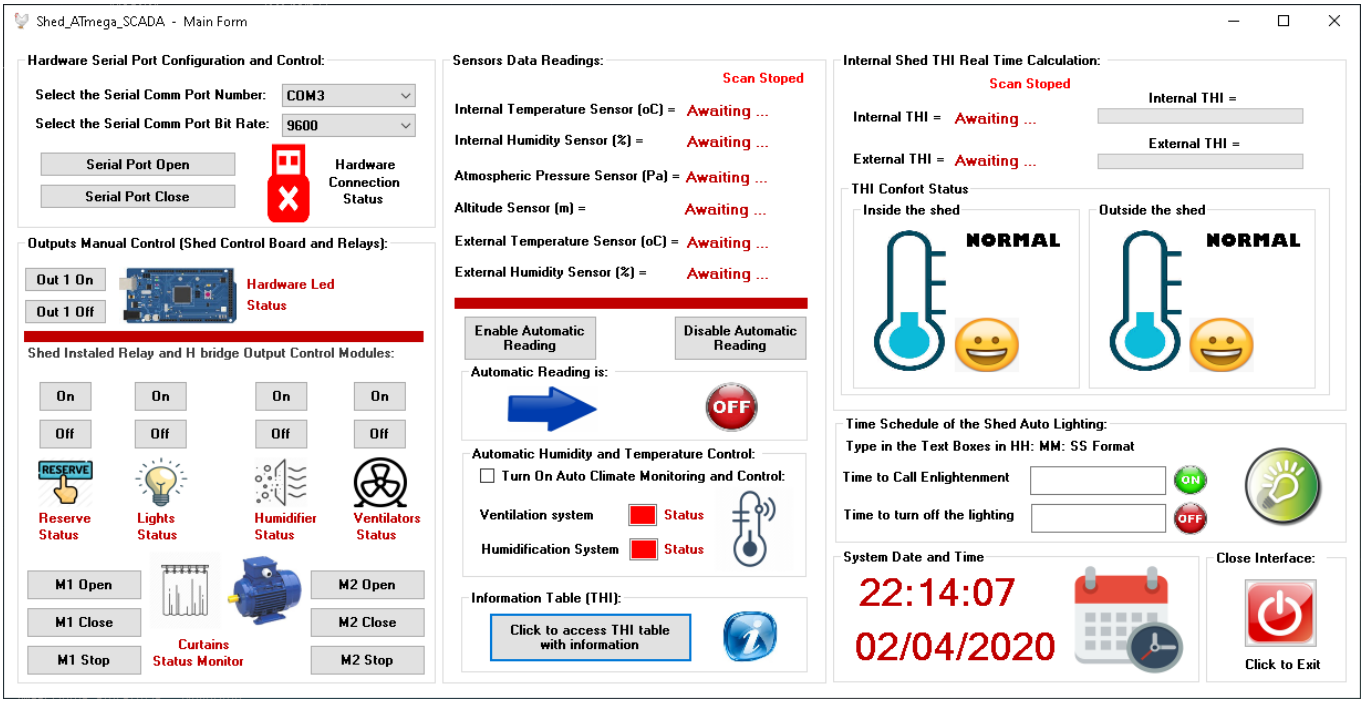

Figure 6. Main Application Form developed in waiting status.

Figure 7 shows the MainForm in data collection mode.

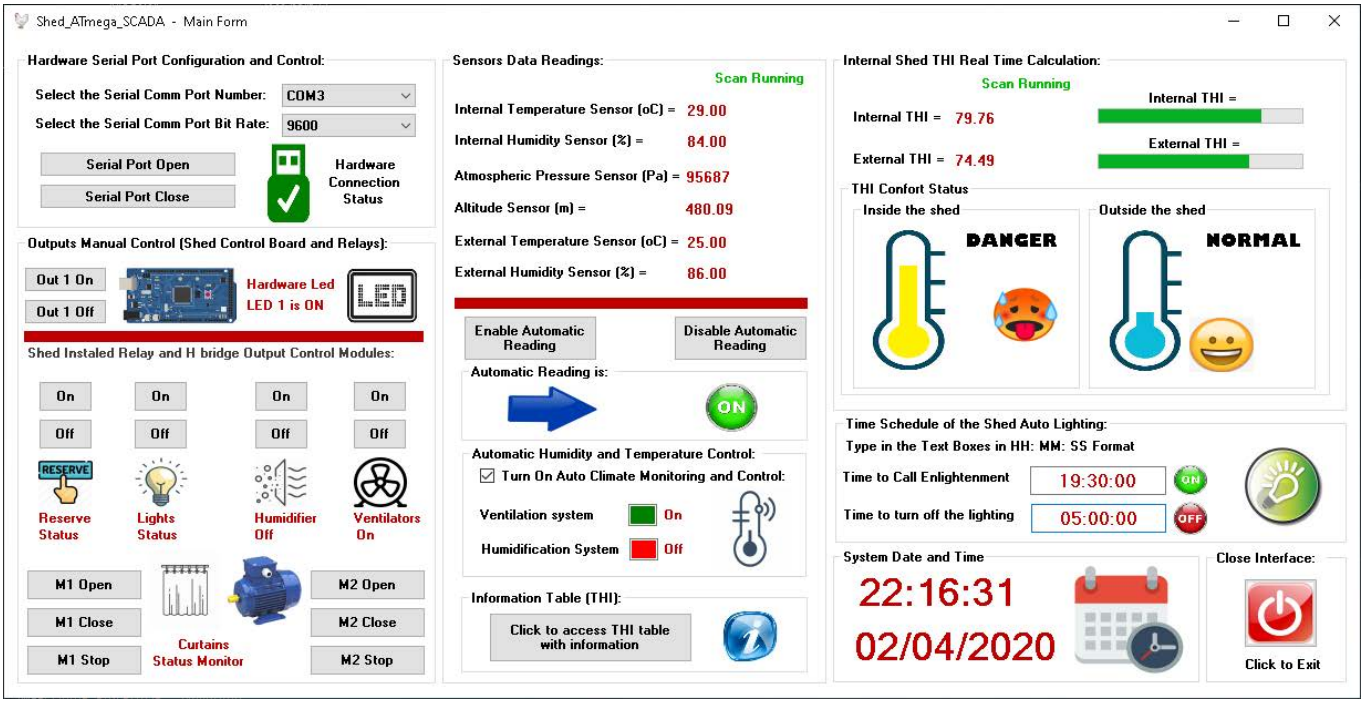

Figure 7. Main Application Form developed connected to hardware in shed monitoring and control status.

The system was tested to validate its operation and measure its real usability, in the laboratory, being

installed in a reduced model of poultry or laying hens (cage-free) production shed that simulates the real production environment on a distorted scale that reproduces the poultry facilities, built in the direction East-West, located at latitude 21o 55 '39' 'S, 50o 29' 30 " W, altitude 495 m, climatic type Cwa (humid temperate climate with dry winter and hot summer), with its surroundings constituted by a flat covered area of grass. The scales used are 1:10 in the horizontal dimensions and 1: 2 in the vertical dimensions.

Table 3 shows the dimensions of the model on a small distorted scale used.

Table 3. Dimensions of the model to verify the usability of the generated system.

Scale	1:1 (natural)	1:10 (horizontal)	1:2 (vertical)
Width	14, 00 m	1,40 m	-
Length	30,00 m	3,00 m	-
Height to ceiling	3,00 m	-	1,50 m
Wall height	0,20 m	-	0,10 m

Users listed for the validation procedures, at the end of the three months of experimentation, issued opinions that allowed to verify the ease of use of the system, its effective performance with very consistent data collections and alerting users whenever the system was in conditions unfavorable thermal environment and also correctly activating the ventilation and humidification devices. Users liked the remote lighting system with timing and also the curtain system.

Thus, the system, at the end of the validation process, proved to be very robust and with good potential for application to real systems for broiler and laying hens, mitigating the problems stated by [1], [4] and [9].

5. CONCLUSION

The generated system, with the developed set of hardware, firmware and application software for Windows personal computer environment, allowed the development of a complete tool for the comfort control of the poultry and laying hens rearing environment automatically aiming to maintain the temperature index and humidity (THI) within the limits of thermal comfort and avoid heat stress.

This device can be installed in any production shed, generating the necessary signals for the proper activation of environmental control utilities. Thus, it can be concluded that the development will help companies to reduce the production losses caused by the sudden temperature fluctuations and, thus, increase their market share, thus gaining greater competitiveness and productivity due to the loss mitigation.

6. ACKNOWLEDGMENT

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The role of unions in intellectual, technological and physical education

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Abstract

The aims are to identify the role of unions in intellectual, technological and physical education of the workers and examine the main motivations of Brazilian union centrals for proposing educational initiatives, according to the existing literature on the subject. The central arguments point out that the intellectual education initiatives provided by unions should seek primarily to demonstrate the importance of dialogue in the educational process rather than merely transmit knowledge. The technological education initiatives may take the form of courses, workshops and lectures promoted by such entities, which could predominantly aim at raising workers' awareness of the notion of "social technology". The physical education initiatives – many focused on sports practices and body awareness – could predominantly move away from hygienist projects, get closer to the promotion of physical and mental well-being not to improve the workers' performance in the workplace, but their quality of life outside the workplace, and achieve greater social integration. The authors conclude that, in fact, the most important union centrals in Brazil sought educational initiatives as ways of garnering workers' support for projects that served the capitalist interests.

Keywords: Intellectual education; Technological education; Physical education; Unions; Brazil.

1. Introduction

After the early stages of mercantilist primitive capital accumulation from the sixteenth to eighteenth centuries, the competitive capitalism in the second half of the eighteenth century began to fuel class struggles which stem from the contradictions between capital and labour. In addition to responding violently to workers' protest movements, the bourgeoisie began to use the threat of unemployment as technology advanced reducing the need for workers. Machines began to automate many production processes which were highly dependent on human work. Innovations operated as powerful weapons in the hand of the bourgeoisie in the class struggle, and the state served to repress workers, maintain the ideal external conditions for capitalist accumulation and the right to property, and secure public order to keep workers framed in the logic of capitalist domination (Netto & Braz, 2006).

At that point, according to Marx (2014), modern industry began to develop mechanical and

technological inventions that were supposed to lighten the burden of labour, but they were used to produce surplus value. In this process, mental conceptions were separated from the physical labour, and workers were reduced to the lifelong task of serving machines. Work has thus assumed an alienating character in the worker's life, since it submitted him/her to fragmented activities that resulted in the production of goods and prevented him/her from enjoying what they produced. Harvey (2013) argues that the workplace acquired a material mode of existence that conditioned the replacement of human force and was based on the conscious application of natural science.

According to Netto & Braz (2006), in the last third of the nineteenth century, it is possible to see the great progress in the development of productive forces, machinery and industry. The capital tended to accumulate, smaller companies were crushed by the larger and more efficient ones, which arose from technological improvement and capital accumulation. The spill-over of monopoly capital beyond the borders of countries and its fusion with banking capital – which led to the sharing of colonial areas among imperialist powers – started a new phase of capitalism. Today, capitalism is characterized by globalization, which promotes an international division of labour. It has developed in a more unevenly – as there are growing asymmetries in the development of countries – and combined way, as less developed countries combine more modern techniques with archaic social and economic relations and remain as dependent and exploited economies.

Faced with the growing hypertrophy of the tertiary sector and the submission of education, health, culture and leisure to the logic of capital, contemporary capitalism – which takes a better defined form from the 1970s on – brought as its fundamental characteristics financialism, rentism and the misconception that conflicts could be remedied by the consensus drawn through representative democracy. However, these characteristics faced resistance. The pressure exerted by the organized movements of workers, the counterculture movements and the revolution in customs projected new actors in the political scene as agents of anti-capitalist mobilization. The unions, which had been defined since the nineteenth century as workers' associations seeking negotiations between the collective representation of these workers and their respective employers, discussed the terms and conditions associated with employment (Farber, 2001). Understood as coalitions of workers who sought to negotiate the sharing of economic earnings with employers, they operated as vehicles through which such workers gained voice opportunities to bring labour-related demands (Hirschman, 1970).

However, the restructuring of capitalism on a neoliberal basis has pointed not only to flexible accumulation and flexibilization of labour processes, markets, products and consumption patterns, but to lower worker stability in employment, precariousness in labour relations and the defragmentation of workers' class consciousness, which generated the loss of rights, the increasing unemployment and the reduction of the unions' strength. Disunited workers started to lose their resilience to capital attacks. The working class became more demobilized in its struggle through the extreme fragmentation of the modes of mobilization (Beaud, 1987). However, the importance of the unions' struggle cannot be ruled out, nor can the death of the "revolutionary subject" be decreed, but the conditions of the workers' political protagonism need to be revised to persist in the struggle against the oppressive action of capital (Netto & Braz, 2006).

For the worker to be aware of the exclusionary processes that characterize the capitalist economy, the need for education of the working class for the radical reconfiguration of conditions of reproduction of this

economy becomes evident. In this sense, Marx and Engels (1983) argue that the education of the working class should be multilateral and include 1) intellectual education; 2) physical and body education, such as that achieved with gymnastic and military exercises; 3) technological education, which unites the general and scientific principles of the entire production process and, at the same time, initiates children and teenagers in the management of elementary tools of the various industrial branches (Marx & Engels, 1983). In a Marxist conception of education, work is understood as an educational principle and aims at social transformation. In this sense, intellectual, technological and physical education is combined with material production to provide every worker with a full understanding of the production process (Saviani, 2003). Among researchers in the fields of work and education, there is a consensus that "polytechnic education" can be understood as the synonym of a Marxist conception of education (Rodrigues, 1998). Nowadays, despite the difficulties mentioned above, several unions have transcended the role of means of mobilization of the working class to act in the process of workers' polytechnic formation in the light of an adverse context of precarious work with the advance of neoliberal reforms and globalization (Santos, 2000).

In Brazil, some unions developed such functions in the context of what Santana (1999) calls the "new unionism". According to the author, the "new unionists" claim that pre-1964 unionism was not autonomous and independent, because the unions were then created by political interests for the benefit of those in power. The new unionists sought to distinguish themselves from past leaderships by distancing themselves from the corporate union structure linked to the interests of the state. They radically criticize the union's state-linking mechanisms and claim for the democratization of the union structure (Santana, 1999). By taking the place that other forces had occupied in the past, the "new unionism" guaranteed the working class a fundamental channel for the representation of their demands, including educational initiatives.

However, there is much question as to whether unions in Brazil today are effectively seeking to provide workers with an awareness of reality transformation – compatible with the notion of polytechnic education – or, by proposing initiatives for intellectual, technological and physical / body education, union leaders intend to mask electoral or political manoeuvres and undermine not only the representativeness of the working class, but the effectiveness of its struggle strategies in the light of the contemporary reconfigurations of capitalism.

The aims of the article are to identify the role of unions in intellectual, technological and physical education of the workers and examine the main motivations of Brazilian union centrals for proposing educational initiatives, according to the existing literature on the subject. The central arguments point out that:

1) The intellectual education initiatives provided by unions should seek primarily to demonstrate the importance of dialogue in the educational process rather than merely transmit knowledge. These initiatives should seek to improve socioeconomic, political and cultural reflections and stimulate transformative actions by workers to free them from oppressive relationships through generative themes that departed from their reality and fostered dialogue, learning and respect for differences.
2) The technological education initiatives provided by unions may take the form of courses, workshops and lectures promoted by such entities, which could predominantly aim at raising workers' awareness of the notion of "social technology". Social technology starts from the view that the questioning of the technological bases of a process could allow the recovery of citizenship

of the most penalized segments in society, the interruption of social fragmentation and economic strangulation processes, the construction of a more sustainable style of development and the inclusion of actors situated across a broad spectrum of ideological interests and visions. These social innovations would be conceived as processes from which a type of knowledge emerged. This knowledge would address the problems facing an organization or group of actors. Social technology refers to a knowledge – tacit or codified, intangible or incorporated into people or equipment – which aims to increase the effectiveness of processes, services and products related to meeting social needs.

3) The physical and body education initiatives provided by unions – many focused on sports practices and body awareness – could predominantly move away from hygienist projects, get closer to the promotion of physical and mental well-being not to improve the workers' performance in the workplace, but their quality of life outside the workplace, and achieve greater social integration.
4) The most important union centers in Brazil sought educational initiatives as ways of garnering workers' support for personal projects that served the capitalist interests. They use opportunistic strategies and distance themselves from social projects aimed at improving the quality of workers' lives.

2. Theoretical framework

2.1. The social metabolic capital system and its structural crisis

A few decades ago, it has been possible to extract apparently significant concessions from capital through labour advocacy organizations, such as unions. Capital was able to grant these gains, but they were absorbed by it during its self-expanding process. Today, the global capital system seeks to thwart interference attempts to take on an uncontrollable form of an extremely dynamic and singular, expansion-oriented and accumulation-driven social metabolic control that eludes human control, because it has historically emerged as a powerful totalizing structure to which everything – including human beings – must fit into all its productive and distributive functions and prove its viability, even though many of its propagandists regard this system as inherently democratic. In this system, not only workers lose control of decision making, but even richer capitalists cannot exercise control over the global dynamics of the capital and must obey the imperative goals of the whole system. The life chances of individuals under such a system are determined according to where the social groups to which they belong are situated within the hierarchical structure of capital's command, and capital retains its primacy over the person through the legal and political body (Mészáros, 2011).

First, it is necessary to understand that, in this system, individuals must reproduce their existence through the primary functions of mediation established among them and in the exchange and interaction with nature, given by the uniquely human ontology of work, through which self-production and societal reproduction develop (Lukács, 2010). The vital functions of the first order of mediation include the regulation of reproductive biological activity in conjunction with existing resources; the regulation of the work process, whereby the necessary community exchange with nature can produce the fundamental goods, work tools, productive enterprises and knowledge for the satisfaction of human needs; the establishment

of an exchange system compatible with the historically changing required needs, aiming to optimize existing natural and productive resources; the organization, coordination and control of the multiplicity of material and cultural activities, aiming at meeting an increasingly complex social reproduction system; the rational allocation of available material and human resources, fighting forms of scarcity, in line with existing levels of productivity and socioeconomic limits; and the constitution and organization of societal regulations designated for all social beings, in conjunction with the other primary mediation determinations and functions. The advent of a second order of mediations corresponds to a specific period of human history, which ultimately profoundly affects the functionality of first-order mediations by introducing fetishizing and alienating elements of social metabolic control. Among the conditions necessary for the validity of second order mediations, one can mention the separation and alienation between the worker and the means of production; the imposition of objectified and alienated conditions upon workers as a separate power that exercises control over them; the embodiment of capital as a selfish value – with its usurped subjectivity and pseudo-personality –, aimed at meeting the expansionist imperatives of capital; and the equivalent personification of the workers as labour, destined to establish a relationship of dependence with historically dominant capital. Such personification reduces the identity of the subject of this work to its fragmentary productive functions. Each form of first-order mediation is altered and subordinated to the imperatives of capital reproduction. The productive and controlling functions of the social work process are radically separated between those who produce and those who control. By constituting itself as the most powerful and all-encompassing system of social metabolism, the second-order mediation system has a constitutive core formed by the capital, labour, and state, and these three fundamental dimensions of the system are materially interrelated, making it impossible to overcome them without eliminating all the elements that comprise this system (Antunes, 2009).

The hierarchical social division of labour stems from the unsurpassable condition, under the domain of capital, that society is antagonistically structured in the light of the separation between the production and control functions of the labour process and their attribution to different classes of individuals. In its social metabolic control, capital extracts and accumulates surplus labour and, to this end, it must free itself from the restrictions on its self-sufficiency. Given the close relationship between economy and politics, the state assumes the exercise of a comprehensive control over the submissive centrifugal forces emanating from productive units isolated from capital. The state acts as a corrective and rectifying structure, compatible with the structural parameters of capital. It is clear, therefore, that the structuring principle of the state is its vital role in protecting the general conditions of extracting surplus value and ensuring that potential recalcitrance and rebellion are under control. However, the alienation of control and the antagonisms it generates are of the very nature of capital. Thus, recalcitrance is reproduced daily through normal system operations; so that the deterrent state guarantee against potential political rebellion cannot eliminate completely the emancipatory aspirations of the labour force. The inability to bring the interest of the capital system to its fundamental logical conclusion results from the structural dissonance between the imperatives emanating from the social metabolic process of capital and the state as the comprehensive political command structure of the system. The state cannot be truly comprehensive or totalizing to the degree that it “should be”, for this is no longer in agreement even with the already attained level of social metabolic integration, even less with the one required to get the global order rid of all its increasing

difficulties and contradictions (Mészáros, 2011).

The contemporary crisis sees the outbreak of more frequent and continuous precipitations, which has motivated a widespread offensive of the capital and the state against the working class. This crisis occurs in a scenario also characterized by the deregulation of capital, trade, technology and working and employment conditions, as well as the strong expansion and liberalization of financial capital. New workforce management techniques, coupled with commercial liberation and new forms of techno-scientific mastery, accentuated the centralizing, discriminatory, and destructive character of this process. In addition to the destructive action against the human labour force, the intensity of structural unemployment levels and the global environmental degradation are increasing (Antunes, 2009). In the light of these changes, it is necessary to develop the critical perspective of workers regarding this system and its crisis, and polytechnic education can be a constructive way to stimulate this.

2.2. *The polytechnic education*

To achieve a critical perspective on the social metabolic capital system and its structural crisis, the development of polytechnic education can be an important element. This perspective on human formation is based on the idea that modern society, which generalizes the demands of systematized knowledge, is characterized by a contradiction: as it is a society founded on the private ownership of the means of production, the maximization of men's productive resources is triggered for the benefit of the portion that owns the means of production, to the detriment of the vast majority of workers who have only their labour force. In the capitalist society, science was incorporated into productive work and became a type of material power. Knowledge turned into a productive force and therefore a means of production. Thus, the contradiction of capitalism also cuts across the question of knowledge: if this society is based on private ownership of the means of production and science as knowledge is a means of production, it should be a private property of the ruling class. The notion of polytechnics is moving towards overcoming the dichotomy between manual and intellectual work, professional and general instruction. Polytechnic education is multidimensional and encompasses elements of intellectual, technological and physical formation (Saviani, 2003).

Regarding the intellectual formation, the polytechnic education demonstrates how important the development of dialogue in the educational process is and how it is opposed to the uncritical and mechanical method of transmitting knowledge. Freire (1987) bases dialogue on love and also addresses praxis, which has as its dimensions reflection and transformative action. The word has a transformative value in the world and the people, in that it enables the oppressed to be freed from their domination condition through dialogue. As the word is a right of all people – not a privilege – and a loving action, Freire (1987) describes as one of the key elements of his method the use of generative themes to foster dialogue and learning, which refer to the reality of people and investigate their action on this reality, not the mobilization of pre-established contents, as in traditional education. There needs to be an investigation and a collection of these themes that are parts of the social life, given that they are the drivers of new dialogues. Exchanging experiences removes the idea of "absolute truths" in which others cannot interfere. With no dialogue, society divides and becomes an easy target for oppressors, who manipulate weak and selfish people. It is also important to emphasize that dialogue does not nullify the self, because it starts from people's own experiences in

communion with others, who also bring their experiences, share their needs and build new visions in this exchange of knowledge. Freedom is thus achieved through a critical consciousness in praxis, where Self and Other will be in constant dialogue in the transformation of reality and the liberation of relations of oppression. Dialogue is important because it grants participants of the teaching and learning processes the freedom of expression, so that the right to reflect is not restricted to the teacher, who only transmits his/her worldview, and opens space for the students to express themselves, their perception of reality and contributions to social transformation (Freire, 1987).

The technological formation, in the perspective of polytechnic education, starts from the questioning of the notion of "technology" itself. Dagnino (2004) defines "technology" as the result of the action of a social actor on a work process that he/she controls. However, due to the characteristics of the context of the social agreement and the productive environment in which this social actor operates, the generated product may be appropriated by someone else other than this social actor. According to Feenberg (1991), technology is not neutral, and it shapes or conditions lifestyles. It is also selected from a process permeated by the correlation of social and political forces that delimit the space of its consolidation (Feenberg, 1991, 2010).The author proposes a subversive rationalization of technology to democratize the process of development, control and use of technologies and give greater human control over means and ends. This would be a way of extending democracy to the technical domain, as well as the process of technological conception and application, and going beyond the search for profit. In the process of construction of a polytechnic education, the concept of "social technology" disseminates the concern with the technological bases of a process that would enable the citizenship recovery of the most penalized segments, the interruption of the path of social fragmentation and internal economic strangulation of the community and the stimulus to sustainable development. Social technology is connected to a process of social innovation, which refers to the provision of some new good or service to increase the satisfaction of social needs (Dagnino et al., 2004). In opposition to conventional technology, social technology starts from a critique of the neutrality of science, and its construction considers the need to adapt the current technology to the construction of a society with new social relations of production. (Henriques et al., 2015).

In this sense, polytechnic education focuses on the sociotechnical adequacy, which means the process of adaptation of scientific and technological knowledge not only to the requirements and purposes of a technical-economic nature, but to the set of socioeconomic and environmental aspects that constitute the relationship among science, technology and society. In defining a new sociotechnical code from which conventional technology would be deconstructed and redesigned in the direction of social technology, one can emphasize the democratic participation in the work process, the fulfilment of requirements related to the environment, the ampliation of the useful life of machines and equipment, the preoccupation with the health of workers and consumers and their self-management training. In this "sociotechnical construction", technological artefacts have their characteristics defined through negotiation among relevant social groups. This can be done by changing the way in which the surplus generated by the adoption of traditional technologies is shared, increasing the worker's knowledge about the productive and managerial aspects and revitalizing and upgrading equipment, for example (Dagnino et al., 2004).

Finally, the physical and body formation is related to the development of concrete pedagogical practices that enable workers to break simultaneously with close professionalization and generic education,

separated from the world of work. The basis of the renewal movement that aims at a socio-cultural perspective of physical education is found in the work of Marinho (2010, 2011), which provided contributions to break the paradigm of body education based on a purely positivist technique. This perspective allowed the development of physical education from a critical and humanistic point of view (Dias et al., 2019). Marinho's ideas challenge medical science and sportsmanship paradigms in the way of thinking about physical education when dialoguing with education, politics and society. According to the author, the humanistic conception of body education uses games, sports, dance and gymnastics – as well as their respective techniques – as ways to achieve educational goals. In this conception, the transfer of learning goes far beyond sports performance, in addition to moving away from technicality when understanding that the technique is no longer conceived as the engine of the historical process (Marinho, 2010). For Marinho (2011), body education transcends the care of the physical aspects of the human being by facilitating human development under its physical, moral and intellectual dimensions. In this perspective of the body dimension of human formation, physical activity allows the process of techno-intellectualization, which means the intellectualization integrated into the action. In this context, the excess of technicality ends up limiting the construction of intelligence and creativity.

The activities of physical and body education must be conceived critically, in the light of philosophy and the human and social sciences, since human beings cannot be understood in a fragmented way. They are integral beings, consisting of body, mind and spirit, therefore their corporal education must also be philosophically grounded, so that the technique present in games and sports should not be understood as the end of the educational process, but as a means to educate (Dias et al., 2019). In line with Vieira Pinto (2005), technique – which is a conscious and immanent act of the human being – allows the constitution of man as a social being, capable of transforming nature through intellectual faculties. Marinho (2010) argues, by incorporating Marxist thought into his reflections, that social agents can choose techniques and methodologies that do not merely lead to a reproduction of historical reality, but to its transformation, so that technical choices are also political by creating syntheses that, in conjunction with historical reality, allow people to see a way for human emancipation.

3. Methodology

The bibliographic research consisted of reading, selecting and organizing topics on the concepts of polytechnic education and Brazilian new unionism and identifying their possible intersections, as well as the social metabolic capital order and its crises to which polytechnic education might represent a way out. The qualitative analysis of the results focused on the indication of the main educational initiatives by the most important union centrals in Brazil from 1964 on and then the investigation of the motivations of union leaders in proposing such initiatives, according to the existing literature.

4. Results and analysis

In the negotiation process between employers and employees in the capitalist economy, unions seek to maximize the welfare of their members. The aims of the negotiation may be limited to raising wages (monopoly model) or payroll (right-to-manage model), which combines employment and wage objectives.

In this context, the bargaining power of a union is characterized by the ability of union structures to mobilize workers to impose loss of profits on companies and bear the costs inherent to strikes. The conventional way of empirically determining the bargaining power of a union is to gauge its mobilizing capacity through the union rate, and the extent of its influence through the union coverage afforded by the legislative context (Portugal & Vilares, 2013). The participation in unions gives the worker a set of personal and collective benefits. Examples of collective benefits include claims for better working conditions, the promotion of worker health and safety and the provision of appropriate channels for reporting bullying. As an example of personal benefits, it is possible to indicate investment in training and education (Farber, 2001).

The functions of the unions became more diversified in the context of the Brazilian new unionism, which aims to turn unions into more autonomous and independent institutions than the pre-1964 institutions, seen as entities created by political interests linked to the state. The new unionism criticizes links between unions and the state and claim for the democratization of the union structure (Santana, 1999). It sees that citizenship is not merely an attempt to eliminate the burden of poverty at the lowest levels of society, but it has taken on the action aspect, promoting a total change in the pattern of social inequality. In the case of new unionism, citizenship does not only intend to raise the level of the lower floor below the social building, but intends to remodel the whole building (Marshall, 1967).

The new unionism in Brazil sees that the world situation becomes unsustainable as there is a deepening of competitiveness, a production of new totalitarianisms, and the growing impoverishment of the great masses. In this scenario, where the tyranny of money and information appear "as the pillars of a situation in which technical progress is exploited by a small number of global actors for their exclusive benefit" (Tavares, 2000), it is necessary to fight for social inclusion, which requires a critical perspective of the world and the role of workforce that polytechnic education can bring. In the light of the process of exclusion, unemployment is becoming commonplace, poverty increases, and all of this is the result of the deterioration in the value of labour in a "world of exclusions", aggravated by social unprotection, a hallmark of the neoliberal model, which is also a creator of insecurity (Santos, 2000). However, as Tavares (2000) argues, a new centrality of the social actors forms the basis for a new policy. In contrast to the alienation of the masses, a new consciousness of solidarity and citizenship arises, with a new moral philosophy opposed to that of mercantile values. Nevertheless, one may question if unions in Brazil today are effectively seeking to transform this reality of exclusion – for which an effective polytechnic education would be fundamental – or operate electoral or political manipulation strategies of the working class, destroying the effectiveness of its struggle against the reconfigurations of capitalism.

When the most important union centrals in Brazil are considered, Souza (2009) argues that their actions and formulations that aim to promote the qualification of their members are consistent with those of the state and the business sector. The unions, which use different arguments, understand that Brazil should be inserted in the dynamics of the globalized world market, which turns the qualification of the worker an essential element for this purpose, that is, the worker must be prepared according to the dictates of the globalized market so that he/she has conditions of employability and becomes a citizen, as he/she is able to increase the productivity and competitiveness of the companies in which he/she is employed (Souza, 2009).

For example, the Central Única dos Trabalhadores (CUT)'s Department of Socioeconomic and Political Studies prepared a 1988 document based on its studies about automation processes and their repercussions for the working class. The immediate aim of this initiative was to contribute or develop new strategies by which the Brazilian union movement could minimize the harmful effects of microelectronic automation for the working class (CUT, 1988). The Força Sindical and the Comando Geral dos Trabalhadores (CGT) did not present proposals for in-depth productive restructuring and recognized that workers were increasingly required to have skills such as problem solving, decision making, teamwork and self-organization (Souza, 2009). In documents from the early 1990s, CUT recognized that the increasing use of automation, linked to new forms of production organization, was leading to the fragmentation and dispersion of labor and the flexibilization of labor relations. This has shaken the ties of solidarity and sociability among workers and significantly altered the profile of the working class, leading to the relative loss of bargaining power of the working and peasant classes in the union movement. This same process has intensified the exploitation of capital over labor, which expanded the proletarianization of increasingly broad contingents of society (CUT, 1992).

However, this Central consented to bourgeois initiatives, placing itself as a representative of the working class in spaces of public participation, but within the limits of capital appreciation. CUT's educational initiatives were already part of the bourgeois renewal of the mechanisms of mediation of class conflict to consolidate bourgeois hegemony. The union central adopted a less aggressive stance aiming at finding spaces in the political arena. Nowadays, CUT and the other union centers still recognize that the new technologies under capital control are destroying historic labor rights, reducing the relative weight of the industrial working class and expanding indirect work in the service sector (Souza, 2009). Nevertheless, the intellectual, technological and physical education initiatives developed by such centers did not stimulate the questioning of workers in relation to capitalism but aimed at training such workers for the preservation of the hegemonic capitalist order.

CUT argued that the automation of new production processes could improve working conditions if there were direct interventions by workers in areas, such as workers' control over innovations and production through struggle and negotiation on investment decisions (CUT, 1988). However, there was no prospect of educating the worker as to the fundamentals of the capitalist and liberal order, so that the mere training to deal with innovations and production seemed to meet the demands of the market. CGT did not make any judgment, in its education initiatives, about the application of science and technology in production. It limits itself to improving the training of workers for productive activities with vague and imprecise criticism of the effects of rationalizing the work of the working class (CGT, 1999). This central did not develop a critical perspective in its education actions and only seeks options that mitigate the harmful effects of the productive use of science and technology in the capitalist order (Souza, 2009). The Força Sindical valued the technological revolution as a diffuser of technologies that established new production paradigms. Its education initiatives emphasized the development of skills to accompany technical progress and incorporate product and process innovations, as well as the proper mastery of basic and product engineering, to allow effective absorption and improvement of imported technologies, and the generation of capacities for the elaboration of new processes and products (Força Sindical, 1993).

5. Conclusion

According to Souza (2009), the current stage of development of the productive forces imposes management measures to guarantee greater flexibility to production processes and increase the possibility of adapting the workforce to changes. The capital shows multiple uses of work capacity and develops the multifunctionality or polyvalence of the worker. These reformulations guarantee an increase in the productivity of companies and the extraction of both absolute and relative surplus value. Such reformulations are necessary to guarantee productivity and competitiveness, essential to the reproduction of capital.

Despite the critical efforts in the 1980s, especially those of the second half of that decade, and the 1990s, reflection on science and technology by central unions in Brazil did not take into account the revolutionary purpose, which a truly anti-capitalist union center should seek to accomplish, reducing science and technology to an economic perspective. Dias (1996) argues that the concept of social formation disappears if faced with the concept of mode of production.

There is a loss of the class character of the analysis on the meaning of the intellectual, scientific and technological advance for capitalism in the name of a technocratic understanding, as if technology were immune to the contradictions of the capital accumulation process. For unions and union centers not to limit their education initiatives to the mere reproduction of capitalism, it would be necessary that technological education, together with other modalities (intellectual and physical, for example), compose a real "polytechnic education", which incorporates, in Rodrigues' (1998) perception, aspects related to professional qualification around work processes in a context of technological transformations, but also concrete pedagogical practices that simultaneously break with the narrow professionalization and generic education. By overcoming the Taylorist-Fordist pattern of work organization and professional training, polytechnic education contributes to the advancement of broader social transformations (Rodrigues, 1998). However, it can be said, from the analysis of the data, that the Brazilian union centrals considered in the research have considerably distanced themselves from a polytechnic formation and their educational initiatives served as means of training workers to meet market needs.

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Rationing of Psychological Immunity Scale on a Sample of Visually Impaired Adolescents

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Abstract

The present study aimed at rationing the psychological immunity scale Prepared by the researcher. The study population is represented in visually impaired adolescents Minia Governorate . The study sample consisted of (40) visually impaired adolescents at El – Nour school for visually impaired students in Minia, which amounted to (40) students of (20 M), (20 F), with an average age (16.5 years) and SD (.506).. The research adopted the descriptive analytical method. The researcher utilized the psychological immunity scale that designed by the researcher. The data was processed and analyzed according to the statistical package for social sciences (SPSS). The results of the study asserted that the scale of psychological immunity is applicable for the age (15-18).The psychological immunity scale has got high psychometric characteristics (reliability& validity) and this assured that the scale is suitable for application with visually impaired adolescents.

Keywords: Psychological Immunity, Rationing, Visually Impaired Adolescents.

Introduction:

Visually impaired adolescents Suffer in our society from many of life stressors; that including the family stress, economical stress, social stress, educational stress, emotional stress, healthy stress, and personal stress which affect adolescents psychologically, physically, and hinders their ability to satisfy their needs. As a result they impact on their mental health, and ability to comply with life so they must learn to face these stressors well and to be adapted with psychological immunity.

Psychological immunity is defined as the sum of personality traits that make the individual able to withstand the effects of exhaustion and stress, and to integrate the gained experience from that, which does not affect the effective functions of the individual, as it produces psychological immunity that protects the individual from negative environmental problems. (Rachman, s.2019.p5)

The Psychological Immune System is defined as 'an integrated system of cognitive, motivational and behavioral personality dimensions that should provide immunity against stress, promote healthy development and serve as stress resistance resources or psychological antibodies' (Dubey & Shahi, 2011, p. 37.). The incorporated resources provide the ability for the individual to tolerate stress and deal with threats in a way that does not harm the personality in any way, rather serves as a base for potential improvement and enrichment. This improvement is due to the knowledge, experience and wisdom gained

through the process of active engagement in the specific issue or stressful situation and the utilization of the available resources (Oláh, 2005).

Visual impairment tends to evoke more discomfiture than any other disability. Primarily, the biggest issue may be that blindness is visible. Furthermore, visual impairment develops serious medical, psychological, social and economic problems.

Psychological immunity dimensions:

The Psychological Immune System (PIS) is built up by three parts (subsystems) which incorporate 16 different resources or potentials that fulfill a similar function. The three subsystems, namely the Monitoring-Approaching Subsystem, the Creating-Executing Subsystem and the Self-Regulation Subsystem dynamically interact with each other in order to facilitate the flexible adaptation and self-development of the individual.

The Monitoring-Approaching Subsystem steers the person's attention to the physical and social environment. It helps the individual in exploring, understanding and controlling their surroundings, while directing their attention towards anticipating positive consequences. The subsystem incorporates Positive Thinking, Sense of Coherence, Sense of Control, Sense of Self-Growth, Change and Challenge Orientation, Social Monitoring, and Goal Orientation.

The Creating-Executing Subsystem integrates potentials that can help in changing the circumstances in a stressful situation, or in generating opportunities in the surrounding environment. It represents the person's ability to modify either their internal or external environment in order to pursue their valued goals. Creative Self-Concept, Problem Solving, Self-Efficacy, Social Mobilizing Capacity and Social Creating Capacity belong to this subsystem.

The third subsystem, that of, the Self-Regulating, contains potentials that provide control over cognitions, attention, emotions and impulses that often emanate as a result of failure, disappointment or loss. It fosters the proper functioning of the other two subsystems by keeping the emotional life of the person stable (Gombor, 2009), and includes Synchronicity, Impulse Control, Irritability Control and Emotional Control.

The three subsystems work together in a dynamic interaction, constantly regulating each other's operation in the process of coping, guiding the individual to use flexible and self-developing strategies (Oláh, 2005; Oláh, A., Nagy, H., & Tóth, K., 2010)..

There are four dimensions of psychological immunity: self-confidence, Family compatibility, Emotional maturity, psychological happiness and positive memories (Bhardwaj, 2012)

Elsherif,A (2015 :13) divided the psychological immunity to three subsystems which were divided to another subsystems :

a) **Introjection Subsystem**: That was divided to counter transference and Containment
b) **Adaptable Confrontation Subsystem**: That was divided to Mask traits , Self-affirmation ,Positive illusions, Serving Attribution, Motivated reasoning, Dissonance reduction
c) **Self-regulation subsystem**: That divided to will power, Synchronicity, Impulse control and Emotional Control

Related Previous Studies

Zidan,S (2012): This study aimed at determining the psychological immunity definition ,dimensions and preparing a scale for it . The study sample consisted of (943) students of Mansoura University whose age ranged (20-27). The researcher designed the psychological immunity scale which contained (9) dimensions (positive thinking, self-control, self-effectiveness, problem solving, psychological hardiness, self-confidence, psychological resilience- optimism and creativity).

Albert-Lőrincz. et al. (2012): This study aimed at identifying the relation between emotional health and psychological immunity system function on a sample of 599 adolescent students in Romania. The researcher used psychological system scale (Olah, 2000) and the adapted scale (olah, 2005). The study proved that there was a positive relation between psychological health and psychological immunity. Moreover, results revealed that positive thinking, optimism, self-regulation, emotional control and self-control helped in adaptation.

Elsherif,A.(2015): The study aimed at investigating the effectiveness of counseling program based on Characteristics of self–determined personality to support the psychological immune system for reducing the psychological alienation. The study sample consisted of Palestinian universities students in Gaza Governorates, which amounted to (661) students. The researcher prepared (counseling program and Psychological immune system scale). The results of the study proved that the counseling program had a great effectiveness to strengthen the psychological immunity on the study sample.

Bhardwaj, A. (2016): This study aimed at identifying the effect of Yoga and spiritual exercises to support psychological immunity for male adolescents. The sample consisted of (62) males whose age ranged from (13-18) years. The researcher used psychological immunity scale prepared by the researcher .the study results confirmed that yoga and spiritual exercises supported psychological immunity for male adolescents.

Khudaier,O & Hussein,K. (2016): This study aimed at rationalizing the psychological immunity scale for the advanced athletes for some individual and mass games in some sport clubs which were (859 players) for the years (2015-2016). The results of the study confirmed that the psychological immunology scale has high validity and reliability.

Study Problem

Psychological immunity is a new concept in mental health, so the current study aimed at investigating the definition and dimensions of psychological immunity and rationing the researcher psychological immunity scale that is prepared by the researcher.

The study problem determined in answering the following questions:

Is it possible to rationing the psychological immunity scale on a sample of visually impaired adolescents?

Study Significance

The significance of the current study is derived from the importance of the topic which try to rationing the psychological immunity scale on visually impaired adolescents, in addition to the importance of the sample age stage which the study dealt with, the importance of the study is demonstrated also in the preparation of a new scale for measuring psychological immunity on visually impaired adolescents.

Study Objective

The current study aims at:

- Rationing the psychological immunity scale on a sample of visually impaired adolescents.

Study Hypothesis

There is a possibility to ration the psychological immunity scale on a sample of visually impaired adolescents.

Study Delimitations

The current study wad delimited to the following:

a) **Place Limits:**
Participants of the study were chosen from El-Nour school for visually impaired individuals Minia Governorate, Egypt.

b) **Time Limits:**
The study was applied at the first semester of the academic year (2019-2020)

c) **Study Sample:**
The study sample consisted of (40) visually impaired adolescents at El – Nour school for visually impaired students in Minia, which amounted to (40) students of (20 M), (20 F), with an average age (16.5 years) and SD (.506).

d) **Study Tools:**
The psychological immunity scale (prepared by the researcher).

Study Terms

Visual Impairment: partial or total inability to see, or to see normally, due to partial or complete loss or absence of vision or to visual dysfunction. Visual impairment encompasses the continuum from blindness to low vision. It can result from disease or degenerative disorder (e.g., cataract, glaucoma, diabetic retinopathy, and macular degeneration), injury, or congenital defects (e.g., refractive errors, astigmatism). The degree of visual impairment is assessed in terms of disability in everyday life. (APA, 2015, 1143)

Psychological immunity: The psychological immunity was defined in Cambridge dictionary of psychology (2015) as a study of the interaction between the psychological stimuli and the interactive response of psychological immunity system. (Matsumoto,D .2015, p.501)

Olah (2000, 2002) defined psychological immune system as "an integrated system of cognitive, motivational and behavioral personality dimensions that should provide immunity against stress, promote healthy development and serve as stress resistance resources or psychological antibodies". So psychological immunity is that capacity/ strength or protection layer of the mind which provides the strength to an individual to fight against stress, fear, insecurity.

Psychological immunity is defined as person's ability to protect himself from possible negative effects of stress , Threats, psychological risks and frustrations .Getting rid of them by psychological immunization and using personal abilities .(Essam Zidan,2013,p.817)

The researcher defined psychological immunity as a preventive method that helps the visual impaired adolescent to get rid of Psychiatric illness, thus the psychological immunity method consists of five major dimensions: self-confidence, emotional control, psychological resilience, challenge and perseverance and optimism.

Psychological immunity scale for visually impaired adolescents (prepared by the researcher)

The researcher divided the psychological immunity to five dimensions:

The first dimension (self-confidence): The researcher defines it procedurally as a conviction of the visually impaired adolescent with his goals, decisions, abilities and potentials. The visually impaired who confident with himself ; respects , appreciates himself, and trusts in his ability to make the right decisions and realizes his competencies, reassurance, optimism and ability to achieve goals . Assessing people correctly and relationships based on his or her own self-worth.

The second dimension (Emotional control): The researcher defines it procedurally as the ability of the visually impaired to control his reactions and emotional stability in the most extreme conditions and the most difficult situations, this appears during dealing with stressful situations and crises." It also indicates to the ability of visually impaired to organize his behavior and reactions.

The third dimension (psychological resilience): The researcher defined it procedurally as the ability of the visually impaired to adapt to the difficult social life, which represented by family, emotional problems, health crises, academic, economic problems and severe disability problems. Resilience is the ability of the visually impaired to overcome this suffering conditions and maintain himself from stressful events.

The fourth dimension (The challenge): The researcher defined it procedurally as a conflict with the self or with others to reach a specific goal that the visually handicapped plans for himself to reach it, provided that it is a positive challenge that does not harm others, for example, to success in exams and overcoming obstacles of disability.

Fifth dimension (optimism): The researcher defined it procedurally as a tendency to look at the best side of events and expect the best results. It is also the view of the visually impaired in life that makes him view to the world as positive, so optimism is against pessimism. Optimistic visually disabled adolescents always think that people and events are positive, and the most of their lives are ultimately going for the best.

Reasons for preparing the scale

Visually impaired adolescents have a special nature, so the researcher must use a suitable scale for their mental and emotional level. Although there are many foreign studies that discussed psychological immunity, there aren't any published Arabic scales for visually impaired adolescents. For that reason the researcher prepared and rationing the scale for the visually impaired adolescents in Minia to have a psychometrical scale suitable for the study sample.

Scale Aims

The psychological immunity scale was designed to determine the different dimension of psychological immunity, which faced the visually impaired adolescents in their lives; the scale contained the following dimensions:

1. Self confidence
2. Emotional control
3. Psychological resilience
4. Challenge
5. Optimism

Procedures of Preparing the Scale

The researcher followed the following procedures:

1. After reviewing the related Arabic and English previous literature and related studies, the researcher designed the scale that was suitable for the sample of visually impaired adolescents. The scale consisted of (46) items
2. Identifying on the psychological immunity scales : The researcher reviewed many scales of psychological immunity as :
   a) **Psychological immunity scale prepared by Olah(2005)** who stated that the Psychological Immune System (PIS) is built up by three parts (subsystems) which incorporate 16 different resources or potentials that fulfill a similar function. The three subsystems, namely the Monitoring-Approaching Subsystem, the Creating-Executing Subsystem and the Self-Regulation Subsystem.
   b) **psychological immunity scale prepared by Barbanel**
3. Setting the initial format of the scale and determining it's sentences: The researcher designed the scale dimensions and sentences to prepare the psychological immunity scale for the visually impaired adolescents. The scale dimensions were: self-confidence – emotional control – psychological resilience – challenge- optimism. Accordingly, the scale was formed in its initial from (52) sentences distributed over the previous five dimensions.
4. Presenting the scale to the jury members: The researcher presented the initial copy of the scale to jury members (eleven professor of Mental Health in Faculty of Education, Minia and Assuit University. The jury members didn't accept on (6 sentences) as they were very long or didn't

suitable for its dimension (46 sentences were accepted by the jury members by 90%. The researcher applied it on a sample consisted of (40) students in El-Nour school for visually impaired in Minia.

Scale Correction System

The researcher determined the total degree of the scale from (0-92). The highest students' scores on the scale referred to the highest level of psychological immunity, while lowest students' scores on the scale referred to the lowest degree level of psychological immunity.

In positive sentences

The response: (Always= 0, sometimes=1, never=2 scores)

In negative sentences

The response: (Always= 2, sometimes=1, never=0 scores)

Table (1): Psychological Immunity Scale Dimensions, Sentence Numbers and Number of Sentences in Every Dimension

Dimension N.	Dimension Name	Sentences Number	Total Numbers of Sentences
The first dimension	Self confidence	1-6-11-20-25-30-35-40-44-46-48	Eleven sentence
The second dimension	Emotional control	2-7-12-16-21-26-31-36-41	Nine sentences
The third dimension	Psychological resilience	3-8-13-17-22-27-32-37-42-45-47	Eleven sentence
The fourth dimension	challenge	4-9-14-18-23-28-33-34-43	Nine sentences
The fifth dimension	Optimism	5-10-15-19-24-29-34-39	Eight sentences

Psychometric Characteristics of Psychological Immunity Scale for Visually Impaired Adolescents:

1. **Scale Validity**

The researcher utilized the following:

a) **Validity of Juries or Trustees**

The researcher presented the initial copy of the scale to a number of jury members (eleven professor of mental health in faculty of Education, Minia and Assuit University). The jury members didn't accept on (6 sentences) as they were very long or didn't suitable for its dimension (46 sentences were accepted by the arbitrators by 90%. The researcher applied it on a sample consisted of (40) students in El-Nour school for visually impaired students in Minia Governorate, Egypt.

b) Criterion-related Validity

The researcher utilized the criterion related validity that the researcher applied the scale to a sample of (40) participants from the research community and not from the original research sample, then applied the psychological immune scale for (Essam Zeidan, 2013) on the same sample. The correlation coefficient between the degrees of participants was calculated on the two scales, and the correlation coefficient was (0.934) which was statistically significant at (0.01) level and this indicated that the scale was valid.

2. The scale reliability

To vertify the scale reliability the researcher utilized the following procedures:

a) Cronbach's alpha:

The researcher used Cronbach's alpha coefficient through applying them to a sample of (40) participants from the research community, and not from the original sample, and the following table shows that.

Table (2) Reliability coefficient by using Cronbach's alpha

Alpha coefficient	The dimension
0.87**	Self confidence
0.86**	Emotional control
0.87**	Psychological resilience
0.89**	Challenge
0.85**	Optimism
0.89**	The total score

The alpha coefficients for the scale dimensions ranged between (0.85: 0.89), and the alpha coefficient for the scale as a whole was (0.89) which are statistically significant coefficients at the level of (0.01) ** which indicates the stability of the scale

b) Test-Retest: The researcher used test and retest method on a sample consisted of (40) students from El- Nour school for visually impaired students. The researcher repeated the scale after 2 weeks on the same sample.

Table (3) the Coefficient Correlation of the First and Second Application

The dimension	Coefficient correlation
Self confidence	.823**
Emotional control	.815**
Psychological resilience	.743**
challenge	.881**
optimism	.876**
Total score	.854**

Table (3) revealed that the coefficient correlation of test and retest for the dimensions were between (0.823 –0.876). The total score of coefficient correlation of the scale was (0.854). All these coefficients correlation is statistically significant on the level (0.01)

c) Internal Consistency:

The researcher used the internal consistency. The sample statistical mean was (16.5) with standard deviation (0.506).The coefficients correlation were calculated between the score of the scale statements and the total scores of the dimensions ,as well as the coefficients correlation between each dimension of the scale and the overall score of the scale.

Table (4): The Correlation Coefficient between Dimensions of the Psychological Immunity Scale

The dimension	correlation coefficient
Self confidence	.592**
Emotional control	.550**
Psychological resilience	.599**
Challenge	.833**
Optimism	.792**

Correlation is significant at the 0.01 level.

Study Results and Conclusion

The current study was conducted in order to identify the psychometric characteristics of the psychological immunity scale presented to visually impaired adolescents prepared by the researcher. The researcher prepared this scale according to the nature of the selected sample. The results showed that the scale was characterized by high validity and reliability.

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Appendix (A)

The scale

N.	The Statement	Always	Sometimes	Never
1	I think that any difficult situation that I will face in to my life will be a bad end			
2	I feel very angry if I am being ridiculed by someone			
3	Bothered by anyone criticized me			
4	I can challenge any difficulties I face			
5	My future is full of happy surprises			
6	I lack satisfaction because of my disability			
7	I have the ability to control my emotions in different life situations			
8	Usually I hold myself accountable			
9	I am unable to cope with the problems of my disability			
10	I see my future life black			
11	It is difficult to me speak with others			
12	I fail to control my emotions according to the situation			
13	I prefer stereotypes and unchanged in all my life aspects.			
14	I can challenge others to achieve my goal			
15	I expect my future plans to go in the opposite direction			
16	I can't express my feelings			
17	I have difficulty in being able to change			
18	I reject the sudden challenge by others			
19	I strive to achieve my future plans			
20	I trust my opinions			
21	I can grip when I have emotional shocks			
22	I aaccept the idea of changing a goal or a future plan			
23	I challenge myself to reach my goals despite my disability			
24	My spirits are falling and I see a dark future			
25	I trust in my abilities when making decisions			
26	I feel nervous when I face new situations			
27	I can deal with any situation facing me in my life			
28	I can be patient on my disability			
29	I'm sure tomorrow will be bright			
30	I feel happy when I succeed in my studies			
31	My thinking is unchangeable			
32	I accept works that challenge my circumstances			
33	I face life with optimism			

34	I doubt my ability to judge the personality of those surrounding me			
35	I am concerned about what other people say about my disability			
36	I can restore my balance after suffering severe stress or illness			
37	I have a goal in life and I strive to achieve it strongly			
38	I can change my life for the better			
39	I prefer relaxing when exposed to negative situations and criticism from others			
40	It is difficult to me to handle negative emotions			
41	I will challenge my disability and gain a prominent position in society			
42	I overload myself with tasks beyond my capacity			
43	It is difficult for me to control my life due to my disability			
44	I rely on myself to perform my daily tasks			
45	I am unable to deal with new and unfamiliar situations			
46	I fail to come up with solutions to my problems			

Private Higher Education Institutions Intangible Assets: A Comparative Analysis of The Human, Intellectual and Integrative Capital of Teachers before and after Titration

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Abstract

This article aims to compare the Human Capital, Intellectual Capital and Integrative Capital production of teachers before and after their academic degree. With this goal, the following problem will be answered: the incentive to the teachers to their professional qualification, the academic degree search, of HEI (Higher Education Institution) interest under the aspect of Human Capital, Intellectual Capital and Integrative Capital production rise, has generated expected results in each capital after reaching the titration? The present hypothesis are two: there are no differences in production of Intangible Assets in Human Resources before and after academic degree and there are differences in production of Intangible Assets in Human Resources before and after academic degree. Regarding the methodology, it was used a qualitative approach with deductions and inductions to the production of theoretical construction from the data analysis, proposed by Silva et al, (2010)

Keywords: Intangible Assets; Human Capital; Intellectual Capital; Integrative Capital.

1. Introduction

There are several conceptions to the word “service”. One of them refers to an immaterial economic well because it is not presented in a material format. They are, actually, products of human work without necessarily acquiring a visible form. The education is an example of service in the category of intangible good which classification in intellectual property is the power of control. (Barbosa, 2010)

Therefore, the universities produces intangibles goods and services with difficulties of mensuration and quantification in terms of economic and social impacts surrounding it. Among them, we can quote: the human capital (teaching, events, extension, forums), the intellectual capital (the scientific productions), the integrative capital (participation in academic and scientific activities as an evaluator, participant and

others). Besides that, how to make it tangible, in terms of economic values; such as making public the results of this intangible production of goods.

In order to that, the teaching profession requires of Human Resources a constant production of intangible assets to keep themselves fit for the function. Among the needed intangible assets used to base evaluations of HEI are the already quoted Human Capital, Intellectual Capital and Integrative Capital.

Soon, it is questioned the incentive to teachers to their professional qualification, search for academic degree, interest of HEI under the aspects of rising production of Human Capital, Intellectual Capital and Integrative Capital, has it generated the expected results in each capital after reaching ten titration?

Based on that questioning, this article aims to compare production of Human Capital, Intellectual Capital and Integrative Capital of teachers before and after their academical degree and as hypothesis:

H_0: There are no differences in production of Intangible Assets in Human Resources before and after academic degree.

H_1: There are differences in production of Intangible Assets in Human Resources before and after academic degree.

2. Methodology

It is about a qualitative approach that constructs theories from deduction, induction with the researchers' interpretation which inferences to hypothesis formulation and concepts construction are the analysis of data (SILVA *et al*, 2010)

Once chosen the HEI searched information in its academic portal available online and checked all the needed information to realization of data collect identifying described teachers in the institutional portal with the selection of teachers that changed titration from specialist to master and from master to doctor, maintaining the link to HEI. Then, it was researched lattes curriculum to the productions categorization in human, intellectual and integrative capital.

3. Results

The results are presented in three tables with the corresponding to each kind of capital and application of t-student test that showed that there are no differences between straight inclinations before and after titration. In all of them, there are analysis of 16 teachers: 11 that went from specialist to master and 5 from master to doctor.

Table 1. Human Capital

Titration	**Index before titration**	**index after titration**	**Variation**
Master	0,02	0,00	-0,02
Doctor	-0,01	0,00	0,01
Master	0,30	-0,60	-0,90
Doctor	-0,05	0,00	0,05

Master	-0,20	-1,00	-0,80
Master	-0,30	-0,20	0,10
Master	-0,50	0,00	0,50
Doctor	0,75	-2,00	-2,75
Doctor	0,80	0,00	-0,80
Master	1,00	-6,00	-7,00
Master	-0,50	0,00	0,50
Master	0,30	0,00	-0,30
Doctor	-2,50	0,00	2,50
Master	-0,05	0,75	0,70
Master	-1,50	0,60	0,90
Master	-0,02	0,00	0,02

The table analysis referring to human capital shows that 7 from sixteen teachers presented a negative variation after titration, that is, 43% had reduction in production. Regarding the doctors, from 5, 2 had negative variation that corresponded to 40%. Already the masters, from 11, 5 presented a negative variation, that is, 45,5%. This shows us that both in the grand total of masters and doctors and in the individual of each degree there always was a percentage starting at 40%.

Another highlighted point in the table is that 9, that is, 56,25% of variations stood on stagnation zero point, that is, low index when compared with the titration evolution, which shows little progress with titration.

Although 57% had positive variation in the index, the value of positive variation is too small related to the negative because, from 9, 4 had variation equal or below to 0,1, that is, 44,44%. The other 4 between 0,5 to 0,9, corresponding also to 44,44% and only 1 above 1, with 2,5, which means only 11,11%.

Regarding to the 43% of negative variation only 1, from seven, had a variation below 0,1, which corresponds to 14,28%. Below of 0,5 only 1, also with 14,28%. And with values from 0,8 and below 1 was 3, corresponding to 42,85%. Completing, there was two variations a lot bigger than 1 to less: 2,5 and 7 corresponding to 28,57%.

While observing the two paragraphs above, we see that the positive variation in terms of variation is very little expressive when compared to the negative variation. Besides that, it is just see that only one value from positive variation in fact it has bigger expression 2,5 while only one from negative has little expression with most above 0,5 passing by 2,5 and reaching 7.

Table 2. Intellectual Capital

Titration	**Index before titration**	**index after titration**	**Variation**
Master	0	0	0
Doctor	-0,07	0	0,07
Master	0,17	-0,17	-0,34
Doctor	0,5	-3	-3,50

Master	0,05	0	-0,05
Master	-0,4	-0,05	0,035
Master	-0,1	0	0,1
Doctor	0,75	-3	-3,75
Doctor	0,3	0	-0,3
Master	0,5	-1,5	-2
Master	-0,2	0	0,2
Master	1	-2	-3
Doctor	-0,05	-0,3	-0,35
Master	1,5	-0,25	-1,75
Master	-0,45	-0,5	-0,95
Master	0	0	0

While reading the table referring to intellectual capital we realize that 10 from sixteen teachers presented a negative variation after titration, that is, 62,5% had reduction in production. Regarding the doctors, from 5, 4 had a negative variation which corresponds to 80%. This show us that from the doctors only 1 presented positive result after titration, in terms of intellectual production and almost 50% from masters too.

Another highlighted point in the table is that 7, that is, 43,75% of variations stood on stagnation zero point, that is, low index when compared with the titration evolution, which shows little progress with titration. Here, in intellectual production, the results of positive variation are quite smaller than the negative the 37,5% (with a lower expression) and, even so, the value of positive variation is really small regarding the negative because from 6, 2 did not have variation staying at 0, that is, 33,33%. From other 4, 2 below 0,1 corresponding, also, to 33,33% and only 1 with 0,1 and 1 with 0,2, being very little expressive representing very little in terms of evolution in intellectual production.

Regarding to the 62,5% of negative variation only 1 from 10 had a variation below 0,1, which corresponds to 10%. Below of 0,5 only 3, with 30%. Above of variation 1, there was 5 corresponding to 50% and only 1 with 0,95, corresponding to 10%.

While observing the two paragraphs above, we see that the positive variation is very little expressive when compared to the negative variation. Besides that, it is just see that not even one value from positive variation in fact it has bigger expression, while in negative, almost all of them has expression reaching 3,75.

Table 3. Integrative Capital

Titration	**Index before titration**	**index after titration**	**Variation**
Master	2	-8	-10
Doctor	0,17	0	-0,17
Master	-0,4	0,8	12
Doctor	-0,8	0,5	13
Master	0,5	-2,5	-3

Master	1,25	-1,25	-2,5
Master	-0,18	0	0,18
Doctor	1,2	1	-0,2
Doctor	2	-12	-14
Master	1,6	0	-1,60
Master	0,7	-0,4	-11
Master	1,3	0	-1,30
Doctor	-0,7	-0,2	0,5
Master	-2	-3	-1
Master	-1,5	-4	-2,5
Master	-0,5	0	0,5

While analyzing the table referring to integrative capital it is realized that 11 from sixteen teachers presented a negative variation after titration, that is, 68,75% had reduction in production. Regarding the doctors, from 5, 3 had a negative variation which corresponds to 60%. Already the masters, from 11, 8 presented a negative variation, that is, 72,72%. This shows us that both in the grand total of masters and doctors and in the individual of each titration, which refers to integrative capital, there always was a percentage from 60%.

Another highlighted point in the table is that 5, that is, 31,25% of variations stood on stagnation zero point, that is, low index when compared with the titration evolution, which shows little progress with titration.

Here, equally to intellectual capital, the results of positive variation are quite smaller than the negative the 31,25% (with a lower expression) and, even so, the value of positive variation is really small regarding the negative because from 5, 2 had variation 0,5, that is, 40%. 20% has a variation smaller than 0,1 and only 40% had a positive expressive variation.

Regarding to the 68,75% of negative variation only 1 from eleven had a variation below 0,1, which corresponds to 9,09%. Below of 0,5 only 1, also with 9,09%. Already with values from 1, there was nine left corresponding to 81,81%. Here, three values from 10 call the attention. Here appears the biggest variations.

While observing the two paragraphs above, we see that the positive variation is very little expressive when compared to the negative variation. Besides that, it is just see that only two values from positive variation in fact it has bigger expression 2,5, while only one from negative has little expression with most above 1 and reaching 14

4. Discussion

The results presented in the previous item shows that regarding the three capitals, the only one that presented a positive result, but not expressive, in the general aspect was the human with 57%, maybe because it is the capital with a bigger straight relation with the HEI, once that is related with the proposed events by it or in participation to the personal construction in other environments.

Already in the intellectual production, that would score a lot to HEI, for example, in a evaluation of ministry of education there was a fall of 62,5%, what shows that produced to step into the master's and doctorate programs and this decrease increased in the integrative capital with 68,75%, that is, they are only fulfilling the process of class and the aggregation of values from the integrative capital, they are not giving feedback to HEI.

One of the ways to improve the previous question would be a better measurement of Intellectual Capital. For that it is necessary to determine specific indicators according to the characteristics of each organization. This happens because it is an intangible asset and therefore loaded with subjectivity and therefore could not be compared to activities inside the same sector and not even between countries because there is no metrical generalization. (MACHADO, 2008).

There is no way for companies to maintain the highest quality content in their productivity with differential expression in relation to the competition without following changes resulting from new technological adventures and the reduction of borders in the globe. To accomplish being in this adaptation, they must be investing in their human capital all the time for the development of professional and personal competencies with training congruent to the company's objectives in order to produce efficiently and quickly what they need. However, many organizations did not realize yet the importance of this intangible that is fundamental to organizations to achieve competitive advantage and survive in the market. (SPINELLI,2015).

On the three capitals, besides the negative values, stagnation stood out, being that human was the biggest. Besides only having a positive value in human, in three capitals the positive variation practically did not have expression. These data present themselves equal in titration changes, regarding the doctors, the same general logic was followed regarding negative values: in integrative capital only 2 evolved; on intellectual only 1; in human 4. The same principles applied to masters.

Therefore, the three capitals must be in complete harmony and must be worked together for the accomplishment of the company. When this happens, there is an increase in each of these company's dimension adding to each other. If the contrary happens, may occur the opposite, also a subtraction instead of adding. Investing in one without a dialogue with another does not generate results, for example, investing in human, but not working the integrative, the question remains for those who sells, even with all the quality of human capital. (VAZ, VIEGAS & MALDONADO, 2017)

When comparing the data before and after titration there are no improvements in terms of capital results to HEI. The Human Resources are the same before and after titration confirming the null hypothesis that there are no differences between Intangible Assets produced by Human Resources before and after academic degree and the capital with less evolution after titration is the integrative. Actually, the data showed that the proportion that the capital asks for more participation of the subject for values to HEI, less evolution has after titration according to relation: HC bigger than IC bigger than INC.

The results of a knowledge management monitored on the basis of indicators are improvements in the products and services of organizations, a collaborative and learning environment with income from people's work, therefore, gains that must be sought. All of this occurs with actions and policies to encourage the correct use of tools to monitor management and the organization of knowledge. However, in fact for this to occur, it is necessary to systematize techniques that organize the production of knowledge and

incorporated into the processes that builds the organization, specially, in three perspectives: transformation, treatment and knowledge availability. Thus, depending on how important is to KM manage best practices in order to create collaborative environments and to encourage the use of IA. For this, it is necessary for KM to present a process with assistive steps and help to build an environment capable of, besides measuring, transforming and making available the knowledge produced, be able to build an organizational memory. (SILVA; DAMIAN; SEGUNDO, 2016).

Although being confirmed lately the importance and value of intangible assets like being the main survival tool of the companies in competitive environment, there still is a lot of difficulty to actually analyze them. There are several theories to evaluate, spite their potentialities, a lot of limitations are noticeable. In fact, it is a complex assessment that has involved major debates in the various areas of accounting in dialogue with finance. In essence, there needs to be a meeting point between the various theories to allow a global analysis of the data and information from these assets, however, in the financial statements there is not much evidence of the completeness of the IA that should be complemented with the financial methodologies. Thereby, the dialogue between these two perspectives would help to improve the power of decision because the accounting shows how there is an intangible assets cycle bringing information that changes the company situation in the patrimonial and economic order whose analysis must now be carried out by the financial sector in relation to external data. (CAVALCANTI et al., 2017)

In the case of HEI, the articulation of administrative processes with academics is part of a good management process so that they are the intangible assets that add value when well managed. That includes the management participating in academic meetings, dialogue with course coordinators, metrics and goals construction for the faculty and decision making from this debate (SILVA DOS SANTOS, 2016).

HEI's egress are the final result that will indicate HEI's value. They take the intangible of intellectual, human and integrative capital of HEI. The academic management process need to keep up, while the students course, the faculty work, the pedagogical project, the student/teachers relationship, extension activities and related researchers to the teaching so that the final result revert in values to HEI. That requires the intangible assets management for decision making (TACHIZAWA & ANDRADE, 2006).

Actually, if HEI does not invest in others institutional interests, the degree will only serve to achieve documentary standards of quality and increase in salary value (increase in expenses). The difference between inclination values, almost all negatives point to the raise Intangible Assets production, specially the intellectual and the integrative.

5. Final Thoughts

After analysis and discussion of results can be inferred the following considerations: from the three capitals, the only one that presented a small positive variation, after titration, although little expressive, was the human; there was a drop in the intellectual and integrative capital; there was a highlight also in terms of stagnation for the three capitals; regardless of specialists to masters or masters to doctors, the results kept the same logic; the capitals evolution after titration followed the following logic of increasing results, INC was the one with the lowest evolution, followed by intellectual and, lastly, the human; there was no improvement to the HEI in terms of intangible assets in Human Resources after teacher's titration; finally,

is fundamental to watch closely the human, intellectual and integrative capitals of HEI' faculty for coherent and assertive economic decision-making, which shows the IA's importance.

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Middle Childhood Adverse Psychomotor Outcomes from Malaria in Pregnancy: A Study using the Denver Developmental Screening Test-II

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Abstract

Objective: to evaluate changes in the development of premature children aged 5 to 6 years, born to mothers with malaria during pregnancy and to compare them to a control group of premature children born to mothers who did not have malaria during pregnancy. Methods: cross-sectional and analytical study. The Denver test-II was applied to 20 children in the study group and 20 children in the control group. Results: in the group of premature children of mothers with malaria during pregnancy, the vast majority showed abnormal performance with more significant changes in the activities of the language sector

"define seven words", "say two compound words", "understand four prepositions" and "account five blocks", "knows three adjectives". In the fine-adaptive motor sector, the activities "draw people with six parts", "copy disassembled square", "copy +" and in the gross motor sector "swing your foot for six seconds", "swing your foot for five seconds", "swing the foot for four seconds", "rocks the foot for three seconds", were the most important developmental changes. In the control group, the performance of suspected delay or possible abnormality was more concentrated in the gross motor sector. Conclusions: children from 5 to 6 years of age, born prematurely to mothers with malaria during pregnancy, 80% had suspected abnormal performance, a result much higher than the group of children born prematurely to mothers without malaria. These results strongly suggest that malaria disease during pregnancy alters fetal development, producing developmental sequelae that can be detected even at 5 to 6 years of age. In addition, the results support the use of the Denver test-II as a simple screening method for the assessment of delays in child development, covering broad motor coordination (coarse), fine motor coordination (adaptive), language and personal-social adaptation. This test has been used to identify children who are at risk of developing problems and to monitor the child longitudinally.

Keywords: Developmental changes; Prematurity; Denver test-II; Malaria; Gestation.

I. INTRODUCTION

According to the malaria therapeutic manual of the Ministry of Health of Brazil, in the Brazilian Amazon, infectious diseases, such as malaria, lead to serious complications for the mother-child binomial [1]. Brazil is responsible for one third of the reported cases of malaria. About 40% of the population in more than 90 countries live with the risk of contagious malaria. The occurrence of malaria during pregnancy is common in endemic areas, in the states of Rondônia, Pará, Mato Grosso, Acre and Amazonas, and is an important cause of maternal and fetal morbidity and mortality [2; 3], a fact confirmed by Amado Neto, Henriques [4].

Immune depression of the humoral component in pregnancy associated with other factors (iron deficiency anemia, deficiency of prenatal services, etc.) is related to the increase in clinical manifestations and severity of the disease, as well as the effects on the fetus [5; 6]. As described in the high-risk pregnancy technical manual of the Ministry of Health of Brazil [7], malaria in pregnancy can lead to abortion, prematurity, low weight, megaloblastic anemia, perinatal and maternal mortality. Complications are more important in primigravidae, cases with exacerbated clinical symptoms and elevated parasitemia, especially malaria caused by *Plasmodíum falciparum*, as described in the high-risk pregnancy technical manual of the Ministry of Health of Brazil.

Duffy, Fried [8] in their work "Malaria in pregnancy" consider that the risk of developing severe or complicated malaria is three times higher among pregnant women, especially if they are primigravidae and / or those coming from areas with hyperendemic or unstable transmission. For the Brazilian Ministry of Health's Malaria Epidemiological Surveillance Information System [9], indigenous women from holoememic areas acquire a considerable degree of partial immunity against malaria. At the beginning of pregnancy, however, their immunity level is reduced, the effect being more pronounced in primiparous than in multiparous women. Severe forms of the disease are more frequent in individuals not exposed to

infection or coming from areas that are not infected, in addition to being associated with the virulence of the parasite strain.

Simões study [5] found the highest incidence of pregnant women who became infected with *Plamodium vivax* in the first trimester of pregnancy. Espinosa [10] in studying patients from the Institute of Tropical Medicine of Amazonas with malaria during pregnancy and Singh, Mehra, Srivastava [11] in a survey "Malaria during pregnancy and infancy, in an area of intense malaria transmission in central India", found results similar to that of Simões carried out in Rondônia [5]. Moorman, Sullivan, Rochford et al [12] in "Retraso del intrauterino crecimiento as a result of malaria" confirm that in places of high endemicity, infection in advanced stage of pregnancy is associated with intrauterine growth restriction and low weight to born.

In the study by Simões [5] it was observed that children born to mothers who contracted malaria during pregnancy, had complications during delivery, such as fetal distress, meconium aspiration, cerebral anoxia, obtained rates of 52.95%, 42.85%, 52.63% in the years 2001, 2002 and 2003, respectively. One must always consider the importance of associating factors such as postnatal complications, Apgar score below seven in the 5th minute, numbers of complications and / or neonatal complications, such as asphyxia, cyanosis, pallor, severe jaundice, seizures, infections, use of oxygen therapy, blood transfusion and the need for phototherapy, suction problems, which contribute to a deficit in the development of these preterm newborns [13]. In the study by Simões [5] and Simões, Tomaz [6], the children studied presented complications shortly after delivery, such as respiratory distress, infant respiratory distress syndrome, jaundice, anemia, pneumonia and changes in the DNPM.

The risks for delay in the DNPM are associated with several factors classified as biological, social and environmental. The sum of several risk factors increases the likelihood of impaired child development [14]. In order to detect changes in neuro-sensory-motor development early, several instruments have been used to assess development in the first year of life [15]. In this period, motor development presents an accelerated pace of changes that culminate in mobility functions, with the acquisition of crawling and independent walking, respectively at 9 and 12 months of age, as concluded by Mancini, Teixeira, Araújo et al [16] in study of the development of motor function at 8 and 12 months of age in children born preterm and at term.

Children living in developing countries are exposed to several risks, including that of having a high prevalence of diseases that interfere with neuropsychomotor development (DNPM), that of being born from unfavorable and / or incomplete pregnancies and that of living in conditions adverse socioeconomic conditions. Pilz, Schermann [17] in their study of biological and environmental determinants of neuropsychomotor development in a sample of children from Canoas in Rio Grande do Sul, state that such a chain of negative events makes these children more likely to have delays in their potential growth and development.

In the study of prematurity, risk and developmental protection mechanism, Linhares [18] demonstrates that in the broad set of risk factors in childhood, the birth of preterm newborns (gestational age below 37 weeks) influencing development has been highlighted and child learning. The impact of biological, psychosocial (individual and family) and environmental factors on child development has been

the subject of numerous studies in recent decades, such as the study on risk factors for suspected delayed neuropsychomotor development by Halpern et al [19].

It is the biological or environmental conditions that increase the likelihood of deficits in the child's neuropsychomotor development. Miranda, Reseque, Figueiras [20] when studying children and adolescents with developmental problems in the pediatric outpatient clinic, claim that among the biological risk factors (prenatal, perinatal, postnatal) malaria was detected during pregnancy, complicating with prematurity, low birth weight.

Simões [5] observed in his study the prevalence of delayed learning development, delayed motor development and delayed neuropsychomotor development. In a broader study on risk factors for developmental changes, Simões [5] observed a higher incidence of premature children associated with chronic childhood encephalopathy, children with delayed motor development, delayed neuropsychomotor development, delayed learning development, myelomeningocele and Down syndrome. Meanwhile, authors such as Gristão, Martins [21] considering the adverse conditions in the lives of children with developmental delay, separate the so-called established risks from biological ones, referring to defined medical disorders, such as innate metabolism errors, congenital malformations, Down's Syndrome and other genetic syndromes.

For Simões [5] and Simões, Tomaz [6] knowledge of morbidity and mortality is essential to guide important decisions related to perinatal care, parental counseling and the forecast of the need for health services. The precise obstetric estimate of gestational age (based on the date of the last menstrual period and early clinical, laboratory and ultrasound examination of the pregnant woman) seems to be better than birth weight to assess the evolution of preterm infants. On this topic, Goulart [22] in his work assisting preterm newborns comes to the conclusion that it is still difficult to obtain accurate information about gestational age, and most survival statistics are related to birth weight.

Several studies show that the survival of extremely low birth weight preterm infants (BPH) is a reality that needs to be improved. Msall, Tremont [23] published a study showing results with groups of very low birth weight newborns (RNMBP), from 1,001 to 1,500 g, who had a survival rate of 93%, newborns weighing between 751 and 1. 000 g with 85%, and among NBs from 501 to 750 g, 50% survived. These authors make a warning. Surviving RNMBP have cerebral palsy (CP) in about 5 to 15% of cases, and 25 to 50% exhibit minor motor impairments; they may also have cognitive, behavioral deficits and disorders at school.

Inder, Volpe [24] observed long-term attention deficits, hyperactivity and psychiatric disorders in adolescence in 25 to 30% of patients. Other researchers presented the results of their work, such as Halpern et al [19]; Carter [25]; Wedge [26]; Spallici, Chiea, Zugaib et al [27]. These same authors demonstrated the significance of birth weight in motor development. Silva, Ceu, Silva [28] conducted a study using a sensorimotor stimulation protocol applied to premature infants with delayed DNPM.

The aim of this study was to evaluate possible changes in the neuropsychomotor development of children aged 5 to 6 years, born prematurely to mothers with malaria during gestation, in Porto Velho, Rondônia, Brazilian Amazon and to compare them to a control group of children premature infants born to mothers who did not have malaria during pregnancy using the Denver Test-II as a screening instrument.

II. METHODS

This is an epidemiological cross-sectional analytical study of 20 children aged 5 to 6 years old, born from premature births, mothers who had malaria during pregnancy, users of the Brazilian Unified Health System - SUS, followed up in a Polyclinic, Service of State Reference for Medical Specialties, in Porto Velho - Rondônia, Brazilian Amazon and in 20 children born prematurely to a mother without malaria.

Sample Features

Of the total of 62 children born prematurely to mothers who had malaria during the gestational period over a period of approximately 3 years, the sample consisted of 20 children aged 5 to 6 years. The Denver II test was applied to these children in the sample. The same test was applied to a control group of 20 (twenty) children, born prematurely to mothers who did not have malaria during pregnancy, called according to Vieira [29] as a convenience sample.

Inclusion, Exclusion Criteria and Ethical Aspects

Inclusion criteria were children born of premature births to mothers with malaria during pregnancy and who were 5 to 6 years old at the time of application of the Denver II Test and a control group of premature children whose mothers did not have malaria during pregnancy and that they were 5 to 6 years old and that the mothers accepted to participate in the research. There is no exclusion because all mothers, after signing the Free and Informed Consent Form, agreed to participate in the research. The study is based on what advocates resolution 196/96 of the National Health Council of Brazil, which establishes rules for conducting research involving human beings, pointing out the four basic references of bioethics: autonomy, non-maleficence, beneficence and justice, which aims to guarantee the rights and duties, with respect to the scientific community, to the subjects of research and study. The execution of the research was authorized by the Directorate General of HBAP; the research project was approved by the Ethics and Research Committee and a free and informed consent form was requested from the mothers to participate in the research.

Data Collection and Procedures

The Denver II Test was applied to premature children aged 5 to 6 years old, born to mothers with malaria during pregnancy and to a control group of premature children whose mothers did not present malaria during pregnancy, who are being followed up at POC. When applying the Denver II Test in children, the post-conception age was considered and not the corrected age, as it is a more sensitive indicator of abnormality, since in premature infants there is a difference in the results if the corrected or chronological age is used according to authors Silva, Ceu, Silva [28].

The screening test that was applied was that of Denver II, translated into Portuguese, which is used in children from fifteen days of age to six years of age, which aims at the early detection of any possible deviation in the DNPM and being used to monitor the development of all children, whether at risk or not. The test consists of 125 items, which are divided into four groups: a) Personal-social: aspects of the child's socialization inside and outside the family environment; b) Adaptive motor: eye-hand coordination,

manipulation of small objects; c) Language: sound production, ability to recognize, understand and use language and d) Gross motor: body motor control, sitting, walking, jumping and all other movements performed by the broad musculature.

The 26/125 items referring to the assessment of children aged 5 to 6.1 years were used, five from the personal-social domain / sector, seven from the fine-adaptive motor domain / sector, eight from the language domain / sector and six of the gross motor domain / sector:

• Domain / personal-social sector: “put on a t-shirt”, “wear without help”, “play cards”, “brush my teeth without help”, “prepare food”.

• Domain / Thin motor sector - adaptive “copy circles”, “draw people with 3 parts”, “copy cross”, “take longer line”, “copy square with help”, “draw person with six parts”, “copy square without help”.

• Domain / Language sector: “understandable speech”, “understands four prepositions”, “names four colors”, “defines five words”, “knows three adjectives”, “counts five blocks”, “says two compound words”, “defines seven words".

• Domain / Large motor sector: “jumps with one leg”, “rocks your foot for three seconds”, “rocks your foot for four seconds”, “rocks your foot for five seconds”, “toe-toe”, “swing your foot for six seconds”.

Children were assessed individually in groups of five children, depending on the result of the first assessment, the children who obtained a result as "questionable" or "abnormal", was / were reassessed one by two weeks after.

In the application of the Denver II Test, a line was designated as the age line that intercepted all the tests that should be performed by the child. Age was calculated using the difference between the date of the exam and the date of birth. Decimal age in years was used.

Each item or test was represented by a rectangle whose left limit corresponded to the 25th percentile (p25), that is, the age at which 25% of children in Denver, Colorado, United States, took that test and the right, the p90, that is, the age at which 90% of children were successful in that test. The Denver II: a major revision and restandardization of the Denver developmental screening test, authored by Frankenburg, Dodds, Archer, et al [30] was the benchmark where p90 was the cutoff point used in the Denver II Test for define: (1) delay - when the child failed an item or test, which was completely to the left of the age line, that is, in addition to the p90; (2) caution or attention - when the child failed a test that was intercepted by the age line between p75 and p90 (inclusive); (3) passes - when the child successfully performed the test.

The performance classification was made according to the number of failures (delay and caution) and this was considered as: (1) abnormal - when the evaluated child had two or more delays regardless of the area or sector; (2) questionable - when the evaluated child presented only one delay or two or more cautions; (3) normal - when the evaluated child had no delay and at most caution. The results obtained: normal, caution or delay were grouped into normal (normal) and delay (caution and / or delay), according to Frankenburg, Dodds, Archer et al [31].

Data analysis

The collected data were compiled into spreadsheets using the CALC Program of the Br Office, to proceed with the descriptive analysis of the data, presenting them in the form of tables. For statistical analysis, the Statistical Package for the Social Sciences (SPSS) 13.0 for Windows (SPSS Inc., Chicago,

United States) programs was used. The statistical methodology adopted was: tabular presentation standards - IBGE, graphical representation, trend measures central and dispersion, non-parametric statistics (chi-square test).

III. RESULTS

The Denver II Test was applied to 40 premature children aged 5 to 6 years, born in 2013/2014 year at HBAP and assisted by POC, with 20 (twenty) premature children of mothers with malaria during pregnancy, where the vast majority obtained abnormal performance, that is, 80% of the children presented abnormal performance and 20% performed with caution. In the control group of 20 (twenty) premature children born to mothers who did not have malaria during pregnancy, the majority had an abnormal performance in 45%. In the control group, 45% of the children showed abnormal performance and 45% were cautious. (Table 1).

Table 1 - Distribution of the performance evaluation of premature children born to mothers with malaria during pregnancy and to mothers without malaria during pregnancy, using the Denver II Test, according to gender, who were born in the years 2013/2014 at HBAP, in Porto Velho - RO.

	Premature children born to mothers with malaria during pregnancy				Premature children born to mothers without malaria during pregnancy			
	Female		Male		Female		Male	
Teste de Denver II	N	%	N	%	N	%	N	%
Abnormal	8	40.00	8	40.00	4	20.00	5	25.00
Normal					2	10.00		
Caution	2	10.00	2	10.00	4	20.00	5	25.00
	0.25*				0.25*			

*P-Value of the non-parametric Chi-square test.

Source: POC. Search result.

The performance of premature children born to mothers with malaria during pregnancy showed statistically significant differences in the four domains evaluated. In the Personal-Social Domain / Sector in the item "prepares food" 10 (50%) children obtained results of caution and 10 (50%) of delay, in the item "brush your teeth without help" 15 (75%) were cautious and 5 (25%) children were late, in the item “playing cards” 5 (25%) children were cautious and 15 (75%) children were late, in the item “clothes without help” 12 (60%) were cautious and 8 (40%) were late and in the item “put on a shirt” 12 (60%) were cautious and 8 (40.00%) were late. (Table 2).

In the performance of the Adaptive Fine Motor Domain / Sector, the following findings were found: item “square copy” 9 (45%) children were normal, 2 (10%) cautious and 9 (45%) delayed, in the item “draws people with six parts ”5 (25%) children showed normal and 12 (60%) delayed, in the item“ copied square disassembled ”5 (25%) children showed normal and 12 (60%) delayed, in the item“ take a longer line ”13 (65%) children showed normal and 6 (30%) delayed, in the item“ copy + ”9 (45%) children showed normal and 11 (55%) showed delay, in the item“ draws people with three parts ”9 (45%) children showed normal and 9 (45%) showed delay, in the item “copy circle” 11 (55%) children showed normal and 9 (45%) delayed. (Table 2).

The performance of premature children born to mothers with malaria during pregnancy in the Domain / Language Sector presented in the item “define seven words” 9 (45%) children were cautious and 10 (50%) children were delayed, in the item “says 2 compound words ”8 (40%) children were cautious and 10 (50%) were late, in the item“ count five blocks ”10 (50%) children were cautious and 10 (50%) were late, the item“ knows three adjectives ”9 (45%) children were cautious and 11 (55%) were late, in the item “define five words” 7 (35%) children were cautious and 9 (45%) children were late, in the item “names four colors” 9 (45%) children were cautious and 9 (45%) children were late, in the item “understands four prepositions” 10 (50%) children were cautious and 10 (50%) were late, in the item “everything talks understandable” 10 (50 %) children were cautious and 7 (35%) delayed. (Table 2).

In the Gross Motor Domain / Sector the following results were found. In the item “rocks the foot for six seconds” 15 (75%) children were delayed, in the item “rocked the foot for five seconds” 14 (70%) children were delayed, the same value was found in the item “rocks the foot by four seconds ”, in the item“ rocks the foot for three seconds ”5 (25%) children presented normal and 10 (50%) delayed, in the item“ toe-toe walking ”9 (45%) children presented normal and 9 (45 %) delay and in the item “jump with one foot” 7 (35%) children were normal and 9 (45%) delayed. (Table 2).

Table 2 - Performance of premature children born to mothers with malaria during pregnancy in the four sectors of the Denver II Test, which were born in 2013/2014 at HBAP, in Porto Velho - RO.

	NORMAL		CAUTION		DELAY	
Personal-Social	N	%	N	%	N	%
Prepares food	0	0.00	10	50.00	10	50.00
Brush teeth without help	0	0.00	15	75.00	5	25.00
Play Cards	0	0.00	5	25.00	15	75.00
Vest without help	0	0,00	12	60.00	8	40.00
Put on a shirt	0	0.00	12	60.00	8	40.00
Fine Motor - Adaptive Copy						
Copy " Square "	9	45.00	2	10.00	9	45.00
Draw people with 6 parts	5	25.00	3	15.00	12	60.00
Copy disassembled Square	5	25.00	3	15.00	12	60.00

Take a longer line	13	65.00	1	5.00	6	30.00
Copy +	9	45.00	0	0.00	11	55.00
Draw people with 3 parts	9	45.00	2	10.00	9	45.00
Copy Circle	11	55.00	0	0.00	9	45.00
Language						
Defines 7 words	1	5.00	9	45.00	10	50,00
Says 2 compound words	2	10.00	8	40.00	10	50.00
Account 5 blocks	0	0,00	10	50.00	10	50.00
Knows 3 adjectives	0	0,00	9	45.00	11	55.00
Defines 5 words	4	20.00	7	35.00	9	45.00
Name 4 colors	2	10.00	9	45.00	9	45.00
Understands 4 prepositions	0	0,00	10	50.00	10	50.00
Speak everything understandable	3	15.00	10	50.00	7	35.00
Thick Motor						
Balance the foot for 6s	2	10.00	3	15.00	15	75.00
Toe-toe walking	9	45.00	2	10.00	9	45.00
Balance the foot for 5s	2	10.00	4	20.00	14	70.00
Balance the foot for 4s	3	15.00	3	15.00	14	70.00
Balance the foot for 3s	5	25.00	5	25.00	10	50.00
Skip with 1 foot	7	35.00	4	20.00	9	45.00

Source: POC / 2013-2014. Search result.

The performance of premature children born to mothers without malaria during pregnancy showed the following domains or sectors evaluated: in the Personal-Social Domain in the item "prepare food" 50% with caution and 50% with delay, in the item "brush your teeth without help" 12 (60%) were cautious and 3 (25%) children were late, in the item “playing cards” 11 (55%) children were late, in the item “clothes without help” 13 (65%) children were cautious and 4 (20 %) delay, in the item “put on a shirt” 14 (70%) children were cautious. (Table 3).

In the Fine-Adaptive Motor Domain item “copy square without help” 10 (50%) children were cautious and 9 (45%) children were late, in the item “draw people with 6 parts” 10 (50%) children were cautious and 9 (45%) were late, the same values were found in the item “draw people with six parts”, in the item “copy square with help” 10 (50%) children were normal, 5 (25%) cautious and 5 (25%) children were late, in the item “take a longer line” 10 (50%) children were cautious and 7 (35%) normal, in the item “copy +” 10 (50%) children were normal and 5 (25%) cautious , in the item “draws people with 3 parts” 8 (40%) showed normal, 6 (30%) caution and 6 (30%) delayed, in the item “copia cirulo” 10 (50%) children showed normal and 5 (25 %) presented caution and delay respectively. (Table 3).

In the Language Domain item “define 7 words” 8 (40%) children have normal and 10 (50%) were cautious, in the item “says 2 compound words” 13 (65%) were cautious, in the item “count 5 blocks” 15 (75%) children presented normal, in the item "knows 3 adjectives" 11 (55%) children presented normal and 7 (35%) caution, in the item "define 5 words" 15 (75%) children presented normal, the same values evaluated in the item “names 4 colors”, in the items “understands 4 prepositions” and “speaks everything understandable” 8 (40%) children were normal and 11 (55%) were cautious.

In the Motor Gross Domain, the results presented were as follows: item “rocks the foot for 6 seconds” 13 (65%) children were delayed and 5 (25%) caution, in the item “rocks the foot for 5 seconds” 10 (50%) children were late and 6 (30%) cautious, in the item “swing your foot for 4 seconds” 9 (45%) children were late and 6 (30%) cautious, in the item “swing your foot for 3 seconds” 8 (40%) were late and 6 (30%) cautious, in the item “toe-heel walking” 11 (55%) children were late and 5 (25%) cautious, in the item “jumps with one leg” 16 (80%) children were late.

Table 3 - Performance of premature children born to mothers without malaria during pregnancy in the four sectors of the Denver II Test, who were born in the years 2013/2014 at HBAP, in Porto Velho - RO

	NORMAL		CAUTION		DELAY	
Personal-Social	N	%	N	%	N	%
Prepares food	0	0.00	10	50.00	10	50.00
Brush the teeth without help	3	15.00	12	60.00	5	25.00
Play Cards	5	25.00	4	20.00	11	55.00
Vest without help	3	15.00	13	65.00	4	20.00
Put on a t-shirt	3	15.00	14	70.00	3	15.00
Motor Fino – Adaptativo						
Copy "Square" without help	1	5.00	10	50.00	9	45.00
Draw people with 6 parts	1	5.00	10	50.00	9	45.00
Copy "Square" with help	10	50.00	5	25.00	5	25.00
Take a longer line	7	35.00	10	50.00	3	15.00
Copy +	10	50.00	5	25.00	5	25.00
Draw people with 3 parts	8	40.00	6	30.00	6	30.00
Copy "Circle"	10	50.00	5	25.00	5	25.00
Language						
Defines 7 words	8	40.00	10	50.00	2	10.00
Says 2 compound words	5	25.00	13	65.00	2	10.00
Account 5 blocks	15	75.00	3	15.00	2	10.00
Meet 3 adjectives	11	55.00	7	35.00	2	10.00
Defines 5 words	15	75.00	3	15.00	2	10.00
Name 4 colors	15	75.00	3	15.00	2	10.00

Understands 4 prepositions	8	40.00	11	55.00	1	5.00
Speak everything understandable	8	40.00	11	55.00	1	5.00
Thick Motor						
Balance the foot for 6s	2	10.00	5	25.00	13	65.00
Toe-toe walking	4	20.00	5	25.00	11	55.00
Balance the foot for 5s	4	20.00	5	25.00	10	50.00
Balance the foot for 4s	5	25.00	6	30.00	9	45.00
Balance the foot for3s	6	35.00	6	35.00	8	40.00
Jump with one leg only	3	15.00	1	5.00	16	80.00

Source: POC / 2013-2014. Search result.

IV. DISCUSSION

4.1 Application of the Denver II Test to Premature Mothers with Malaria in Pregnancy

The Denver II test according to Pena [32] is the most suitable instrument to perform an early assessment of neuropsychomotor development in low birth weight preterm newborns. This same author argues that the Denver II Test is more for the purpose of screening and not to diagnose developmental abnormalities and that it can be applied to children from 15 days to 6 years of age. For Caon, Ries [33] the Denver II Test should be used to identify children who are at risk of developing problems and to monitor the child longitudinally. They confirmed their understanding with the study of screening motor development in the first two of life.

In our study, we did not seek to assess children as to gender. In other studies such as the "Development of children attended at the pediatric hospital of the federal university of Rio Grande do Norte in the first year of life through the Denver II", Cunha [26] and Rezende, Costa, Pontes [34] where no relationship was found between genders. However, other studies have shown different results such as the "Turkish children's performance on Denver II: effect of sex and mother's education" by Durmazlar, Ozturk, Ural, et al [35].

Premature children born to mothers with malaria showed suspicion of delay or abnormality in 50% of children and 50% were cautious in the personal-social domain / sector in the item "prepares food" in agreement with other studies such as (93). In "brush your teeth without help" 75% of the children were cautious and 25% late, the item "playing cards" is quite significant with 75% of the children with delay or abnormality, "wear without help" 60% were cautious and 40% delay, and in the item "put a shirt on" 60% were cautious and 40% late. These findings are in agreement with Souza et al [36] who reports that the activity "prepares food" is important to stimulate and develop skills to meet basic needs such as eating and drinking, in addition to learning the use of utensils such as glass, spoon, plate , providing the incorporation

of healthy practices of body hygiene, food, and mainly stimulating motor coordination. Simões [5] in a research at the same health unit found a delay in 42.11% of children in the activity "prepares food", 15.79 in the activity "brush your teeth without help", 68.42 in the activity "play cards". Similar results to those found in the current research.

The performance of premature children born to mothers with malaria during pregnancy in the Language Domain / Sector showed a 50% delay in the items "define seven words", "says 2 compound words", "counts five blocks" and "understands four prepositions". In the item "knows three adjectives" 55% of the children were late, in the items "define five words" and "name four colors", 45% of the children were late. These results differ from those found by Simões [5]. In Simões' survey, 36.84% of delay was found in “define 7 words”, “count 5 blocks”, “know 3 adjectives”, “define 5 words” and “understand 4 prepositions”, 42.11% delay in “Says 2 compound words” and “names 4 colors”. In the item “says everything understandable”, 47.37% of children with delay or abnormality were found.

In the performance of the Adaptive Fine Motor Domain / Sector, 45% of children in the item “square copy” were late and 60% were late in the items “draws people with six parts” and “copied square disassembled” In the item “copy +” 55% of children were late. Simões [5] also found inferior results in the activities “copy square” and “copy square disassembled” with 31.58% of children showing delay.

The children showed significant delay in the item "shakes their feet for six seconds" with 75% of children with abnormality or delay, 70% in the item "shakes their feet for five seconds", 70% in the item "shakes their feet for four seconds" and a 50% delay in the item “balance your foot for three seconds”. In the gross motor domain, Simões's work [5] also diverges mainly in the activities of "swing your foot for six seconds", "swing your foot for four seconds" and "swing your foot for three seconds".

In personal-social and language skills, as in other areas of development, children depend on the opportunities offered by the environment to fully develop their genetic heritage. Shore [37], when studying the new views on brain development, states that the development of personal-social skills is a product of its interaction with the environment, constituting the so-called interactionism. When evaluating language and personal-social skills through the Denver II Test in early childhood education institutions, Rezende, Beteli, Santos [38] concluded that in the personal-social area, the achievement of the child's independence is valued in order to carry out daily tasks and important, for example, how to wash your hands, eat and brush your teeth.

In the current study, it was found that the area of language was severely impaired, with a higher occurrence of “delays” and “cautions”, similar to other studies. The studies by Rezende, Costa, Pontes “Screening for neuropsychomotor development in early childhood education institutions according to the Denver II Test [34] and “Evaluation of the performance of a group of children assisted in daycare centers using the Denver II Screening Test” designed by de Souza, Siqueira [39] corroborate our findings.

The study “Motor skills of children from 0 to 3 years old who attend daycare centers, according to the Denver II Developmental Screening Test by the authors Rezende et al [40] and“ Prevalence of idiopathic speech and language disorders in children of one to eleven years of age ”by Andrade [41], both devolved with children in daycare centers also highlight the persistence of deficiencies in the area of language and in the personal-social domain, which are accentuated from the age of three deity. This

situation is justified according to these same authors, due to the neurophysiological immaturity for the acquisition and mastery of language and the social stimuli, essential for linguistic patterns to develop.

Moraes et al [42] clarify that as a child is very dependent on others for the development of this skill, it would be important to advise parents on the need to monitor their child's activities and use strategies that encourage their verbalization, how to speak slowly and articulate, sing songs, read children's stories, among others. For Biscegli et al [43] in the persistence of "risk" tests, the possibility of referring the child to specialized professionals (speech therapist, psychologist, otorhinolaryngologist, among others) should be evaluated. Moraes et al [42] corroborate advising that it should be referred to health professionals from different specializations in order to identify other factors related to this insufficient performance, such as, for example, hearing deficits or emotional problems.

4.2 Application of the Denver II Test to Premature Mothers without Malaria in Pregnancy

The performance of premature children born to mothers without malaria during pregnancy in the personal-social domain showed in the activity "prepares food" 50% of children with delay, "brush their teeth without help" 60% with caution, "play cards" 55% delay , "Wears without help" 65% children were cautious and "put on a shirt" 70% cautious. Regarding the personal-social domain or sector, Simões [5] and Simões, Tomaz [6] found similar results. In the activity "preparing food" 42.11% were late and 57.89% cautious, in the activities "brushing your teeth without help" 73.68% of the children were cautious, "playing cards" 57.89% late, "dressing without help "73.68% caution and," put on a shirt "73.68% caution.

In the activity "copy square without help" 50% of the children were cautious and 45% delayed, "draws people with 6 parts" 50% cautious and 45% delayed, "draws people with six parts", 50% cautious and 45% delayed, "Take a longer line" 50% caution. Similar values were found by Simões [5], Simões, Tomaz [6] where in the activity "copy square without help" 57.89% were cautious and 42.11 delayed, "draws people with 6 parts" 52.63% cautious and 47.37% delay, "take a longer line" 57.89% were cautious. In the activity "define 7 words" 50% of the children evaluated were cautious, "says 2 compound words" 65% cautious, "understands 4 prepositions" and "says everything understandable" 55% were cautious. Simões [5] found results in agreement: in the activity "define 7 words" 57.89% of the children evaluated were cautious, "says 2 compound words" 63.16% cautious, "understands 4 prepositions" and "speaks everything understandable" 57,89% caution.

In the "swing your foot for 6 seconds" activity 65% of the children evaluated were delayed, "swing their foot for 5 seconds" 50% were delayed, "toe-toe walking" 55% were delayed and "jumped with one leg" 80 % delay or abnormality. These results are not in agreement with those found with Simões [5].

Several studies on assessing the development of premature children using the Denver II Test, however, according to Halpern, Barros, Horta [44], the Denver Test is a screening test, where the developmental delay found must be confirmed through tests specific tests performed through systematic follow-up, especially in premature children who are more susceptible to greater changes.

The most important references on the Denver II Test are exactly the works Denver II Technical Manual, by Frankenburg, Dodds, Archer [45], DENVER II: training manual by Frankenburg, Dodds,

Archer et al [31] and The Denver II: a major revision and restandardization of the Denver developmental screening test, by Frankenburg, Dodds, Archer et al [30].

The Denver II Test should be used to identify children who are vulnerable to delayed neuropsychomotor development and to monitor it longitudinally. The Denver II test was used in important studies, such as Brêtas, Silva, Silva [46]; Beteli [47]; Bateli [48]; Moraes et al (42); Magalhães et al [49].

With regard to the personal-social domain / sector, Halpern, Barros, Horta [44] question the neuropsychomotor development from the differentials according to birth weight. Caon, Ries [33] found different development in children in the first two years of life. Drachler [50] measuring child development in epidemiological studies identified the underlying difficulties of the children studied, while Barros [51] points out that activities in this sector are risk factors for delayed neuropsychomotor development.

As for language development, Lordelo [52] reports that, as a cognitive and communicative function, language presents its stimulated aspects in social relationships and the way the child interacts with his environment and the quality of the information he receives are important factors for this domain. This study corroborates the publication "Infection an preterm birth: epidemiological and biochemical linkage" [53]; "Language and social skills of children aged 0 to 3 years cared for in daycare centers" [54]; "Language acquisition: considerations from the perspective of social interaction" [55].

Manoel [56] in relation to the fine-adaptive motor sector, reports that the development of the motor depends on a set of factors that involve the task, the environment and the organism. It also states that some stimuli can facilitate the acquisition of these skills (fine motor), however the biological factors (prematurity) can, with greater influence, limit their development. Souza, Gomes, Cambraia et al [57] found suspicion of delay in the area of motor skills, in the motor-fine domain in children, where some revealed the occurrence of prematurity and other gestational complications (arterial hypertension, premature rupture of membranes and infection). Caon, Ries [33] found children who had a suspicion of delay in the area of fine motor skills, however, some also with questionable development in gross motor skills.

The research "Early Delay in Motor Development" by Benner [58] states that normal variations are more typical in the context of gross motor development and that it is less affected by environmental factors, being strongly conditioned by family characteristics, which corroborates the findings of this research. Studies by Rugolo [59], Murphy, Such-Neibar [60], Morton [61] report that around 30% of premature children develop with severe motor damage and are frequently diagnosed as brain paralyzed and that the rates neuromotor disorders can reach 50% in premature children of very low weight and extremely low weight.

By analogy, the study sought confirmation with important studies already carried out. Among them, the authors [56]; [62]; [63]; [64]; [65]; [66]; [67].

4.3 Main Differences Found

In Table 1 we present the main differences that we observed in the application of the Denver II Test in premature children born to mothers with malaria during pregnancy and in children whose mothers did not present malaria during pregnancy.

Table 1 - Main differences observed in the Denver II Test in premature children born to mothers with malaria during pregnancy and in premature children born to mothers without malaria during pregnancy.

Sector	Premature children of mothers with malaria during pregnancy	Premature children of mothers without malaria during pregnancy
Personal-social	↑↓ "prepares food" ↑ "brush your teeth without help" ↓ "play cards" ↑ "wear without help" ↑ "put on t-shirt"	↑↓ "prepares food" ↑ "brush your teeth without help" ↓ "play cards" ↑ "wear without help" ↑ "put on t-shirt"
Fine-adaptive engine	↓ "copy square without help" ↓ "draw people with 6 parts" ↓ "copy unmounted square" ↓ "copy +" ↓ "draws a person with 3 parts" ↓ "copy circle"	↑ "copy square without help" ↑ "draw people with 6 parts" ↑ "take a longer line"
Language	↓ "define 7 words" ↓ "says 2 compound words" ↑↓ "count five blocks" ↓ "knows 3 adjectives" ↓ "define 5 words" ↓↑ "name 4 colors" ↓↑ "understands 4 prepositions" ↑ "speak everything understandable"	↑ "define 7 words" ↑ "says 2 compound words" ↑ "knows 3 adjectives" ↑ "speak everything understandable"
Thick motor	↓ "swing the foot for 6s" ↓ "swing the foot for 5s" ↓ "swing the foot for 4s" ↓ "swing the foot for 3s"	↓ "swing the foot for 6s" ↓ "swing the foot for 5s" ↓"swing the foot for 4s" ↓ "swing the foot for 3s"

↓ “jump with one foot” ↓ “jump with one foot”

Note: Summary of items that have statistically significant differences. Where ↑ indicates a higher percentage of caution and ↓ a higher percentage of delay in the children in this study.

V. CONCLUSIONS

Malaria infection during pregnancy in Rondônia, the Brazilian Amazon, led to the occurrence of premature births with results superior to those seen in the Brazilian literature. Of the children aged 5 to 6 years old, born prematurely to mothers with malaria during pregnancy, 80% showed abnormal performance, a result much higher than the group of children born prematurely to mothers without malaria. In the control group, 45% of the children showed abnormal performance and 45% were cautious.

The Denver II Test contributed to the detection of developmental changes and probable delay or abnormality in the language sector, fine-adaptive motor and large motor. The most significant changes in the performance of the activities of the domain or language sector were "define seven words", "says 2 compound words", "understands four prepositions" and "counts five blocks" with 50% abnormality, "knows three adjectives" with 55% delay or abnormality. In the fine-adaptive motor sector, the activities evaluated that showed changes suspected of delay or abnormality greater than 50% were, “draws people with six parts”, “copied square disassembled”, “copied +”. In the gross motor sector, suspicions of developmental changes of more than 50% were found in the activities "swing your foot for six seconds", "swing your foot for five seconds", "swing your foot for four seconds", "swing your foot for three seconds”. In the control group, the performance of suspected delay or abnormality was more concentrated in the gross motor sector.

Early diagnosis of developmental changes in children born prematurely to mothers with malaria during pregnancy or children born prematurely to mothers who did not contract malaria during pregnancy is important for possible therapeutic interventions and stimulations, in order to alleviate or prevent complications, and thus be able to improve the quality of life of these children. The early identification of changes in development is a complex task for health professionals working in primary care [5]. It was demonstrated that early diagnosis allows early intervention, thus reducing the sequelae of these children. When screening for abnormality or delay and risk to the development of these children, it facilitates early intervention. Performing screening to detect abnormalities and risks for development facilitates therapeutic intervention.

The use of the Denver II Test is recommended as it is a simple method for the assessment of children aged one month to six years old, and aims to detect delays in child development, covering the following functions: extensive motor coordination (coarse), fine motor coordination (adaptive), language and personal-social adaptation. This test has been used to identify children who are at risk of developing problems and to monitor the child longitudinally. The evaluation of the four sectors of this Screening Test is justified because motor behavior is associated with the maturation of the nervous system, corresponding to the control of motor acquisitions. Language behavior encompasses the perceptions of sounds, images and their responses, while adaptive behavior comprises the child's reaction to objects and situations.

Personal-social conduct, on the other hand, corresponds to the assessment of behavior in the face of cultural stimuli.

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TEACHING HISTORY IN BRAZILIAN EDUCATIONAL LEGISLATION: A Brief Review, A Brief Introduction

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Abstract

In this article we intend to elaborate, in narrative-descriptive form, a brief reconstruction of the trajectory covered by the History of Brazilian education and, especially of History teaching, in the period between the colonial period until the 1990s, through documentary research as well as, and mainly, through bibliographic research from the works produced in the last decades by relevant authors on this theme.

Keywords: History teaching; History of Brazilian Education; History of History Teaching; history teaching research

1. Introduction

The History to is the field of knowledge that studies humankind in time and space and it is through it that we understand and we understand the acontecim ents and processes of the present and from the relationship of this with our past. History search explains r, interpret and present the actions of the s individual s and societies n contextualized reality in this s ism. Or as proposed by BURKE (2002, p.12), History can be defined "as the study of human societies in the plural, highlighting the differences between them and the changes that occurred in each one as time went by". Demand thus present in the individuals and social groups and m the relations between them, and the development and transformation of a historical period in their continuities and differences of others.

In turn, teaching History seeks to address, interpret and explain this relationship between individuals and societies at different times in the environment and under the focus of didactic-curricular practices and specificities, recreating History field of knowledge and academic research in School History, History to be taught / learned / learned in school education. School history is a selection, a temporal and historical cut of themes, characters, facts, processes and contexts, which integrate the human being in different periods, bringing to the school a set of knowledge and knowledge to be taught, reworked in the relationship with the students and appraisals , who create and recreate the specific field of knowledge in an incessant re-elaboration, seeking to expand and develop the historical awareness of students in relation to this disciplinary re-elaboration.

As proximidades e pontos de contato entre o estudo da História e do ensino de um determinado campo disciplinar escolar tem sido possível a partir dos trabalhos desenvolvidos em História da Educação e em especial sobre História do ensino de uma determinada discplina. Embora as pesquisas sobre História da Educação se situem mais próximas das Ciências da Educação e da Pedagogia, procedimentos, métodos e base conceitual oriundas da pesquisa historiográfica tem cada vez mais orientado os trabalhos de

investigação sobre a história das disciplinas escolares, permitindo a construção de um campo disciplinar que bebe nas fontes das Ciências Educacionais, bem como na História sobre os saberes e conhecimentos vivenciados na escola . Destarte, nos orienta Fonseca, a história do ensino vem, há muito,

> Constituindo-se como importante tema de estudos no campo da História da Educação, estando, muitas vezes, próxima da história do currículo e da história das disciplinas escolares. Os estudos nesses campos têm privilegiado os processos de elaboração de currículos, de construção de procedimentos metodológicos e da definição de políticas voltadas para o ensino de determinadas disciplinas nas escolas, desde os níveis elementares até os níveis superiores de escolarização (FONSECA, 2013, p. 3).

Thus, the history school in basic education, it is not essential to the formation of the c riança and adolescents, when the history teacher recognizes the importance of education d this disciplinary field pair to the reflection on the educational role of the teaching H istory in construction of historical consciousness of s individuals, enabling the establishment of social beings participatory s, critical and responsible in front of us rights and duties. The presence of history in Brazilian school curricula is affirmed by the need to build a more reflective, more humane and more supportive society, in the face of the diversity, social, ethnic, age, gender and regional diversity of our country, as well as in the mobilization and the action fighting the inequality, the s social and injustice to the prejudices of all kinds.

It is questioned about the importance of the National Education Guidelines and Bases Laws for the educational system during the History of Brazil, in particular Law No. 9394 of December 1996, and in which it is different from the previous ones. For this reason, it was asked what would have influenced the development of this most recent LDB and what has changed in education in relation to the other educational legislation of the previous periods of the Brazilian historical trajectory. Specifically dealing with the teaching of history in Brazilian educational legislation, in the periods ranging from colonization to the 1990s. Thus, this article aims to dialogue with different authors in order to answer the main question: What were the legislative changes in the teaching of History during the country's history and what has changed since LDB 9394/96?

Thus, the primary objective of this article is to address the teaching of history in educational legislation and educational policies, from colonial times to the 1990s . Seeking to understand what the teaching of this discipline was like in the past and how it has been transformed over time in our society, starting from what is foreseen in the educational legislation and in the educational policies in this long Brazilian period. Therefore, it was necessary to deepen our knowledge about educational historiography and Brazilian legislation, based on an approach proposed by documentary research and bibliographic research in reference authors on the History of Brazilian Education and, in particular, about the history of school history in our society.

The specific objectives of this project are to review the educational historiography and to review the changes in the educational system. Starting with the period of colonization with Jesuit education, passing through Brazil-Empire until the twentieth century, a period of great events in several sectors and scenario of the emergence of LDB's and, at the end of the millennium, the concept of Basic Education.

The second specific objective is to try to approach, in a narrative-descriptive way and with the brevity that an article like this presupposes, the trajectory traveled by the teaching of History in Brazil, when the colonial processes began until the last decade of the 20th century. Some of the most visible characteristics

of this disciplinary field according to each era and the degree of relevance that was given according to the historical context in which it was inserted, we hope to have addressed.

Thus, this work it is a literature search of some relevant texts and authors / authors related to the history of education and history of history teaching in particular, in our Wonderland. For this reason, the text that will be developed throughout the chapters is based on renowned authors in the field so that we can achieve the desired objectives.

In the following sections, we will work with such authors in order to better understand how the process of development of education took place. In order to better clarify the path taken to reach the present day. For this, the text developed will be divided into two parts, two chapters so to speak. In the first part, we will talk about the history of the legislation and structure of Brazilian education. Divided into three topics; we will deal with the educational system in the colonial period, Brazil-Empire and much of the 20th century.

Then we will approach the same periods, but covered in only two topics and under the theme of history teaching. Divided into "History Teaching Path: from the colony to the end of the 19th century" and "History Teaching in the 20th century".

2. THE HISTORY OF THE LEGISLATION AND STRUCTURE OF BRAZILIAN EDUCATION: FROM THE COLONY TO 1990

2.1 School education in the colonial period

With the creation of the General Government in 1548, the dynamics of colonization underwent some changes. However, nothing too grand, the hereditary captaincies would continue, since the creation of this new Regulation was intended to complement the colonial administration, not to replace the previous system.

In order to protect the American territory belonging to Portugal, the Portuguese government discards plans for colonization through occupation and opts for colonization through settlement. It is at this juncture that on March 29, 1549, he landed in what is now the state of Bahia, the first governor general of the then Portuguese colony. His name was Tomé de Sousa and he was appointed on January 7 of that same year. Its function was to "help the requests formulated and encourage agriculture", mainly that of sugar cane, according to Guilherme de Andrea Frota in his work about history of age's Colonialist brazilian.

Together with the youngest - and the first - governor of Brasil-Colônia, he also landed, under the positions of Chief Captain of the coast, Chief Ombudsman of the Treasury and General Ombudsman, respectively, Pero Góis, Antônio Cardoso de Barros and Pero Borges. Settlers, soldiers, degraded workers and workers, directed by Luís Dias, likewise, made up the cast of this new endeavor that would be the intensification of the population of Lusitanian America. Father Manoel da Nóbrega and six other Jesuits were also part of this milestone, the first of whom should lead.

"Among the basic guidelines contained in the Regiment, that is, in the new policy dictated by D. João III (17-12-1548), one is found referring to the Catholic faith through catechesis and instruction" (RIBEIRO, 1998, p. 18). According to Luiz A. de Mattos, this Regiment will be decisive in

this colonizing endeavor, since it is from the conversion of the indigenous people into the Christian beliefs and values of European society at the time that "Portuguese colonization could take definitive roots".

Thus, Maria Luisa Santos Ribeiro (1998. p. 18) realizes: "(...) For these few facts, that the school organization in Brazil-Colony is, as it could not fail to be, closely linked to the colonizing policy of the Portuguese ".

In other words, school education in the colonial period was limited to the orders and wishes of the Portuguese metropolis, which, interested in increasing its wealth and conditioned by the Christian values of the time, aimed to remove from the land all possible raw materials and precious metals at the same time. in which they tried to believe that they were doing the favor of "saving" the native peoples (true owners of the land) by introducing them to the Christian faith and civilizing them. "The first reaction of astonishment and fear was followed by the need and the will to dominate by faith, profit and political power." (WEHLING; WEHLING, 1994 P. 49).

José Carlos Reis also makes a brief comment about this ambitious and colonizing European of the 16th century. He highlights his vision of the European's thirst for discovering new worlds and how he uses the idea of "saving humanity" as a justification for the lack of sensitivity in disregarding the beliefs and culture of the conquered peoples and annihilating a good part of them. Reis (2006. p. 23) says the following:

> The conquest of the world did not necessarily mean the loss of the soul and the acceptance of the devil, but the collaboration of men in the restoration of divine creation. Europeans take up the imperialist logic of the Roman Christians and feel they are at the service of the salvation of humanity when they overcome and subdue non-European pagans from all over the world.

Before the creation of the General Government (1548), the clergy did not have as active participation in the colonization activities, as they will perform from that point on. At first, the priests who arrived here with the first expeditions, were much more willing to serve their own interests than those of the Church. Now, they were tasked not only with educating and catechizing the Indians, but also with the children of the Portuguese colonists. "The Jesuits started catechesis and the educational process with the school in Salvador" (FROTA, 2000. p. 61).

Prior to the arrival of the Portuguese, indigenous children did not have an education along the lines as they will be presented, in a systematic way and using didactic resources such as music, dance and theater, as Anna Cecília Sobral Bezerra (2000, p. 13) in his monograph (From A School 'To the Indian' To An Indigenous School: Ideas on Indigenous School Education in the History of Brazil).

> In addition to using singing, dancing and theater to educate the indigenous, the Jesuits organized the reductions, villages that brought together a great diversity of peoples with different cultures, it is worth emphasizing that for Loyola's children, the natives were generic, no they had cultural differences between them.

And according to Ribeiro (1998), completing this information, the execution of daily tasks in the tribe, was sufficient to enable the indigenous child to adulthood in that community, before the Jesuits' arrival in American lands.

When Tomé de Sousa arrives in Brasil-Colônia, he reinforces his defense against enemy actions, stimulates the recognition of the countryside and favors the work of catechesis and teaching that will be carried out, as already said, by the Jesuits. As time went by, villages formed by Christianized indigenous

people began to exist, with a population "ten or fifteen times greater than that of Portuguese cities or towns".

The education of the Portuguese colony will be divided into two groups: that for the children of the colonists (even these were limited in number) and that education for the indigenous people. This was organized in simple schools, with the objective of just reading and writing and catechizing them, in order to "civilize" them. While the schools that would be used to train the children of the colonists were, according to Bezerra (2000), divided into two styles: "the first one for training in classical sciences and the one for priestly training". Classical Sciences for those who wanted courses in Law, Medicine or Philosophy, and Priestly, as its name suggests, was intended to prepare new members of the religious institution.

Jesuit priests were also dedicated to learning the native language, so that they could be better understood at the time of Christian teachings.

> At school, in addition to teaching catechism, Portuguese was taught, so that as the missionary taught, he also learned the indigenous language, which facilitated the relationship with the surrounding population". (BEZERRA, 2000, p. 14)

These teachings were almost always directed at the indigenous child, who had a very important role in this mission and served as mediators of these new teachings for his parents. Another characteristic of this Jesuit period and which was fundamental in the consecration of this "disaggregation of indigenous culture" was precisely the conviviality and interaction of these indigenous children with white children. As Bezerra (2000) states, the Jesuits even went so far as to "import orphaned children" in order that these and native children could be educated mutually. "The missionaries, with all the goodwill their ideology allowed, did not intend to eradicate the indigenous, but to educate them to become a Christian." (BEZERRA, 2000, p. 14)

Jesuit education was based on the *Ratio Studiorum* and was part of colonial education until the middle of the 18th century, when its educational method came to be seen as outdated in relation to the intellectual development that occurred around the world. It is in light of these facts and on the charge of "being an obstacle to the conservation of Christian unity and civil society" that the Companhia de Jesus is expelled from the Portuguese Colony in 1759 by Sebastião José de Carvalho e Melo the Marquis of Pombal.

In those centuries when the company spent in Brazil, it enabled the Jesuits to achieve great economic growth and social importance for the order. Such enrichment of the company had not much pleased the Portuguese government, which aspired to be the sole holder of this power. All this, together with the time of reforms that occurred in Portugal in the period called the Pombaline phase, will result in the expulsion of the Companhia de Jesus from Portugal and, consequently, of its colonies in the year 1759. According to Frota (2000, p. 164), added to this all the accusation that religious of this order participated in the attack in 1758, against the king.

> Pombal's action was particularly intense against the Jesuits, who did not want to accept the theory of the divine right of the kings accused of participating in the attack against the king (9/3/1758) and of hindering the action of the merchants of the Treaty of Madrid , generating the Guaranitic War.

This phase begins after the declining economy in which Portugal found itself as a result of the fall in mining and also as a result of the Spanish domination over the Portuguese territory during the Iberian

Union that occurred from 1580 to 1640. In addition to the cultural backwardness they were in. In this way, all this conjuncture, allied with the criticisms of Portuguese intellectuals influenced by Enlightenment ideas that called for a modernization, the Marquis of Pombal, as Minister of State, puts such reforms into practice.

However, it was 13 years before this happened. From the moment that the Companhia de Jesus was expelled from Brazil until these reforms, the educational system went through many difficulties, the administrative teaching structure was undone and the symmetry of the pedagogical action, the transition from one series to another plus graduation ended up being replaced by "the diversification of isolated disciplines" according to Romanelli (2014).

2.2 School education during the empire (1808-1889)

As a result of the political scenario in which Europe found itself - the so-called Great Revolution - the Portuguese Royal Family, under the threat of having its territory invaded by Napoleão Bonaparte's troops, was forced to transfer its government to Brazil. View this prepared by the Marquis of Pombal. " (...) in case of safeguarding the Monarchy in danger, transfer it to Brazil" (FROTA, 2000, p. 180).

Thus, on January 22, 1808, D. João, the Royal family and part of the Portuguese Court arrived in Brazilian lands. With that, and on the advice of important figures of the time such as the Marquis of Aguiar (D. Fernando José de Portugal and Castro) and the governor of the captaincy of Bahia, D. João de Saldanha da Gama Melo e Torres, the prince regent, in short, agrees with the idea of opening ports to friendly nations, putting an end to the Colonial Pact. The disembarkation had been in the city of Salvador, but the royal caravan continued towards Rio de Janeiro - capital of the Colony at the time - and settled there. But not before creating the Medical-Surgical School on February 18, 1808, in the captaincy of Bahia.

Within this new reality that came to be the Portuguese government installed in Brazil, there is also the need for reorganization in the administration of the colony.

> (...) with the appointment of the heads of the ministries and the establishment, in Rio de Janeiro, then capital, of almost all the organs of public administration and justice, which also occurred in some of the captaincies. On the other hand, it provoked the development of urban life in Vila Rica, Salvador, Recife and mainly in Rio, which, at the time with about 45,000 inhabitants, receives more than 15,000 people. (RIBEIRO, 1998, p. 40)

In addition, changes about the intellectual field are also necessary. As a result, the Royal Press, the Public Library — created in 1810 and offered free to the public only in 1814 — was created in 1808 — the Botanical Garden in 1810 and the National Museum in 1818. In 1808, the first newspaper (A Gazeta do Rio), in 1812, the first magazine (The Variations or Essays of Literature), in 1813, the first magazine in Rio — O Patriota. (RIBEIRO, 1998, p. 40).

With regard to education in this period, it is important to highlight the creation of vocational courses and schools. Among them, courses in economics, agriculture, chemistry and technical drawing will appear in Bahia. The agriculture course had attached studies related to botany and botanical gardens, while the chemistry course covered industrial chemistry, geology and mineralogy. "Due to the revocation of the 1787 license, which closed all factories, in 1812 the school of locksmiths, lime officers and shotguns (MG) was created" (RIBEIRO, 1998, p. 41).

In order to train officers, civil and military engineers, the Royal Navy Academy and the Royal Military Academy will be created — which over time underwent changes and became the Central School (1858), then the Polytechnic School, and is currently known as the National School of Engineering.

In Rio de Janeiro, surgery and anatomy courses will be created in 1808, and in the following year, medicine. The goal will be to train surgeons for the Army and Navy. Still in Rio de Janeiro, with the purpose of training technicians in economics, agriculture and industry, chemistry laboratory courses (1812) and agriculture course (1814) will be created. " These courses represent the inauguration of higher education in Brazil." (RIBEIRO, 1998, p. 41).

Ribeiro (1998) points out that the word “course” is perhaps not the term that best defines what she will call “single classes” because they were just that; common classes held to empower the aristocratic elite with the intention of filling the bureaucratic and administrative positions of the government. In addition to meeting so many other needs that the headquarters of the Portuguese Crown needed to meet. The greatest concern of Brazil at that time was to professionalize those who could be useful in some way in administration, health, security or any other sector needed in a metropolis.

It must also be remembered that such reforms were not made at all in education. The primary school, for example, still had to just learn to read and write. And it didn't seem to matter much to the government. Only when they begin to see this school level as a means of reaching secondary school or an opportunity to get “small bureaucratic jobs” as Ribeiro explains, does the primary ultimately gain more importance.

With regard to secondary education, chairs of Latin grammar, higher mathematics were created in Pernambuco (1809), drawing and history in Vila Rica (1817), rhetoric and philosophy in Paracatu, Minas Gerais (1821) and two chairs in English and one French in Rio de Janeiro.

The Portuguese Court stayed here for a long time, but the Portuguese population was increasingly dissatisfied with the delay in the return of the king and all of the royal and court family. The Portuguese people at that point were impatient and in the midst of all that, the Constitutionalist Revolution started, which ended up resulting in the return of the king and his entire entourage (1821). Members of this revolution were in favor of the return of Brazil to its origins as an exploratory colony. This generates unrest, positions contrary to what in 1822 has the consequence of Brazil's independence.

The constitution of this new nation was granted only in 1824 and it was established that primary education would be free for all citizens.

> After the promulgation of this Constitution, the first Law of Primary Education, enacted on October 15, 1827, was passed, determining that schools of first letters should be created in all cities, towns and villages and schools for girls in the most populous cities and towns (GODINHO, p. 32).

The 1850s are seen as a time of great deeds when it comes to education in the Empire. It was in 1854 that the Inspector General of Primary and Secondary Education of the Municipality of Corte was created, with the purpose of supervising and guiding public and private education. According to Ribeiro (1998), the reasons that led to these achievements in the educational sphere are due to the “economic growth and the conciliation of the parties (1853)”. “Furthermore, it is pointed out as the result of the actions of men considered notable, such as Couto Ferraz, Itaboray, Euzébio de Queiroz, etc.” (RIBEIRO, 1998, p. 55) .

The ruling class, with privileges, and therefore even unconcerned with major changes in the educational system that could benefit the lower classes, stopped at superficial changes, with a greater interest for the higher level. However, even higher education courses did not have much depth, at least with regard to content. The purpose of these courses was only to professionalize.

> Institutions devoted to scientific research and methodical philosophical studies were lacking. These were developed, at the time, largely by those trained in legal courses under almost always French influence, in an eclectic line (RIBEIRO, 1998, p. 56).

The negative aspects found in primary and secondary schools and the consequences that this will have on students coming from this lagged education, were a consequence of the central government's decision to exempt itself from the obligation to care and inspect these levels, which were the responsibility of the provinces. In that period, what counted was Doctor's *Status*, and that is why secondary schools were seen more as a preparation for reaching higher education, than a system dedicated to preparing citizens.

2.3 School education in the 20th century (until 1996)

The 20th century was a century of great political, economic and cultural transformations, all of this, in a very short period of time. These changes occurred in several areas, including education. However, many of these transformations began in the previous century, with the end of the Monarchy and the beginning of a new form of government in 1889. The Brazilian Constitution of 1891, created after the establishment of the Republic in Brazil, instituted, among other things , the decentralization of education. Making the Union (federal power) in charge of creating universities and secondary education institutions in the States (former provinces), as well as having the duty to promote secondary education in the Federal District. Thus, the responsibility to create and control primary and professional education for the states remains. Romanelli (2014) highlights how unequal this division of responsibilities was and reflected essentially in the distance that occurred between the education of the ruling class - which always aimed at secondary and higher education - the education of the people.

While Godinho, he talks about the changes that took place in the 20th century and how much it is mostly made up of urban centers and how it affects the values of the time and modifies them.

> The twentieth century differs, notably, by being constituted of mostly urban societies, of complete economic, social, occupational structure, and mainly, by the speed of changes in values. (GODINHO, 2014, p 18)

Such an act resulted in a great disorganization in the elaboration and application of this educational system. This is because all this autonomy given to both delegations meant that not only one educational system, but several educational systems, existed in every country. Realizing all this disorganization in force in the country, the First Republic took the risk of reforming and solving problems in education. However, as Romanelli (2014) points out, such reforms have not been very successful. Starting with the reform proposal Benjamin Constant, which tried to replace the academic curriculum with an encyclopedic, which would include scientific disciplines, in addition to organizing the entire system, including primary, normal, secondary schools, among other proposals. However, his ideas were not put into practice, because, according to Romanelli (2014), there was no guarantee of an institutional infrastructure for the implementation and execution of the project, much less the “political support of elites” who saw the ideas

as a threat to the "values and standards of the old aristocratic-rural mentality" that the ruling class passed on to youth through the current educational system.

After the failure of the Benjamin Constant reform, others included the Rivadávia Corrêa Organic Law , which occurred under the government of Marechal Hermes da Fonseca. This was also unsuccessful.

> (...) they even led to a setback in the evolution of the system, by virtue of providing total freedom and autonomy to the establishments and suppressing the official character of teaching, which brought disastrous results. (ROMANELLI, 2014, p. 43 and 44)

The post-reform was Carlos Maximiliano, who reformed Colégio Pedro II, regulated admission to higher education and, in addition, was responsible for " reofficializing " education. In 1925, the Rocha Vaz Reformation emerged. Its main mission was to organize the country's unstructured education.

> All these reforms, however, were nothing more than unsuccessful attempts and, even when applied, they represented the isolated and disorderly thinking of political commands, which was far from being comparable to a national education policy. (ROMANILLI, 2014, p. 44)

The population's illiteracy rates were very high, at the same time that the importance of spreading primary education was beginning to be perceived. Politicians campaigned for this, recognizing these needs, with some not only wanting to combat illiteracy, but also to encourage the birth of a new feeling through civic education, the feeling of patriotism.

> With Brazilian society developing on an urban-commercial basis since the second half of the 19th century, illiteracy becomes a problem, as reading and writing techniques are becoming necessary instruments for integration in such a social contexto (RIBEIRO, 1998, p. 82).

Unfortunately, there was not enough money or a satisfactory solution to address this. Contrary to what was proposed, there was a significant increase in the number of illiterates at the time. There was no system of efficient records that could enlighten us about the expenses that the government could have had related to education. However, Ribeiro concludes that they were certainly insufficient to serve the entire Brazilian population. " In order to understand the basic characteristic of the school organization in this republican period, it is necessary to understand the characteristic, also basic, of Brazilian society." (RIBEIRO, 1998, p. 77).

As Ribeiro reports, this series of reforms that took place in the educational system during the twentieth century, shows that there was an alternation between classical humanistic, realistic or scientific influence in teaching in force at the time.

In the reform of Epitácio Pessoa, the biology, sociology and morals of the teachings were removed and logic included. The Rivadávia reform, on the other hand, had a positivist influence "trying to infuse a practical criterion into the study of disciplines, expanding the application of the principle of spiritual freedom by preaching freedom of teaching (de-officialization) and of frequency (...)". (RIBEIRO, 1998, p. 79 and 80).

During this period, the diploma was abolished and replaced by a "certificate of attendance", it was also transferred to the responsibility of exams for admission to upper secondary education to the universities themselves. The aim was to give a new meaning to the secondary school, which, as mentioned before, was seen only as a means of reaching higher education. The results, however, were

disastrous. Hence the reforms of 1915 (Carlos Maximiliano) and 1925 (Luís Alves/Rocha Vaz) (RIBEIRO, 1998).

The moment before the Revolution of 30 is, according to Ribeiro (1998), thanks to "the existence of new social forces", as a consequence of the changes in the economic condition of the time. As in the establishment of the Republic, the military led the movement that challenged the current political power. This culminated in a series of revolts "(...) such as the Copacabana Fort, in 1922, the one led by Isidoro Dias Lopes, in 1924, and the Prestes Column — 1924 to 1927." (RIBEIRO, 1998, p. 98).

During the period from 1930 to 1937 reforms in the educational sector took place in Brazil carried out by the Minister of Education and Public Health, Francisco Campos. After this phase of history, another one of equal importance begins, the Estado Novo. At this moment, according to Romanilli (2014), education is increasingly seen as an "important factor for development". This phase, which began in 1937 and ended in 1946, was:

> (...) the decree of the Organic Laws of Education and the creation of Senai and Senac. However, it represented an interval in the ideological struggles around educational problems. (ROMANELLI, 2014, p. 129)

In the period of time that corresponds from 1946 to 1961: "(...) it was characterized by the resumption of ideological struggles, around the draft Law of Guidelines and Bases." (ROMANELLI, 2014, p. 129).

National Education Guidelines and Bases Law No. 4,024 was enacted in December 1961 and organized the levels of education as follows: Primary Education, High School Cycle, High School Cycle and Higher Education. In 1964, the military coup took place in Brazil, where a dictatorial regime was established, which lasted for 21 years. During this period a new LDB was sanctioned in August 1971.

> The 1971 educational reform completes the configuration of the Brazilian education framework, with changes in teaching guidelines and curriculum directly affecting the field of humanities, especially history and geography. Thereafter, due to pressure from the organized educational sectors, there are revisions in the legislation, and in the struggles that outlined a process of redemocratization in the country, the emergence of new experiences and processes of changes in the curriculum and teaching projects, seeking to resize the history taught at the elementary school level. (GUIMARÃES, 2012, p. 13).

After this re-democratization movement, the 1988 Constitution was promulgated, in which it sought to re-establish freedom and citizens' rights. It was only on December 20, 1996 that LDB No. 9394 was enacted, which is still in force today. In this new LDB, education started to be divided into Basic Education (composed of Early Childhood Education, Elementary School and High School) and Higher Education.

3. TEACHING HISTORY IN THE HISTORY OF BRAZILIAN SCHOOL EDUCATION

3.1 History teaching trajectories: from the colony to the end of the 19th century

Authors interested in the history of history teaching point out that there is possibly a relationship of mutual influence between academic history and history as a school subject. In Teaching & Language of History, the authors address the trajectory of school subjects, highlighting the influence they suffer

according to the historical context in which school programs are developed. Such disciplines carry characteristics and seek to satisfy the interests of the elites of the time.

> We must not disconnect the knowledge that is transmitted in the disciplines that make up the curricular matrix of educational institutions and the ideals of those who are subjects of the teaching and learning process. (MAGALHÃES JR, LIMA, FREIRE, 2015, p. 18).

It happened with the discipline of History. All the elaboration of the contents, the transmissions of these, the choice of teaching materials that would be used, among other things, were made and based on the interests of those who held power at each moment in the country's history.

Educational historiography tends to portray the arrival of Jesuits in Brazil-Colony as a milestone for Brazilian education. And as we saw in the previous chapter, the coming of the Society of Jesus to Portuguese America, in fact, was decisive for the beginning of the history of education in Brazil. However, we cannot forget how much this Jesuit education suffered European influence and was, who knows, one of the important characteristics that made up the teaching of Brazil-Colony onwards.

In Jesuit education, what stood out was Sacred History. Teaching during this period gave great importance to literature and rhetoric, while leaving aside practical activities and the study of science. In the Jesuit educational curriculum, there was no official teaching of history, and what was learned from the past was through reproductions of texts, which in turn were nothing more than translations.

> In our country, at certain times, the State itself acted to disseminate the images that most interested it. Like the Church in the Middle Ages, the State also took care of its "saints", elaborating or electing hagiographic narratives about the heroes of the nationality and their exemplary deeds in the service of Brazil. (MORAIS, 2010, p. 203).

Until the 19th century, there was no systematization of history as a discipline in Brazil. It was only with the independence of the former colony that it was possible to develop actions to organize the Brazilian educational system, and one of the main objectives was precisely the construction of the national identity.

> Before being structured as a higher education course, aiming to train bachelors and graduates from 1934, history was a discipline taught in different courses, the contents being chosen and worked on depending on whether the course was religion, art, economics or another area that needed historical knowledge to assist in the proposed training. (MAGALHÃES JR, LIMA, FREIRE, 2015, p. 18).

Fundamental education in Brazil-Empire had as a priority the teaching of reading, writing and calculus, in addition, Christian moral principles based on Catholic doctrine were transmitted. To improve reading, texts were used that could assist in this process of building national identity, such as the Constitution of the Empire and History of Brazil. The influence of the Catholic Church in the choice of content worked in the classroom at that time is notable:

> Catholicism was the official religion of the Empire and the school was influenced by official policy. The contents of History comprised Civil History linked to Sacred History, endorsing the union of the Church with the State. Used to reinforce the knowledge of Christian morality, the discipline of History was nothing more than a set of optional contents, illustrating a humanist-based curriculum that valued the formation of an elite, with economic and political privileges. (MAGALHÃES JR, LIMA, FREIRE, 2015, p. 23 and 24).

The history of the indigenous people, or of the blacks who were uprooted from their lands and enslaved in Brazil, was not addressed. The Story told was a Story turned to Europe and it was up to the student to only faithfully reproduce the teacher's words.

According to Selva Guimarães (2012), history teaching in Brazil officially became part of the country's school programs from the 19th century onwards, since then it has been present in Brazilian elementary schools and bringing in them strong traces of "European traditions".

In the text, Integrated History, in the collection New Themes in History Classes, Marcus Vinícius de Moraes talks about post-independence Brazil and the need that arose to find his own identity and how Bellegarde's book contributed to the formation of this thought:

> In this sense, the first Brazilian book on the History of Brazil, by Henrique Luiz de Niemeyer Bellegarde , *Summary of History of Brazil* , from 1828 , appeared. In fact, the work was a translation of the *Resume by L'histoire du Brésil* by Ferdinand Denis, written in 1822, "augmented" with quotes from the *History of Brazil* , a collection of three volumes by the Englishman Robert Southey , published between the years 1810 and 1819. Bellegarde's work was the initial step towards the formation of an imagined Brazilian national unity, the from inspirations of European history, of which Brazil itself was a part. (MORAIS, 2010, p. 203 and 204).

Katia Abud (2001), in her text in the book O Saber Histórico Na Sala De Aula, recalls that the history of History in Brazilian schools in relation to the secondary school curriculum and also in the elaboration of their programs was not easy. And he stresses that such school discipline became effective as a matter, in fact, with the creation of Colégio D. Pedro II at the end of the regency of Araújo Lima, in 1837.

According to Abud (2001), History as a discipline began with academic History. In the same year that Colégio D. Pedro II appeared with the objective of being a model school for the others, the Brazilian Historical and Geographic Institute (IHGB) was also founded. The Colégio D. Pedro II had as one of its purposes, to form the children of the nobility of the Court of Rio de Janeiro. While the IHGB had the function of "building the national genealogy", so that a Brazilian identity could be formed and through the teaching of History it could also constitute a social science capable of instructing students about the different societies of the past and giving / showing all the direction of its evolution.

School programs varied according to each province, as did the duration of primary schools and the approach to content in elementary and complementary primary schools.

> History studies were only foreseen for this last stage of teaching, in the complementary primary school, but, as you know, there is always a gap between the study proposals and their implementation in the classroom. The creation of complementary primary schools occurred to a limited extent, existing only in some more developed urban centers. (BITTENCOURT, 2011, p. 61 and 62).

The teacher was required to dedicate himself to the compulsory teaching of reading and writing, grammar and a special attention to the metric system and religious teaching. Sacred history was more widespread than secular history. Even after the establishment of the Republic and the rupture of the State with the Catholic Church, the teaching of religious doctrine continued in public schools.

> Civic morality was then linked to religious morality. This predominated in school texts, and it was common to use lectures with stories about the lives of saints, characters who served as an example of character, morals and faith and often became true heroes through martyrdom. (BITTENCOURT, 2011, p. 62).

According to Bittencourt (2011), the study of the History of the motherland was not mandatory, however, "always appeared in the instructions" provided to the teachers by the inspectors and, like the Sacred History, they were taught through narratives of the lives of important characters and taken as examples to be followed. This narrative was called biographical history, because it dealt with the life trajectory of the saint or hero narrated.

At the end of the century, after the abolition of slavery, an intense wave of immigration and a process of urban development began. Due to these circumstances, there were many debates in relation to the idea that citizenship had until now in order to develop a new concept around this term. In this context, the school was necessary as a training for political citizens, since the main requirement was to be literate.

> With the introduction of the republican political regime and the right to vote for literate people, educational policies sought to provide schooling for a broader social contingent, and new curricular programs sought to consolidate a national identity, through the homogenization of school culture in what it says respect to the existence of a unique past in the constitution of the Nation (BITTENCOURT, 2011, p. 64).

Now History as a discipline was also intended to include other social strata that previously had no teaching opportunity. However, the narrated history was still that of the great names, those great national heroes and the lower strata continued to be ignored in these narratives.

> For most educators who agreed with the schooling of popular classes, the history to be taught, from the first school year, to free workers who emerged in substitution for slaves should inculcate certain values for the preservation of order, obedience to hierarchy, so that the Nation could reach progress, modernizing in the way of European countries (BITTENCOURT, 2011, p. 64).

As stated before, during this period the need to define the concept of citizenship arose, and history should propagate this new definition, which would serve to establish the place of each individual in society: "it was up to the politician to take care of politics, and the common worker the right of the institutional order remained" (BITTENCOURT, 2011, p. 64).

During the 19th century, a teaching method focused on memorization prevailed in History: "Learning History meant knowing names and facts with their dates by heart, repeating exactly what was written in the book or copied in the notebooks" (BITTENCOURT, 2011, p. 67).

According to Bittencourt (2011), it was common to use a specific textbook model, the catechism, in elementary schools of this historical phase. History texts aimed at children followed the same line.

> History, according to the catechism method, was presented by questions and answers, and so the students had to repeat, orally or in writing, exactly the answers of the book. As punishment, for the imprecision of the terms or forgetting some words, they received the famous paddle or ferula. The evaluation system was associated with physical punishment. (BITTENCOURT, 2011, p. 67).

Learning was associated with memorization and, therefore, activities to develop this capacity were created. The set of exercises that had this purpose were called "mnemonic methods". In the 19th century, the French historian Ernest Lavisso was the creator of one of these mnemonic methods used in the teaching

of History and which served as a model for the production of national pedagogical literature. His proposal aimed to improve the child's intelligence through the memorization and association of words and images.

Over time, this method aimed at setting dates and events began to suffer criticism. And after the end of the century, suggestions for new methods began to break out. Bittencourt (2011) points out, however, that despite the time, such criticisms are still recurrent today, making it evident that this method still persists in today's schools.

3.2 Teaching history in the 20th century (Until 1988)

According to Marcus Vinícius de Morais (2010), Brazil in the twentieth century had significant changes in the way of narrating and teaching history, thanks to the reforms of Francisco Campos, Minister of Education and Public Health, in the 1930s and the Guidelines and Bases Law of 1961. The first LDB of nº 4. 024.

As Tatiane Lima de Almeida (2013) states in: The Teaching of History and Its Perspectives and Contributions From the PCN's , the History of Brazil became one of the tools used for "national and patriotic formation, consolidating the cult of heroes and the creation of national traditions ". (ALMEIDA, 2013, p 14).

Circe Bittencourt (2011), talks about this search for the feeling of patriotism when she remembers how school books were at the beginning of the 20th century and how their History contents made such goals evident.

> In his famous book *Why I pride myself on my country* , Afonso Celso synthesized the basic contents of the History of the Fatherland: the richness and beauty of the land, the forests and rivers, the climate, the laughing and peaceful mestizo people, the history of the Portuguese , representatives of civilization, and Christianization, which enabled a moral without prejudice (BITTENCOURT, 2011, p. 65).

During this period, influenced by the concept of education and culture in the United States and amid criticism by intellectuals of the time in relation to "Traditional School", the interest of a greater participation of students in group studies and in field classes is perceived. History.

Initially in the program for secondary schools, General History and History of Brazil was a single discipline, the latter being an appendix, just a brief chapter of the former. As time went by, the History of Brazil was emancipated and with Gustavo Capanema's Reformation in 1942, the General History and that of Brazil were definitely separated.

> In the 1960s, History and Geography also lost a large space in the curriculum, although they remained autonomous subjects in junior high school. The reduction in the workload was fatal for his teaching because it impoverished him greatly. Of the four junior high school grades, only three had History and Geography classes. This is because other more "useful" subjects had been incorporated into the curriculum and needed space (ABUD, 2001, p. 39).

During the military regime, established in 1964, subjects such as history and geography had been banned from teaching and transformed into Social Studies. These Social Studies were inspired by American schools and sought to include the individual in society aided by the contents of this discipline.

> The Social Studies programs were based on the studies of cognitive psychology, which developed mainly from the 1930s and improved in the 1950s, through pedagogical studies. (BITTENCOURT, 2011, p. 73).

The contents covered in Social Studies were gradually introduced to children, according to the age group, subjects related to society were introduced to students. The teachings should start based on the reality closest to the child and over time that past that was more distant than the student knew was added to the knowledge about the immediate past, this one, composed by the family, the place where he lives and the school.

> Social Studies were adopted in some schools, called "experimental" or "vocational", during the 1960s, and, after the educational reform during the military dictatorship, by Law 5,692 of August 1971, the area was introduced in the entire education system — which then came to be called the first degree—, extending to the other grades of the old gym (BITTENCOURT, 2011, p. 73).

According to Guimarães (2012), in the 1950s, social studies were implemented in the state of Minas Gerais. These were supported by the Brazilian-American Assistance Program for Elementary Education, created in 1953 from an agreement between the federal government of Brazil, the government of Minas Gerais and the United States. The objective of this program would be to train and improve teachers for normal and primary schools, as well as to produce and deliver teaching materials.

> Under the influence of American authors, American works and studies resulting from the work developed by the program in Minas Gerais were published. These works became a reference for the experiences developed later (FONSECA, 2012, p. 54).

Later, with LDB 4,024, social studies were no longer seen as a relevant subject for high school. While in the gyms and in the School of Application of the University of São Paulo, they ended up being included in their junior high school curriculum and in the late 1960s they also became part of state schools. “In these early experiences, the North American conceptions of education and the teaching of history are striking.” (FONSECA, 2012, p. 54).

This program aimed, through social studies, to instruct children in a way that they could adapt to society. Making them understand how it works and preparing them for this adaptation.

Also according to Guimarães (2012), the teaching of history in the 1970s in Minas Gerais, São Paulo and other states, was based on the principles that governed the 1971 Educational Reform guidelines.

> (...) Law 5.692 / 71 did not change Brazilian education in depth, it only consolidated measures that were already being adopted, institutionalized some experiences already carried out, such as social studies, for example, and established educational guidelines in line with the broader education project in the Brazilian state (FONSECA, 2012, p. 55).

According to Selva Guimarães Fonseca (2012), the 1971 educational reform brought changes in teaching, which aimed at greater control and, therefore, started to be planned and systematized with the help of specialists in each discipline.

> The teaching of history became the object of control by the councils and the discussion remains basically limited to the teaching programs developed by the education departments and to textbooks written in the same way as programs adopted on a large scale (FONSECA, 2012, p. 57).

Bittencourt (2011) recalls that one of the precursors and defenders of social studies, Delgado de Carvalho, believed that the main function of this discipline was to form moral values. In the midst of a

period of so many transformations that was the twentieth century, the upper layers were looking for ways to contain these transformations and preserve the values that formed the Brazilian family and society.

> Social Studies could address the problems of modern society and help to face their risks as they are made up of "different subjects", in order to provide security and stability to students. Such "subjects" came from human geography, sociology, economics, history and cultural anthropology, which mixed together to constitute "moral sciences" (BITTENCOURT, 2011, p. 74).

Together they explained capitalism based in the United States, which aimed at competitiveness and the development of a critical view, where "according to liberal standards: criticize to improve the current system and better adapt to it." (BITENCOURT, 2011, p. 74).

With the intention of integrating children into society, in Minas Gerais social studies were part of the curriculum of the early years and sought to "integrate or adjust the student to the social environment" through this discipline, which in turn was composed of geographical and social concepts. historical nature.

> (...) the program establishes that the contents of history, geography, moral and civic education and OSPB are worked on in a systematic and integrated manner. The proposed vertical and horizontal integration is not radicalized as from the 1st to the 4th grade; there is no fusion of different fields of knowledge and the specifics of history and geography have been preserved (FONSECA, 2012, p. 59).

With the redemocratization, in the 1980s, changes began to occur and in that same period "curricular restructuring" started to be carried out in several states in Brazil. Which generated many debates about the teaching of history and how the contents could be approached. In addition to the methodologies that should be used and what are the best ways to evaluate the student.

> The content of 70's history teaching recorded in programs, textbooks and official guidelines brings with it the constitutive marks of its own historicity. That is why, at the moment when — in the late 1970s — the process of organizing 1st and 2nd grade teachers begins to resonate within the organized social movement, the school and the teaching of history along with the teaching of other subjects appear as the target of criticism and contestation (FONSECA, 2012, p 87).

The 1980s and 1990s had significant changes in the Brazilian social and political context, at that moment, a new historiography emerged "loaded with a tendency of Cultural History". This had an impact on the elaboration of textbooks and this new way of seeing History was highlighted.

> Thus, both the new Law of Guidelines and Bases (LDB) of 1996, as well as the National Curriculum Parameters (PCNS) of 1997, highlighted the idea of multiplicity of views, respect for differences, valuing diversity and pluralities as cultural heritage in Brazil . In the century of rapid changes and the end of national, political and economic frontiers, education privileges the study of the characteristics of certain groups (the characters of History "seen from below", the local communities, the "losers", "the working class ", Among others) to the detriment of homogenizing and exclusive national history, seen as archaic and outdated (MORAIS, 2010, p. 205- 206).

Fonseca (2012) also speaks of this new historiographical production and how the teaching of history is being rethought with this new scenario in which Brazil found itself. New interpretations of history emerge as well as new themes to be rethought and debated.

> In the field of academic historiographical production, several balances released point, from the 1970s onwards, to a rethinking of themes, assumptions and interpretations. There is an expansion of the field of history through

> the search for new themes and new documents. Social history starts to be resized and studies on the working classes are expanded and enriched. This new production brings up studies of themes such as family, leisure, sexuality, women, witchcraft, madness and many others. Thus, the specialized bibliography starts to reveal an expansion of the universe of objects and documents, a diversity of interpretations that allows us to apprehend multiple readings of the social (FONSECA, 2012, p. 87- 88).

This new way of thinking about History starts to gain space in scientific and union associations. These open space for debates to be held in relation to these agitations and discussions about the degrees of education.

> The media also deals with debates about the possible paths of teaching history. The recurring discussions prioritized the following aspects: the production of historical knowledge as a way to break with the reproductive role that traditionally is conferred on the 1st and 2nd degrees; the textbook: the meaning of its use and the analysis of the contents conveyed; thematic teaching as an alternative proposal to the traditional teaching of history and experiences using different languages and teaching resources, such as music, literature, films, TV, comics and other documents (FONSECA, 2012, p. 88).

These discussions gained space, were systematized and published in collections, where it was possible to find several reports of experiences and interpretations of the way of making and thinking about History. With this, revisions in the legislation related to the teaching of History are now made, as well as reforms in the History curricular.

> Thus, the 1980s are marked by discussions and proposals for changes in fundamental history education. Rescuing the role of history in the curriculum becomes a primary task after several years in which the textbook took on the curricular form, becoming almost an "exclusive" and "indispensable" source for the teaching-learning process (FONSECA, 2012, p. 88).

The 1980s were marked by discussions related to the re-elaboration of school curricula and new ways of approaching History, aiming at the people as agents / subjects that determine this history. In the 1990s, new proposals for changes in the teaching of history appear in these curricula "(...) in an attempt to incorporate historiographic productions that would respond more adequately to the most significant themes of contemporary society" (OLIVEIRA; CAINELLI; OLIVEIRA, 2006, p. 106).

It is in this period of redemocratization that major changes take place. As a consequence, a new Federal Constitution is necessary. Among the seven Constitutions that Brazil had, the one of 1988 was certainly the one that gave the people more right and freedom. It sought to cover various sectors of society and based on its principles, LDB 9394/96 was prepared.

5. Conclusion, Heading Level-1.

Research on the History of Education, and especially on History of History Teaching, has great contributions to offer us. On the one hand, it supports the development and experience of new educational public policies, since, as Nóvoa defends, "the historical understanding of educational phenomena is an essential condition for the definition of innovation strategies" (NÓVOA, apud CARVALHO et all, 2002, p. 73) in the fields of school educational design and practice, not only in history, but in any subject area included in the basic education curriculum.

Furthermore, and no less important, research on the History of History Teaching can contribute to the elaboration of approaches, action strategies and forms of struggle of social movements, sidicates and Non-Governmental Organizations, as it offers these groups, as stated L.F. Cerri,

> Knowledge of previous experiences in which History teaching workers acted in proposing changes in their work, whether in terms of self-organization and development of experiences, or in terms of resistance and demands from governments and civil society institutions (CERRI apud MONTEIRO; GASPARELLO; MAGALHÃES, 2004 p. 68).

Therefore, with this brief article, we expect much more to point out paths, indicate itineraries, than to answer the questions and demands that have been succeded by historical research in education and the history of history teaching. After all, this history of glimpsing the processes and paths followed by History as a school discipline still lacks many other works, many other discussions, and, without a doubt, raises many other questions and demands that are still in the process of being explored.

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Use of isolated fungicides for the control of *Phakopsora pachyrhizi* in soybean

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ABSTRACT

The occurrence of diseases in soybean crop has negatively affected its development and caused significant losses in productivity. Among the diseases, Asian rust caused by the fungus Phakopsora pachyrhizi Sydow stands out because of its high severity. As a way of controlling, chemical fungicides is a tool used to mitigate the damage. The objective of this work was to evaluate the efficiency of different isolated fungicides in the control of Asian rust. The experiment was carried out in the experimental area of the University of Cruz Alta in the state of Rio Grande do Sul with a randomized block design and four replications. The cultivar used was BMX Ativa, and the fungicide applications occurred before the interline closure and later with 15 days of interval between applications. The fungicides tested in the experiment were: metominostrobin + tebuconazole, piraclostrobin + fluxpyroxade, picoxystrobin + cyproconazole, Azoxystrobin + benzovindiflupir, picoxystrobin + benzovindiflupir, Trifloxystrobin + protioconazole, Pyraclostrobin + epoxiconazole + fluxpyroxade, Bixafen + protioconazole + Trifloxystrobin, Mancozebe + picoxystrobin + tebuconazole and control. The variables analyzed were yield kg ha^{-1}, weight of one thousand seeds and disease severity. The fungicides Mancozebe + picoxystrobin + tebuconazole and bixafen + protioconazole + trifloxystrobin showed the highest yield, one thousand grain weight and lower severity of Asian soybean rust.

Keywords: Asian rust; *Glycine max*, production.

INTRODUCTION

The edaphoclimatic conditions found in Brazil promotes the most diverse farming activities. The country stands out as the world's second largest producer of soybeans, falling behind only the USA. According to CONAB (2019) in the 2018/19 harvest, this legume grew by 1.9% in relation to the previous harvest, corresponding to the planting of 35.8 million hectares.

Among the main factors that compromise soybean yield are the diseases, which, depending on their level of severity, can reduce the total crop productivity by 15% to 20% annually, in addition to contributing to the raise in production costs (TECNOLOGIAS, 2010). Among the main soybean diseases, Asian soybean rust (*Phakopsora pachyrhizi* Sydow) stands out due to its high severity.

The first report of the disease in commercial soybean crops was in the 2000/01 harvest (YORINORI et al., 2002). The symptoms are particularly evident in the leaves, evolving from isolated uredias to areas with pronounced coalescence when it causes yellowing and premature leaf abscission (NAVARINI, 2007). The damage caused to the leaves of the plants reduces the photosynthetic area and spreads rapidly, starting in the lower third of the plant and moving upwards in the final stages of the crop.

Some conductions are indicated for the control of this disease, among them, choice of cultivars with early cycle, use of cultivars less susceptible to disease, management of plants in the off-season, crop rotation and the main and most used currently by producers is the chemical management by means of fungicides (AMORIM *et al*, 2016).

Although there are a large number of commercial products registered to control Asian rust in Brazil, they belong to only three mechanisms of action (DUHATSCHEK, 2017). Multisite or protective fungicides have contact action, whereas those with preventive action are systemic, carboxamides and strubirulins are the main examples of these, yet there are curative action fungicides represented by triazoles and morpholines, which are responsible for controlling diseases and maintaining plant productivity.

The fungus has already shown resistance to the main existing actives for several harvests, so it is essential to study the control efficiency of the main fungicides used in isolate manner to identify possible deficiencies in the control and selection of molecules, which will be able to formulate further mixtures. The objective of this work was to evaluate the efficiency of fungicides used separately to control *Phakopsora pachyrhizi* in soybeans.

MATERIAL AND METHODS

The experiment was carried out in the Experimental Area of the University of Cruz Alta – UNICRUZ, Cruz Alta/RS. The climate in the region is humid subtropical (Cfa), according to the Köppen's classification. It has an average annual precipitation of 1300mm and an average annual temperature of 20ºC. The experiment area is classified at Distrofic Red Latosol, clay texture (EMBRAPA, 2018).

The experimental design used was randomized blocks, totaling 10 treatments with four repetitions of each treatment, using plots of five lines of 0.45 m by 3 meters in length, consisting of corridors spaced by 0.5 m between plots.

The experiment consisted of a single soybean cultivar, BMX-Ativa® which was sown on December 7, 2018. This cultivar has high susceptibility to the fungus. Fertilization, pest and weed control was carried out according to the recommendation for the crop. Fungicides applied isolate were tested for disease control. The first application occurred in the pre-closing of the between-line and the others with an interval of 15 days, totaling three applications. The sprays were performed using a CO_2-based backpack with a spray volume of 150 L ha^{-1} (Table 1).

Table 1 – Active ingredient (a.i.), commercial product (c.p.) and dose of fungicides in treatments to control Asian soybean rust, 2018/19 harvest

Active ingredient (a.i,)	Dose g a.i. ha^{-1}	Dose L or kg c.p. ha^{-1}
Control	-	-
Metominostrobin + tebuconazole[5]	79.75 + 119.63	0.725
Pyraclostrobin + fluxpyroxade[6]	116.55 + 58.45	0.35
Picoxystrobin + cyproconazole[2]	60 + 24	0.3
Azoxystrobin + benzovindiflupir[1]	60 + 30	0.2
Picoxystrobin + benzovindiflupir	60 + 30	0.6

Trifloxystrobin + protioconazole[3]	60 + 70	0.4
Pyraclostrobin + epoxiconazole + fluxpyroxade[6]	65 + 40 + 40	0.8
Bixafen + protioconazole + trifloxystrobin[3]	62.5 + 87.5 + 75	0.5
Mancozebe + picoxystrobin + tebuconazole [4]	1000 + 66.5 + 83.33	2.5

Source: Author, 2019.

1Added Nimbus 0.6 L ha-1; [2]Added Nimbus 0.75 L ha^{-1}; [3]Added Áureo 0.25% v/v; [4] Added Rumba 0.5 L ha^{-1}; [5] Added iharol gold 0.25% v/v; [6]Added Assist 0.5L ha^{-1}.

Evaluations of the severity of *Phakopsora pachyrhizi* (leaf area covered with symptoms) were performed using a diagrammatic scale (Figure 1) (GODOY et al., 2006). Such assessments were performed at 7 days after the application of the fungicides (7DAA), on the respective days 73 days after sowing (DAS), 90 (DAS) and 120 (DAS) and after averaging the severities.

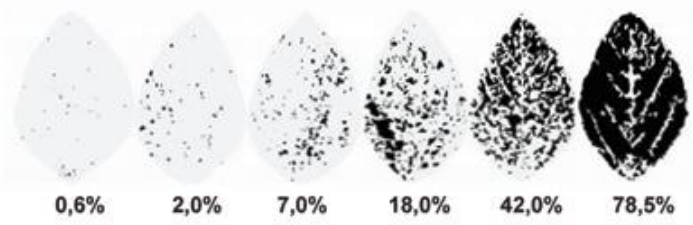

Figure 1-Diagrammatic Scale for Assessment of Soybean (*Glycine max*) Rust Severity, (Godoy et al, 2006).

The area was subsequently harvested to determine productivity, where the useful area of each plot consisted of 3 lines of 0.45m by 2.5m in length totaling 3.375m², the results obtained were extrapolated to kg ha^{-1} and 13% moisture adjustments were made for each sample with the aid of the formula:

= ((100 – moisture of the plot) x sample weight /87).

The variable a thousand seed weight (TSW) was obtained by counting a thousand soybean seeds for each treatment, which were then weighed with the aid of a precision scale to determine the weight in grams.

The data obtained in this work were subjected to analysis of variance and the means of the treatment were compared through the Scott-Knott test at 5% error probability, using the Assistat software.

RESULTS AND DISCUSSION

Regarding productivity, a statistical difference occurred between the variables analyzed in here, and greater productivity was observed for the treatments mancozebe + picoxystrobin + tebuconazole (4878.24 kg ha^{-1}) and bixafen + protioconazole + trifloxystrobin (4269.40 kg ha^{-1}). On the other hand, the lowest yields were obtained in the control (2192.00kg ha^{-1}) (Table 2).

Table 2. Productivity in kg/ hectare and weight of one Thousand seed in different active principle (grams).

Treatment	Productivity kg ha^{-1}	Weight of one thousand seeds (g) (PMS)
Mancozebe + picoxystrobin + tebuconazole	4878.24 a	185.41 a
Bixafen + protioconazole + trifloxystrobin[3]	4269.40 a	175.38 a
Pyraclostrobin + epoxiconazole + fluxpyroxade[6]	3705.01 b	164.31 b
Trifloxystrobin + protioconazole[3]	3693.54 b	156.38 b
Picoxystrobin + benzovindiflupir	3569.58 b	144.00 c
Azoxystrobin + benzovindiflupir[1]	3434.90 b	143.81 c
Picoxystrobin + cyproconazole[2]	3374.36 b	142.81 c
Pyraclostrobin + fluxpyroxade[6]	3330.78 b	142.75 c
Pyraclostrobin + fluxpyroxade[5]	3308.14 b	141.38 c
Control	2192.00 c	115.63 d
CV (%)	**18.48**	**3.92**

Means followed by the same letter are not different from each other by the test of Scott-Knott at 5% probability.

The highest productivities of these fungicides can be associated with the triple mixture of actives and the presence of a multisite in its composition, as is the case of the fungicide mancozebe + picoxystrobin + tebuconazole, which, in a way, results in a plant with greater protection and better effectiveness in controlling the fungus. Multisites affect different metabolic points of the fungus and show a low risk of resistance, showing an important role in the anti-resistance management for site-specific fungicides (MCGRATH, 2004).

Similar but superior results were found by Guterres (2019) where the treatments of picoxystrobin + tebuconazole + mancozebe used separately totaled 94 bags ha $^{-1}$ approximately 5640 kg ha^{-1}. Soares, 2004 states that the use of fungicides provides an increase in the productivity of soybeans.

For the variable a thousand seed weight (TSW), the highest results were observed in the treatments bixafen + protioconazole + trifloxystrobin and mancozebe + picoxystrobin + tebuconazole, 185.41 and 175.38 grams respectively, followed by the fungicides trifloxystrobin + protioconazole + pyraclostrobin + epoxiconicon fluxpyroxade. Such fact demonstrated superiority when compared to the treatment without fungicides, which showed the lowest result for TSW of 115.63 grams (Table 2). In this sense, some studies were carried out explaining that among the yield components of the plant, one of the most affected by rust is the seed size (COSTAMILAN et al., 2002). A work carried out by Pinto *et al*, 2011 demonstrated that the high severity of Asian rust in soybean plants negatively affected the thousand seed weight, as it was seen in treatments 1 (control) and 2 (Flutriafol + methyl thiophanate (triazole), which presented the lowest averages totaling 91.6 and 100.7 grams, respectively.

In the first assessment of rust severity, the symptoms were not evident in the leaves, which resulted in low means of severity. The lowest severities were obtained in the treatments: piraclostrobin +

fluxpyroxade, trifloxystrobin + protioconazole, azoxystrobin + benzovindiflupir, bixafen + protioconazole + trifloxystrobin, picoxystrobin + benzovindiflupir, metominostrobin + tebuconazole, mannobonazole, mannoboxazone. The highest mean of severity was observed in the control treatment, totaling 40.48% (Table 3).

Table 3. Severity of Asian soybean rust evaluated at 7 days after each application of different fungicides 07/20, 03/06 and 04/01 2019.

Treatment	Mean of the severities	Control efficiency %
Mancozebe + picoxystrobin + tebuconazole	11.77 a	70.92%
Bixafen + protioconazole + trifloxystrobin[3]	14.74 a	63.58%
Pyraclostrobin + epoxiconazole + fluxpyroxade[6]	19.99 b	50.61%
Metominostrobin + tebuconazole[5]	18.90 b	53.31%
Trifloxystrobin + protioconazole[3]	18.27 b	54.86%
Picoxystrobin + benzovindiflupir	23.48 c	41.99%
Picoxystrobin + cyproconazole [2]	21.34 c	47.28%
Azoxystrobin + benzovindiflupir [1]	36.28 d	10.37%
Pyraclostrobin + fluxpyroxade [6]	35.70 d	11.80%
Control	40.48 e	0%
CV (%)	8.46	

*Means followed by the same letter are not different from each other by the test of Scott-Knott at 5% probability.

For treatments mancozebe + picoxystrobin + tebuconazole, bixafen + protioconazole + trifloxystrobin where the severities were lower, also showed the best fungus control efficiencies, totaling 70.92% and 63.58% respectively (Table 3). Similar results were found by Embrapa (2014), where the lowest severities were observed in isolated fungicide treatments with the active ingredients azoxystrobin + benzovindiflupir, followed by the treatment bixafen + protioconazole + trifloxystrobin, and trifloxystrobin + protioconazole. The same study conducted by EMBRAPA in the 2017/2018 harvest obtained control efficiencies in fungicides isolated in the mancozebe + picoxystrobin + tebuconazole treatments of 71%, and bixafen + protioconazole + trifloxystrobin of 72%. However, use them separately is not a recommended practice due to the selection of resistant individuals. For the management of the disease, anti-resistance

strategies must be followed, which include not using more than two applications of the same product in sequence and a maximum of two applications of the products must be used (EMBRAPA, 2018). The combination of active ingredients, as long as the application stage is correctly positioned, makes it vital for an effective control of the disease (NAVARINI, 2007).

Fungicides based on azoxystrobin + benzovindiflupir and pyraclostrobin + fluxpyroxade, picoxystrobin + cyproconazole showed low control efficiency totaling 10.37% and 11.80% respectively. Those were also the treatments that presented greater severities when compared to the others.

CONCLUSION

The fungicides mancozebe + picoxystrobin + tebuconazole and bixafen + protioconazole + trifloxystrobin show higher productivity, greater a thousand seed weight o and less severity of *Phakopsora pachyrhizi*.

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DYNAMIC MODELING AND STABILITY ANALYSIS OF A NONLINEAR SYSTEM WITH PRIMARY RESONANCE

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Abstract

In recent years, there has been growing interest in the study of nonlinear phenomena. This is due to the modernization of structures related to the need of using lighter, more resistant and flexible materials. Thus, this work aims to study the behavior of a mechanical system with two degrees of freedom with nonlinear characteristics in primary resonance. The structure consists of the main system connected to a secondary system to act as a Nonlinear Dynamic Vibration Absorber, which partially or fully absorbs the vibrational energy of the system. The numerical solutions of the problem are obtained using the Runge-Kutta methods of the 4th order and approximate analytical solutions are obtained using the Multiple Scales Method. Then, the approximation error between the two solutions is analyzed.

Using the aforementioned perturbation method, the responses for the ordinary differential equations of the first order can be determined, which describe the modulation amplitudes and phases. Thus, the solution in steady state and the stability are studied using the frequency response. Furthermore, the behavior of the main system and the absorber are investigated through numerical simulations, such as responses in the time domain, phase planes and Poincaré map; which shows that the system displays periodic, quasi-periodic and chaotic movements. The dynamic behavior of the system is analyzed using the Lyapunov exponent and the bifurcation diagram is presented to better summarize all the possible behaviors as the force amplitude varies. In general, the main characteristics of a dynamic system that experiences the chaotic response will be identified.

Keywords: nonlinear mechanical systems, primary resonances, multiple scales method, Lyapunov exponent, Poincaré map, stability analysis and chaos

1 Introduction

The decrease in vibration levels in the response of a system is vitally important to have a reliable and efficient design as these vibrations are undesirable phenomena that may cause damage, failure, and sometimes destruction of machines and structures. According to Sayed [1], the vibration analysis of mechanical systems can provide information and improve a design in terms of quality, durability and productivity. They considered a two degree of freedom vibration system including quadratic and cubic nonlinearities subjected to external and parametric excitation forces and solved it using the multiple scale

perturbation method. All possible resonance cases are extracted; however, the stability of the system is investigated at one of the worst resonance cases, confirmed numerically, which is the simultaneous primary, principal parametric and internal resonance. The system is studied numerically for selected values of different parameters. The numerical simulations show that the system exhibits periodic motions and chaotic motions, and that the vibration of the main system can be controlled applying a nonlinear absorber. Thus, there is growing interest in tools to attenuate unwanted vibrations in various types of systems. One of the most effective ways to attenuate unwanted vibrations in a given structure is through Dynamic Vibration Absorbers [2]. A classic DVA consists of a mass coupled by means of a spring and a damper to a given system, obtaining a new degree of freedom. The system is then tuned to vibrate at higher amplitudes, absorbing thereby partially or fully vibratory energy in the coupling point, see [3]. The DVAs may have linear or nonlinear characteristics. However, in recent years, there has been increasing interest in studying DVAs with nonlinear characteristics, due to their greater robustness when compared to the linear absorber, based on the fact that linear DVA operates satisfactorily only in its tuning frequency [4].

In recent years, more attention has been paid to the study of nonlinear phenomena due to the modernization of structures, thus there are various studies concerning different models of continuous systems. [5], [6]. However, methods for analyzing nonlinear systems, the opposite of linear, are far less known; some are only found partially developed and analysing the equations that model a given problem are difficult to apply. Nonlinearities offer greater variability in the solutions. Therefore, it is necessary to formulate mechanisms to study and understand the characteristics of nonlinear phenomenon, emphasizing the chaos [7], [8].

One of the particularities of systems which show chaos is the high sensitivity to the initial conditions, that is, solutions with near initial conditions have a completely different behavior [9].

Differential equations that describe vibration systems are usually nonlinear and not always is it possible to obtain an analytical solution. However, often an approximate solution can be obtained. One of the most efficient ways of handling nonlinear phenomena is the perturbation theory, which is defined by interactive methods that has the purpose of obtaining approximate solutions involving a suitable choice of perturbation parameters. The only drawback of the theory is that it provides good results only for small displacements [10]. Still with respect to non-linearity, [11] studied the stability on a system of a two degree of freedom for various time delayed values to confirm its influence on the attenuation of vibrations.

Among the perturbation methods is the multiple scales method. The basic idea of this method is to achieve the expansion of the solution representing the response as a function of multiple independent variables or multiple scales [8]. Due to their wide range of applications, perturbation methods have been used to analyze vibration phenomena of various types of problems in engineering. In particular, bifurcation and stability problems have been solved by means of perturbation techniques. We will briefly review the state of art involving these techniques and how they can be applied in solutions to problems regarding chaotic behavior.

In [12], a numerical method is presented to analyze the bifurcation due to both lateral and torsional vibrations in rotating systems. A nonlinear model with three degrees of freedom is obtained from the Hamiltonian formulation. Using a standard procedure from classical mechanics, the authors showed that the dynamic of the system is described using nonlinear differential equations. From this model and using

the linearized matrix of the system, the stability of the equilibrium points and the linear normal modes are analyzed. The bifurcation of periodic orbits is investigated using a computing algorithm of the nonlinear normal modes adopting the multiple shooting technique and the pseudo Arclight continuation method.

The Routh-Hurwitz stability criterion is used to investigate the absolute stability of dynamic systems. Edward John Routh (1831-1907) established the first criterion for a polynomial to have roots (solutions) with a negative real part. However, Adolf Hurwitz (18591919) classified this as a necessary condition, but not sufficient and developed the Hurwitz matrix or H matrix, built through the coefficients of the polynomial. Thus, the criterion established that, besides the polynomial having all its positive coefficients, all the determinants of the matrix also had to be positive. [7].

Passive suppression mechanism of the vortex-induced vibration in solids, based on nonlinear elements and a nonlinear energy sink are investigated in [13]. A van der Pol oscillator is used to model a load-induced flow and in the main frame a structure is coupled that works as a nonlinear energy sink. Based on the equations of motion, the analysis performed indicated that the mass and frequency of the nonlinear energy sink showed significant effects in reducing the vibration response [13].

One of the most important criteria among those used to define chaos in dynamic systems is the Lyapunov exponent that measures the exponential average rate of divergence or convergence of phase space trajectories. Thus, the dynamic behavior of a system can be provided through signs of the Lyapunov exponents, which indicate the presence of fixed points, periodic movements, almost periodic and chaos [5].

There is also interest in experimentally studying nonlinear phenomena. An interesting study, [14], involves the experimental study of resonance of a discrete structure with forced oscillations.

Chaotic responses in the study of vibrations in beams attached to non-linear springs, which are in turn bound to a foundation, are investigated in [15]. In this case, the equations of motion are obtained and used to produce the Poincaré section in phase space. Together with the Lyapunov exponent, these techniques are used to study the chaotic behavior of the frequency response of the system. Resonance conditions and the existence of homoclinic orbits are also analyzed.

According to [7], another useful procedure for analyzing chaotic behavior is the bifurcation diagram. In general, bifurcation is understood as a qualitative shift in the nature of the dynamical system behavior because of the variation of the parameters. The bifurcation theory is usually developed in two ways: local bifurcations, which treat bifurcations in a limited region of the phase space, and global bifurcations that represent a qualitative change in the structure of orbits in a region of phase space.

In [16], the problem of chaotic motion of a nonlinear elastic beam axially compressed and subject to a transversal load was considered. The authors assumed that the damping force, as well as the material used to manufacture the element were nonlinear in nature. From there, the non-linear governing equation was obtained, as well as the corresponding dynamic system using the non-linear Galerkin method. The Melnikov's method was used to study the existence of homoclinic orbits. According to the authors, the results showed suitable choices of loaded parameters yielding to chaotic behavior of the vibration response.

[17] studied the nonlinear dynamics of a two-degree-of-freedom vibration system with nonlinear damping and nonlinear spring. The bifurcation diagram, the Poincaré map and amplitude–frequency spectrum are analyzed to identify the periodic motion, quasiperiodic motion and chaotic motion of the system. It is worth

mentioning that according to the authors the numerical simulation shows that the effect of reduction of the vibration amplitude can be obtained by properly selecting the values of nonlinear dampers, nonlinear spring stiffness and the range of exciting frequency.

Another very interesting study was that of chaotic dynamics of a Duffing system with softing stiffness, subject to periodic external forces with multiple frequencies [18]. The authors pointed out that the mechanism that generates chaos is the transversality of homoclinic orbits when considered in the torus. Using the concept of stable and unstable manifolds, the authors obtained the Melnikov's function, which in turn is used to determine the existence of homoclinic orbits. From the existence of homocinic orbits, the authors estimate both the Poincaré map and a parameter region where the chaotic dynamics may occur.

Chaotic phenomena are a behavior that rise in dynamical systems and their causes are due to many factors such as the number of degrees of freedom, the geometry of the problem and movement constraint among others. In recent years, the study of chaotic dynamics has attracted the attention of researchers in the field, due to its unpredictability in relation to the analysis and the effects that nonlinearities can cause in the stability of the system [19].

In this paper, our main aim is to study the emergence of chaotic behavior of the dynamic vibration absorber subject to nonlinear elements in the stiffness. It is assumed that the system operates in primary resonance. From the method of multiple scale techniques [20], an approximate analytical solution is given and compared numerically through four Runge Kutta methods [21]. In addition, the Routh-Hurwitz is used to establish a parameter region of stability. The chaotic behavior and existence of bifurcation solutions is analyzed through Poincaré mapping and Lyapunov exponent methods. The article finishes with a numerical analysis using Matlab® software.

2 Modeling a discrete system

In this section, our main concern is the vibratory system of two degrees of freedom where the concept of Nonlinear Dynamic Vibration Absorber (nDVA) is introduced [22]. The main aim of the device (absorber) is to attenuate the vibration levels of the main system, as can be seen in Fig. 1.

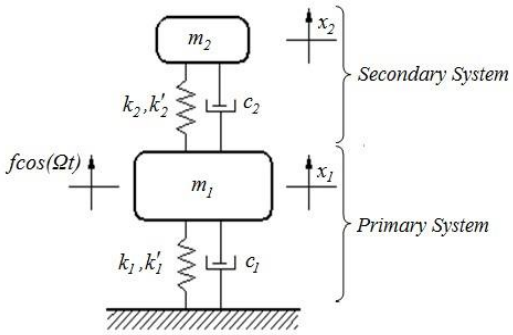


Figure 1: Discrete mechanical system.

By applying Newton's second law in the two masses separately, we have the following set of motion equations:

$$m_1\ddot{x}_1 + k_1x_1 + k_1'x_1^3 + c_1\dot{x}_1 - k_2(x_2 - x_1) - k_2'(x_2 - x_1)^3 + c_2(\dot{x}_1 - \dot{x}_2) = f\cos(\Omega t) \quad (1)$$

$$m_2 \ddot{x}_2 + k_2 (x_2 - x_1) + k_2' (x_2 - x_1)^3 + c_2 (\dot{x}_2 - \dot{x}_1) = 0 \quad (2)$$

$$\ddot{x}_1 + \omega_1^2 x_1 + \varepsilon\alpha_1 x_1^3 + \varepsilon\xi_1 \dot{x}_1 \varepsilon\alpha_2 x_2 - \varepsilon\alpha_3 (x_2 - x_1)^3 + \varepsilon\xi_2 (\dot{x}_1 - \dot{x}_2) = \varepsilon f \cos(\Omega t) \quad (3)$$

$$\ddot{x}_2 + \omega_2^2 (x_2 - x_1) + \varepsilon\beta_1 (x_2 - x_1)^3 + \varepsilon\xi_3 (\dot{x}_2 - \dot{x}_1) = 0 \text{ where} \quad (4)$$

$$\omega_{12} = \frac{k_1 + k_2}{m_1}, \omega_{22} = \frac{k_2}{m_2}, \alpha_1 = \frac{k_1'}{m_1}, \alpha_2 = \frac{k_2}{m_1}, \alpha_3 = \frac{k_2'}{m_1}, \quad (5)$$

$$\xi_1 = \frac{c_1}{m_1}, \xi_2 = \frac{c_2}{m_1}, \xi_3 = \frac{c_2}{m_2}, \beta_1 = \frac{k_2'}{m_2}, f = \frac{f_0}{m_1}, \quad (6)$$

c_1	main system	0.1	Ns/m
c_2	Linear absorber damping constant	0.08	Ns/m

This vibrating system consists of springs (k_1', k_2') with nonlinear characteristics, which are assumed to be sufficiently weak. An external force $f(t) = \cos(\Omega t)$ excites the main m_1 mass.

We can rewrite Eq. (1) and (2) in the following way:

$$\frac{m1}{m1}, \frac{m1}{m2}, \frac{m2}{m2}, \frac{m1}{m1}$$

and $\varepsilon \ll 1$ is used to indicate values with a small order of magnitude.

Table 1 lists the parameter values of the main system and the absorber.

Table 1: Parameter Values of the System

Symbol	Variable	Value	Unit
m_1	Mass of main system	10	*kg*
m_2	Absorber mass	0.8	*kg*
k_1	Linear stiffness of the main system	44	N/m
k1'	Nonlinear stiffness of the main system	8	*N/m3*
k_2	Linear absorber stiffness	2	N/m^3
k2'	Nonlinear absorber stiffness	0.5	N/m^3

Linear damping constant of the

3 The multiple scales method applied to a nonlinear mechanical system

In this section, our aim is to use the multiple scale technique according to [23] to uniformly approximate the solution of Eqs. (3) and (4). In order to perform the calculation, we will consider the expansion of the solution with two terms

$$x_1(t.;\varepsilon) = x_{10}(T_0, T_1) + \varepsilon x_{11}(T_0, T_1) \quad (7)$$

$$x_2(t.;\varepsilon) = x_{12}(T_0, T_1) + \varepsilon x_{21}(T_0, T_1) \quad (8)$$

where $T_0 = t$ and $T_1 = \varepsilon t$, represent the slow and fast scale, respectively, of the time. As can

be seen, the expansion is performed until□*(□)*, and $x_j, j = 1,2$, are functions to be determined.

Taking into account the previous comments and using the chain of rules, the first and second order derivatives of x in relation to time should be expressed in terms of partial derivatives, relatively the T_n such that,

$$\frac{dx}{dt} = D_0 + \varepsilon D_1, \quad (9)$$

$$\frac{d^2x}{dt^2} = D_0^2 + 2\varepsilon D_0 D_1, \quad (10)$$

where $D_n = \frac{\partial}{\partial T_n}$ $(n = 0,1,...)$ are differential operators.

Substituting Eqs. (7) and (8) in Eqs. (3) and (4) and separating the terms with power of the same order, we obtain the following set of equations:

Order ε^0:

$$(D_0^2 + \omega_1^2)x_{10} = 0 \quad (11)$$

$$(D_0^2 + \omega_2^2)x_{20} = \omega_2^2 x_{10} \quad (12)$$

• Order ε^1:

$$(-D\square 022D + 0\omega(12x10)x - 11x = 20f)\cos(\square t) - 2D0D1x10 - \square 1D1x10 - \square 1x103 + \square 2x20 + \square 3(x20 - x10)3 -$$

(13)

$$(D_0^2 + \omega_2^2)x_{21} = -2D_0 D_1 x_{20} + \omega_2^2 x_{11} - \square_1(x_{20} - x_{10})^3 - \square_3 D_0(x_{20} - x_{10}) \quad (14)$$

The general solutions of Eqs. (11) and (12) can be expressed in the following ways:

$x_{10} = Ae^{i\square 1T0} + cc$ (15)

$x_{20} = Be^{i\square 21T0} + \square_1 Ae^{i\square 1T0} + cc$ (16)

where $\Gamma_1 =$ _____$^{\omega 22}{}_2$, A and B are unknown functions of T_1 and which can be calculated from

$\omega_2^2 - \omega_1$

the elimination of secular terms at the right hand side of the equations. The particular solutions of Eqs. (13) and (14) are given by:

$$x11 = Ce i\omega 1T0 + U1ei\,\Omega T0 + H1e3i\omega 1T0 + H2ei\omega 2T0 + H3e3i\omega 2T0 + H4ei(2\omega 1 + \omega 2)T0$$

$$+ {}^{H}{}_{5}ei(2\omega_1 - \omega_2)T_0 + {}^{H}{}_{6}ei(\omega_1 + 2\omega_2)T_0 + {}^{H}{}_{7}ei(\omega_1 - 2\omega_2)T_0 + cc \quad (17)$$

$$x21 = Dei\omega 2T0 + U\,2ei\,\Omega T0 + H\,8ei\omega 1T0 + H\,9e3i\omega 1T0 + H10e3i\omega 2T0 + H11ei(2\omega 1 + \omega 2)T0 \quad (18)$$

$$+ H12ei(2\omega 1 - \omega 2)T0 + H13ei(\omega 1 + 2\omega 2)T0 + H14ei(\omega 1 - 2\omega 2)T0 + cc$$

where C, D, U_j, $j = 1,2$. and $H_i = 1, \ldots 14$, are complex functions in T_1.

The general solution of x_1 and x_2 until the first order approximation is given by:

$x_1 = x_{10} + \varepsilon x_{11}$ (19)

$x_2 = x_{20} + \varepsilon x_{21}$ (20)

3.1 Evaluation of the response obtained by the Multiple Scale Method

The search for precisely approximate solutions of an equation can be performed in two ways: Numerical Method (Fourth-Order Runge-Kutta Method) and Analytical Methods (Multiple Scale Method). An analytical approach is obtained when a parameter of the problem is small, hence the name [10], [24].

After the solution has been calculated analytically, it can be observed to what extent the numerical solution of the system in question can be approximated

In order to evaluate the efficiency of the analytical solution through the Multiple Scale Method and the numerical solution (fourth order Runge-Kutta), the relation between these two solutions is presented in Figure 2 (a) and (b). Considering this, it can be observed that the perturbation method used is satisfactory to represent the response of the presented non-linear system. The values are listed in Table 1, presented in the previous section.

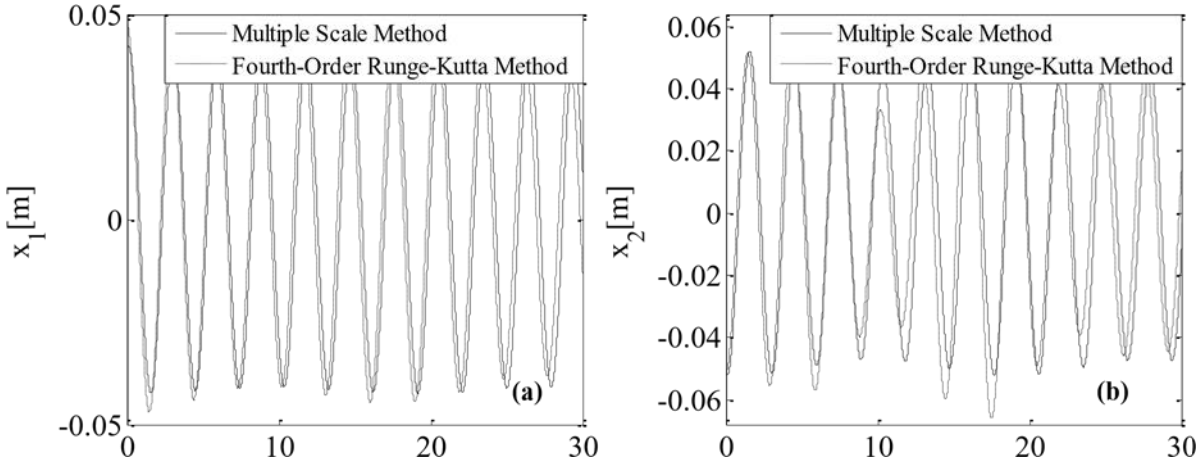


Figure 2: main system (a) and absorber (b): numerical solution - equation (3) and (4) and analytical solution - equations (19) and (20).

This shows that the general solution obtained by the perturbation method, to the first order approximation is sufficiently close to the numerical solution for the nonlinear system, although it presents some discrepancy points of the oscillation amplitude. For better accuracy of the analytical solution, generally terms of higher orders have to be considered in the expansion [11], [25].

4 Study of the stability in the mechanical system

The stability of the vibratory system of two degrees of freedom, with damping, is investigated for the case of the primary resonance, i.e., in which the frequency of the external excitation Ω is very close to the natural frequency ω_1, As usual, instead of using the excitation frequency Ω as a parameter, a tuning parameter σ is introduced, such that [26]:

$$\Omega = \omega_1 + \varepsilon\sigma , \qquad (21)$$

Substituting Eq. (21) in Eqs. (13) and (14) and eliminating the secular terms leads to the following conditions of solvability:

$$2i\omega 1D1A = [-\xi 1i\omega 1 + \alpha 2\Gamma 1 + \xi 2i\omega 1(\Gamma 1 - 1)]A -$$

$$- 3[\alpha 1\alpha 3(\Gamma 1 - 1)3\,]A2\quad A + 6\alpha 3(\Gamma 1 - 1)ABB + 2f\, ei\sigma\sigma 1 \qquad (22)$$

$$2$$

$$\omega 2\,[6\alpha 3(\Gamma 1 - 1)2\,AAB + (\xi 2i\omega 2 + \alpha 2\,)B + 2iD1\omega 2B =$$

$$(\omega 12 - \omega 22\,) \qquad (23)$$

$$+ 3\alpha 3B2B] - 6\beta 1(\Gamma 1 - 1)2\,AAB - \xi 3i\omega 2B - 3\beta 1B2B$$

Expressing the complex functions A and B in polar form, we have:

$$1\ i\theta \qquad (24)$$

$$A = ae\ 2$$

$$1\quad i\gamma \qquad (25)$$

B = be

2

where, a, b, □ and □ are real. Substituting Eqs. (24) and (25) in Eqs. (22) and (23) and separating the real and imaginary parts, we obtain the following set of solutions:

a' = c1a −dsen(η) (26)

aη' = c2a + c3a3 + c4 ab2 − dcos(η) (27)

b' = c5b (28)

bγ' = c6b+c7b3 +c8a2b (29)

where

f 1 1 3 3], (30)

d = ,c1 = [−ξ1 + ξ2(Γ1 −1)],c2 =− α2Γ1, c3 = [α1 −α3(Γ1 −1)

2ω12 2ω18ω1

3 1 2),c6 =−α2Γ2ω2 (31)

c4 =− α3(Γ1 −1),c5 = (ξ2ω2 Γ2 − ξ3

4ω12

3 3 3 2

c7 =− α3ω2 Γ2 +β1 ,c8 =− α3(Γ1 −1) ω2 Γ2 +

8 8ω24

1

β1 Γ1 −1)2 (32)

where Γ2 = 2 2 , η = θ −σT1, a and θ are the amplitude and phase of the main system, ω1 −ω2 respectively, b and □ are amplitudes and phase of the absorber.

In order to obtain stationary solutions, we do a' = b' = η' = γ' = 0 in (26) - (29). Thus, the stationary values become solutions of an algebraic system of equations:

c1a−dsen(η)=0 (33)

(c2 −σ)a + c3a3 −c4ab2 − dcos(η) = 0 (34)

c5b =0 (35)

c6b +c7b3 +c8 a2b = 0 (36)

Resolving the resulting algebraic equations (33) - (36) produces three possibilities for the fixed points, namely:

Case (1):a □ 0,b = 0;

Case (2):a = 0,b □ 0 and Case (3):a □ 0,b □ 0 . in which only the first can happen.

Thus, considering b=0 and squaring the two sides of each of the Eqs. (33) and (34) and summing them, we obtain:

[(c2 −σ+c3a2)2]a2 +c12a2 =d2 (37)

which is the frequency response for the system given in Fig.1.

It is worth mentioning that the values of a and □ are solutions of Eqs. (33) and (34), since the case in which b =0is considered.

Figure 3 shows the variation in a and □ in relation to T1 calculated by a numerical integration of equations (33) and (34). It can be noted that, in principle a and □ exhibit oscillations, but in the steady state it becomes constant.

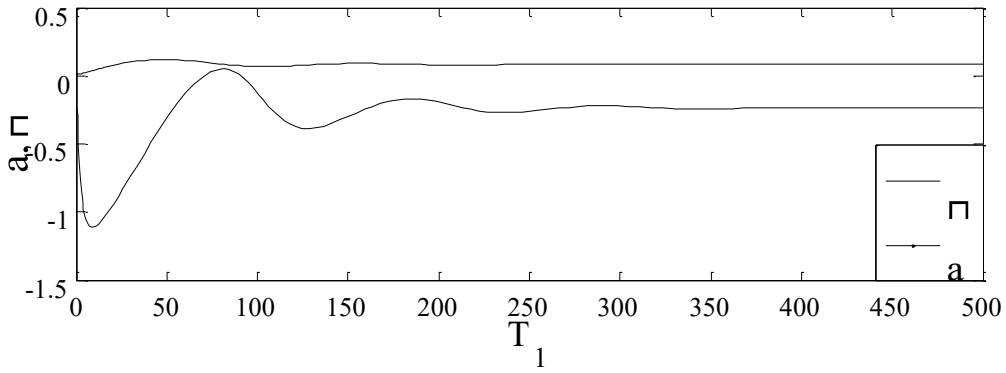


Figure 3: Variation in *a* and *η* with T_1 numerically calculated (25) and (26) to $\sigma = 0$, $b = 0$, $a(0) = 0.01$ and $\eta(0) = 0.01$.

In order to analyze the stability, we will use the method by Andronov and Vitt (see [27] and [23]). Thus, considering the first order approximate:

$$\begin{aligned} a &= a_0 + a_1 \\ \eta &= \eta_0 + \eta_1 \\ b &= b_0 + b_1 \end{aligned} \tag{38}$$

where a_0 , η_0 and b_0 are solutions of the steady state. Substituting Eq. (38) in equations (33)-(36), we have:

$$\begin{bmatrix} a_1' \\ \eta_1' \\ b_1' \end{bmatrix} = J \begin{bmatrix} a_1 \\ \eta_1 \\ b_1 \end{bmatrix}, \tag{39}$$

where J is the Jacobian matrix given by:

$$J = \begin{bmatrix} 0 & c_1 & -(c_2 - \sigma)a_0 - c_3 a_0^3 & 0 \\ \frac{(c_2 - \sigma)}{} + 3c_3 a_0 & c_1 & 0 & \end{bmatrix}. \tag{40}$$

$\square\ a_0 \quad \square\ \square_{\square} \quad 0 \quad 0 \quad c_5\square\square$

The eigenvalues of matrix J are given by:

$$\lambda^3 + c_9\lambda^2 + c_{10}\lambda + c_{11} = 0 \tag{41}$$

where c_9, c_{10} and c_{11} are the following constants:

$$c_9 = -2c_1 - c_5 \tag{42}$$

$$c10 = 3a04c32 + 4a02c2c3 - 4a02c3\sigma + c22 - 2c2\sigma + c12 + 2c5c1 + \sigma 2 \tag{43}$$

$$c11 = -3c5a04c32 - 4c5a02c2c3 + 4c5a02c3\sigma - c5c22 + 2c5c2\sigma - c5c12 - c5\sigma 2 \tag{44}$$

4.1 Saddle-node bifurcation

The real parts of the eigenvalues of matrix J determines the amplitude of oscillations of the coupled system (3) and (4). Thus, if we denote by λ_{ci} the eigenvalues of matrix J, we see that equation $Real(\lambda_{ci})=0$ determines the points at which the solutions bifurcate, [28], [29]. In it, there are three real solutions between two points of vertical tangent, which are called limit point bifurcation, known in the literature as saddle-node bifurcation.

The saddle-node bifurcation is a nonlinear phenomenon and is related with a nonlinear model of a quadratic equation [30]. At the saddle-nodes, the tangency of the frequency response curve is vertical. The locations of the jumping points are obtained through differentiation of the

^{2} d^{σ} frequency response Eq. (37) with respect to a and considering $\_\_\_da_2 = 0$. Thus, the resulting expression is

$$(c_3a^2 + c_2 - \square)^2 + c_1^2 + 2a^2c_3(c_3a^2 + c_2 - \square) = 0\,, \tag{45}$$

in which the solution is given by:

$$\sigma_{\square} = c_2 + 2c_3a^2 \square\ c_3^2a^4 - \sqrt{c_1^2}\,. \tag{46}$$

From equations (46), we can obtain an interval $\sigma_- \square \sigma \square \sigma_+$ in which three real and positive solutions can be obtained from Eq. (37).

4.2 Stability analysis

The stability region of the frequency response curve, Eq. (37), will be determined by Routh-Rurwitz criterion. A system is considered stable if all eigenvalues of the Jacobian matrix associated with a particular point of balance have a negative real part [10]. In order to apply the Routh-Hurwitz criterion, all coefficients

and determinants of Hurwitz matrix (H) must be positive. If one of these values is negative, the Jacobian matrix has at least one eigenvalue with a positive real part, making the system unstable [7].
Thus, considering Eq. (41), matrix *H* is constructed:

$$H = \begin{bmatrix} c_9 & c_{11} & 0 \\ 1 & c_{10} & 0 \\ 0 & c_9 & c_{11} \end{bmatrix}. \quad (47)$$

Applying the Routh-Hurwitz criterion in Eq.(41), we obtain the following set of inequalities $c_9 > 0, c_{10} > 0, c_{11} > 0, c_9c_{10} - c_{11} > 0, c_9c_{10}c_{11} - c_{11}^2 > 0.$ (48)

If the expressions are in accordance with Eq. (48), then all the critical points of the system given by Eqs (26) to (29) are stable, otherwise they are unstable.

4.3 Frequency response for the system

The expression given in Eq.(37) is a nonlinear algebraic equation solved numerically using implementations in software MATLAB® and the result is shown in Fig. 4. In this figure, the frequency response curve is composed of continuous and dashed lines, which represent the stable and unstable solutions, respectively, calculated according to the Routh-Hurwitz criterion.

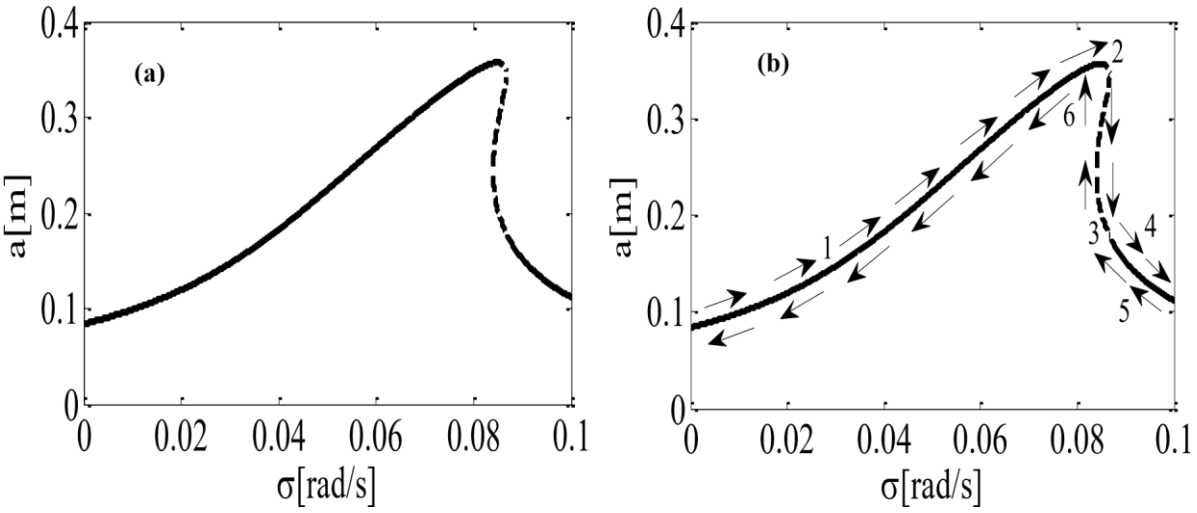


Figure 4: (a) Amplitude of the main system in case of a primary resonance with $f_0 = 0.2106N$, (b) Jump Phenomenon.

In Figure 4 (a), we note that the curve shows the jump phenomenon that is one of the outstanding characteristics of nonlinear systems. The jumping phenomenon occurs where the steady state behavior

changes dramatically due to a transition from one stable solution to another unstable solution when the tuning parameter □ is varied.

Figure 4 (b) shows the jump phenomenon. Initially, in point 1, we see that the curve of the input frequency □ is low. As the frequency □ is increased, amplitude *a* increases until point 2 is reached. If the frequency □ increases, then it undergoes a jump from position 2 to position 3. This part of the response is unstable (eigenvalues of the Jacobian matrix have a positive real part). In addition, a change in its amplitude and phases can be observed. When the frequency □ increases, the amplitude follows curve Section 3 towards point 4. On the other hand, in the opposite direction, there is a decrease in the values of the frequency. In this figure, the frequency response for the main system was also observed. It has a maximum value of peak amplitude in $a_{max} = 0.3568m$ that occurs when □= 0.0850 *rad /s* and presents an unstable region in the interval $0.08399 \leq \sigma \leq 0.08669$, as shown in the eigenvalues listed in Table 2. Is worth mentioning that the stability region was obtained applying the Routh Hurwitz criterion as described above.

Table 2: Eigenvalues of the system with nonlinear absorber in force $f_0 = 0.2106N$.

σ	λ_1	λ_2	λ_3
0	-0.0137 + 0.05872i	-0.0137 - 0.05872i	-0.045
0.08	-0.0137 + 0.014051i	-0.0137 - 0.014051i	-0.045
0.08398	-0.0137 - 0.0073204i	-0.0137 + 0.0073204i	-0.045
0.08399	-0.0137 + 0.007265i -0.028148	-0.0137 - 0.007265i 0.00062373	-0.045
0.08669	-0.0137 +0.01465-0.026818 i -0.026881	-0.0137-0.00070583 - 0.01465 i -0.00064263	-0.045
0.08671	-0.0137 + 0.01472-0.028113 i	-0.01370.00058928 - 0.01472 i	-0.045
0.09	-0.0137 + 0.023129i	-0.0137 - 0.023129i	-0.045
0.1	-0.0137 + 0.03856i	-0.0137 - 0.03856i	-0.045

5 Numerical results and discussion

To study, numerically, the behavior of the main system and the absorber, the Runge-Kutta fourth-order method was applied to Eqs. (3) and (4) with implementations in software Matlab®, according to [31]. In order to do this, we rewrite Eqs. (3) and (4) as a system of first order differential equations, given by:

$\dot{x}_1 = y_1$

$$\dot{y}_1 = -\alpha_{12} x_1 - \alpha_1 (x_1^3) - \alpha_1 y_1 + \alpha_2 x_2$$

$$+\alpha_3 (x_2 - x_1)^3 - \alpha_2 (y_1 - y_2) + f\cos(\Omega t)$$

(49)

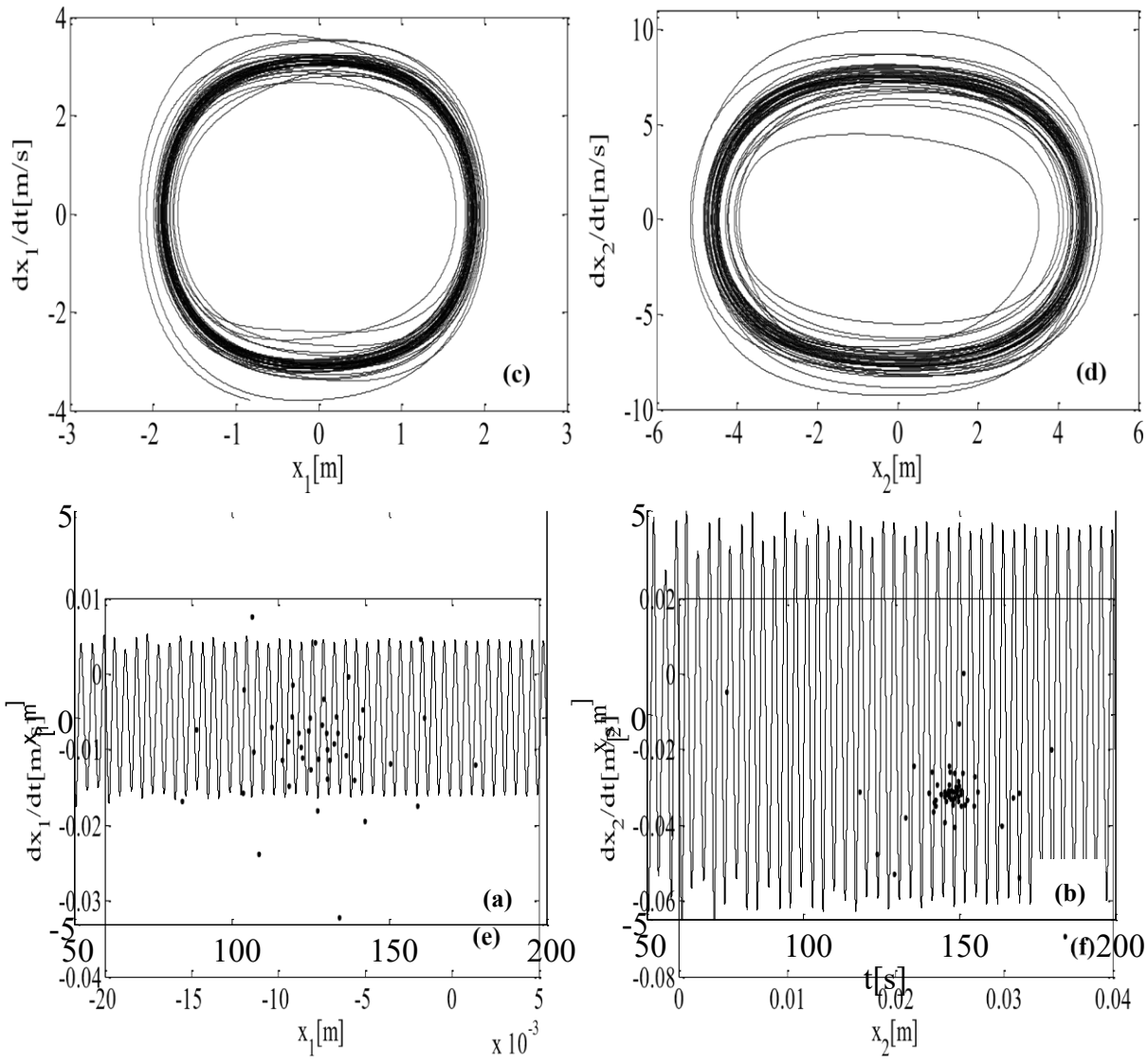
$$\dot{x}_2 = y_2$$

$$\dot{y}_2 = -\alpha_{22} (x_2 - x_1) - \alpha_1 (x_2 - x_1)^3$$

$$-\alpha_3 (y_2 - y_1)$$

The responses in the time domain, phase planes and Poincare sections of the main system and absorber, varying the parameter of amplitude force are shown in Figures 5 - 7. In this study, we considered the case of primary resonance. The simulations were performed eliminating the initial transient part and the values of system parameters are listed in Table 1.

Figure 5: (a) – (b) Response, (c) – (d) phase plan and (e) – (f) sections of Poincaré of the main system



and absorber, respectively, in primary resonance Ω □□1 and f =0.02.

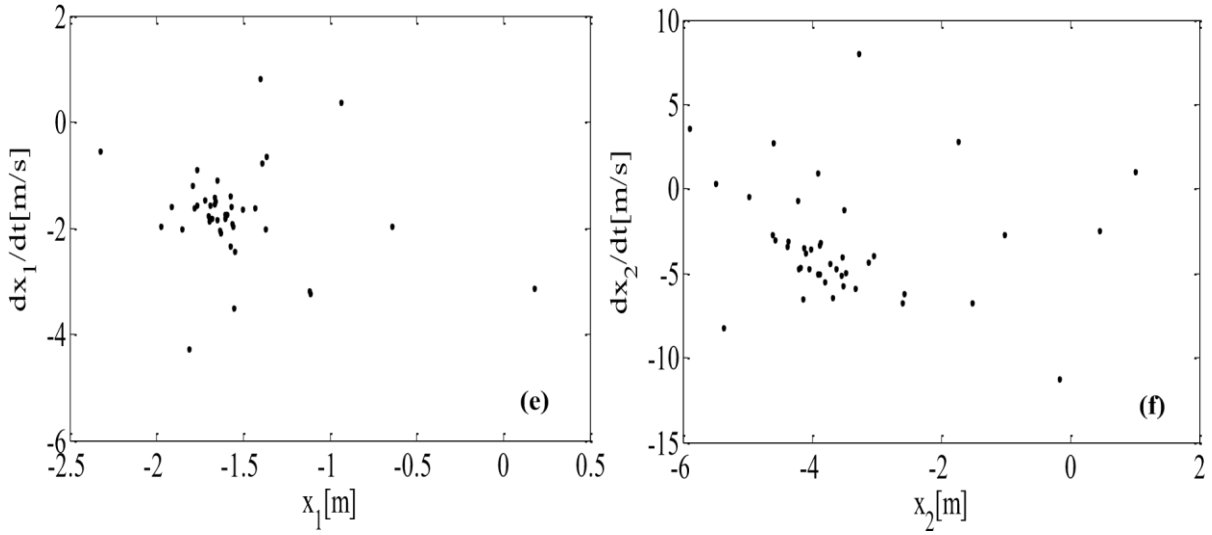


Figure 6. (a) – (b) Response, (c) – (d) phase plan and (e) – (f) Poincaré section of the main and absorber system, respectively, in primary resonance $\Omega \square\square_1$ and $f = 5$.

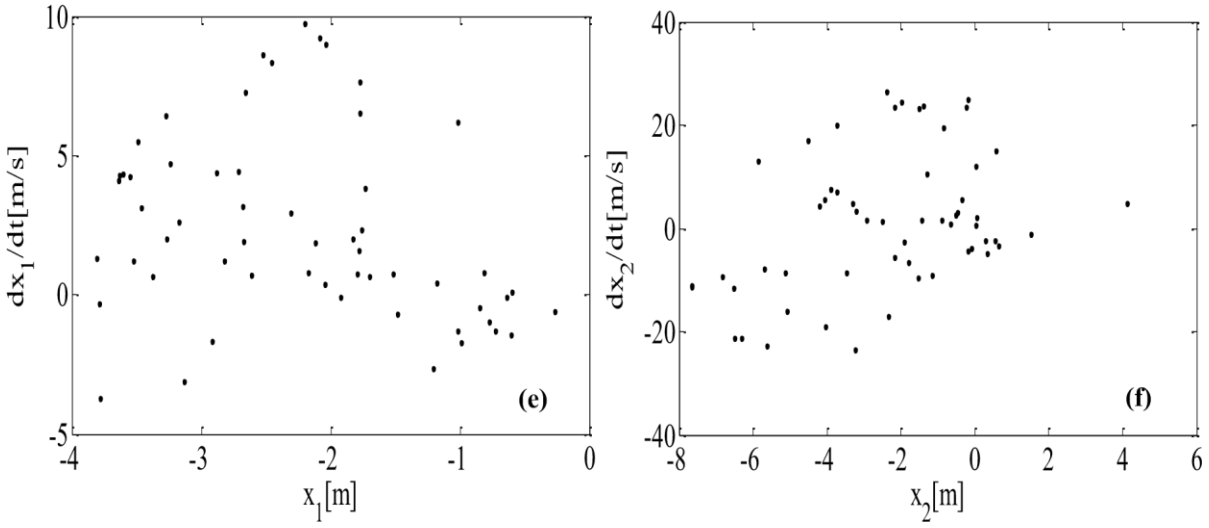
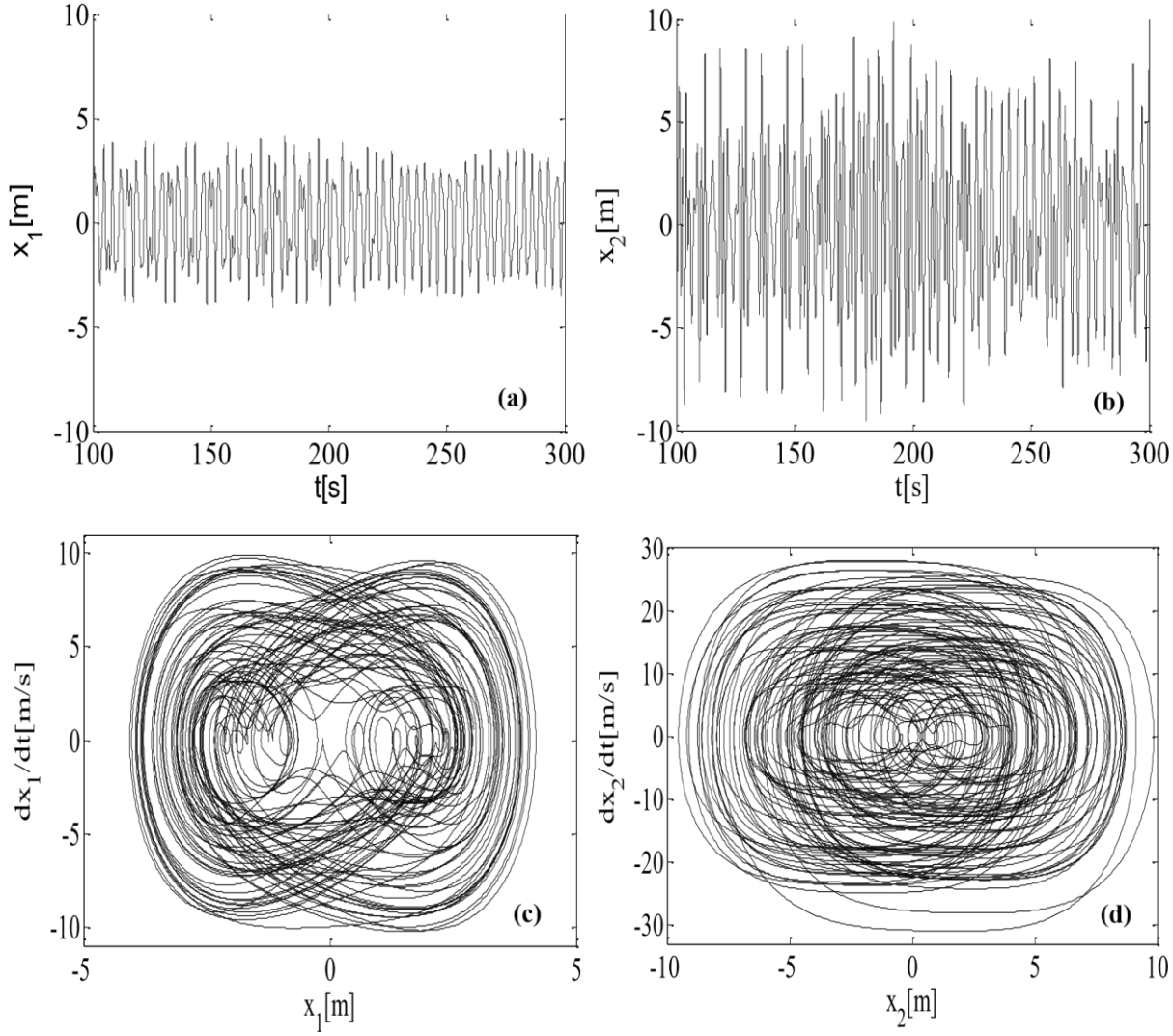


Figure 7: (a) – (b) Response, (c) – (d) phase plan and (e) – (f) Poincaré section of both the main and

absorber system, respectively, in primary resonance $\Omega \approx \Omega_1$ and $f = 15$.



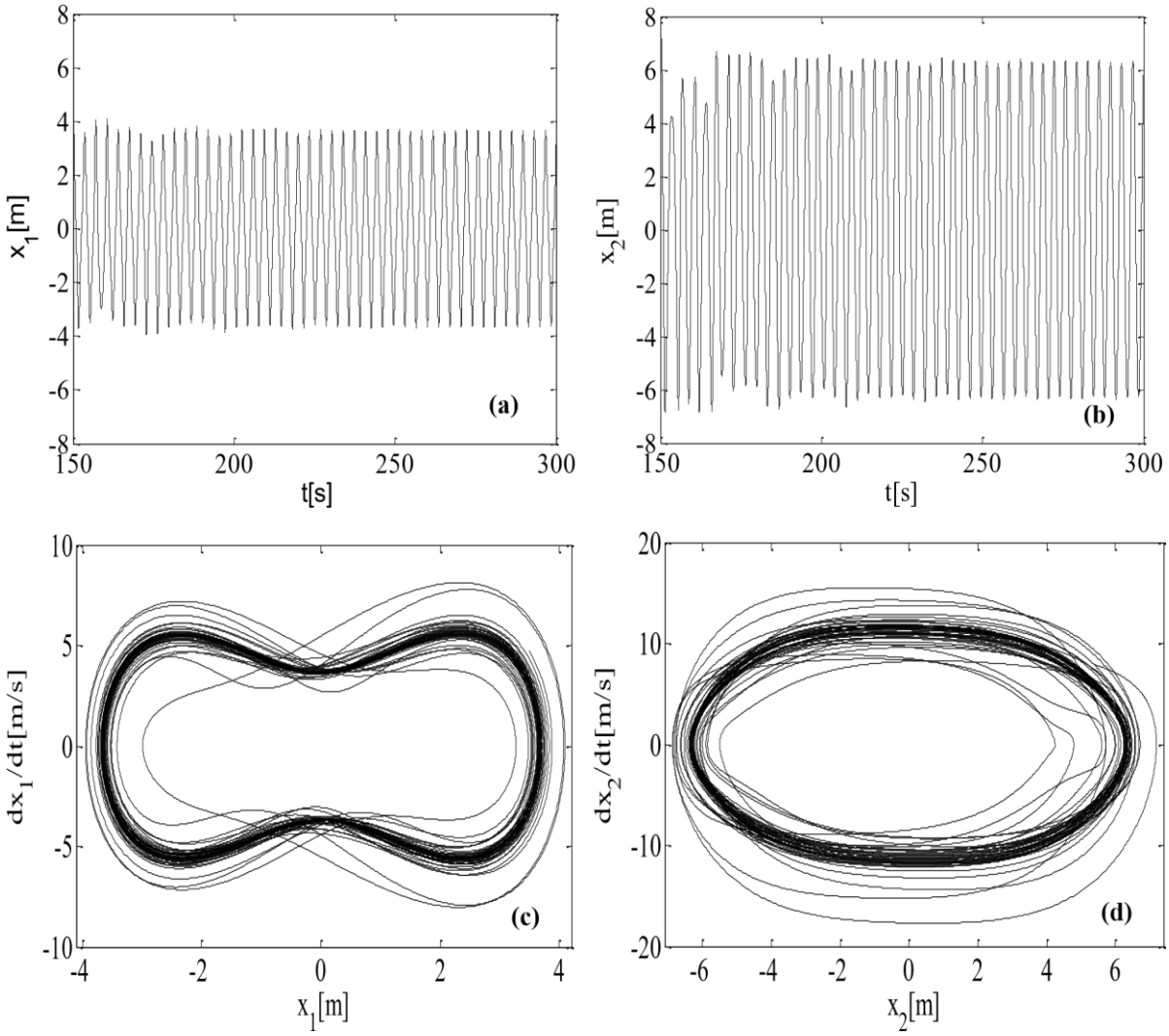
In Figure 5, when $f = 0.02$, note that the graphics of evolution in the time domain, represented by (a) and (b), in Figure 5 correspond to the behavior of both the main and secondary system (absorber), respectively, which exhibit low-amplitude oscillations around the steady solution. They are initially irregular, and after a period of time, become regular. It can be observed that the closed curves in the phase pictures, Figure 5 (c) and (d), for both the main system and the absorber system, are characteristic of periodic behavior. As a result of this, the Poincaré sections display points closer to each other, as can be seen in Figure 6 (e) and (f):

For $f = 5$, Figure 6 (a) and (b), we note a considerable increase in the response amplitudes of both the main system and the absorber. In the phase picture, given by Figure 6 (c) and (d), it can be observed that an increase in the oscillation of the system occurs. However, both systems continue to show considerable stable behavior, as shown in the Poincaré sections, Figure 6 (e) and (f).

In Fig. 7 (a) and (b), the responses in the time domain for $f = 15$ are observed. In these responses, both the main system and the absorber have irregular oscillations, that is, there is a well-defined period. On the other hand, Figure 7 (c) and 7 (d) show evidence of chaotic behavior. This behavior is obtained by analyzing the

Poincaré section of both main and secondary systems (absorber), according to Figure 7 (e) and (f), respectively, as their points are irregularly scattered on the phase plane.

Fig.8 shows the results obtained for the main system and absorber, for $f = 25$. When compared with $f = 15$ in Figure 7, the behavior of the complete system in the case $f=25$ (Figure 8), is more stable, but still exhibits chaotic behavior. Figure 9 shows responses of the system (both main and absorber system) for $f = 30$. The system presents chaotic behavior showing an increase in irregular variation (c) and (d). Fig. 9 (e) and (f) for the main and secondary (absorber) systems also show a large number of scattered points in the plane.



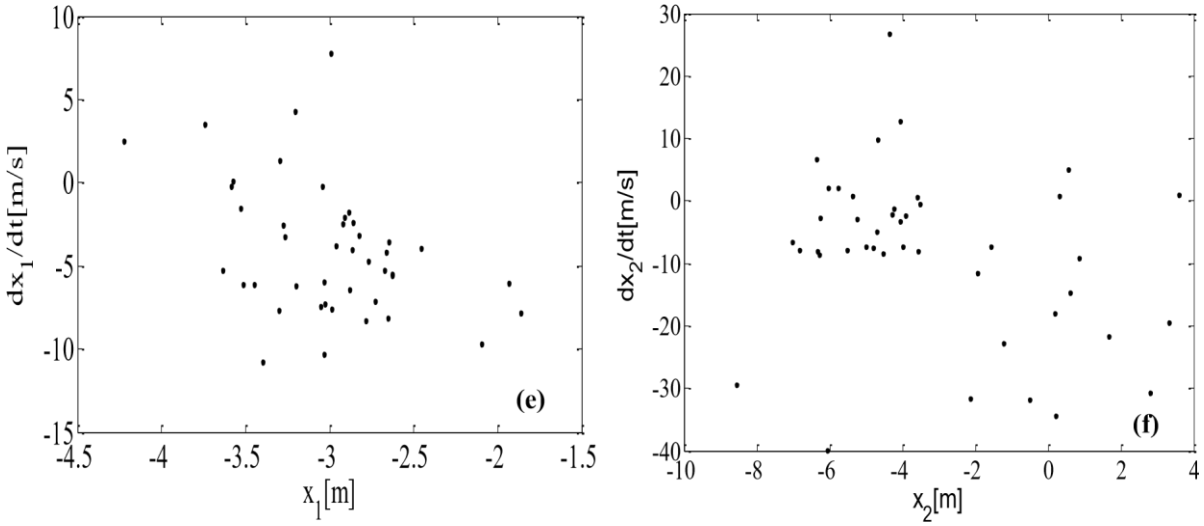
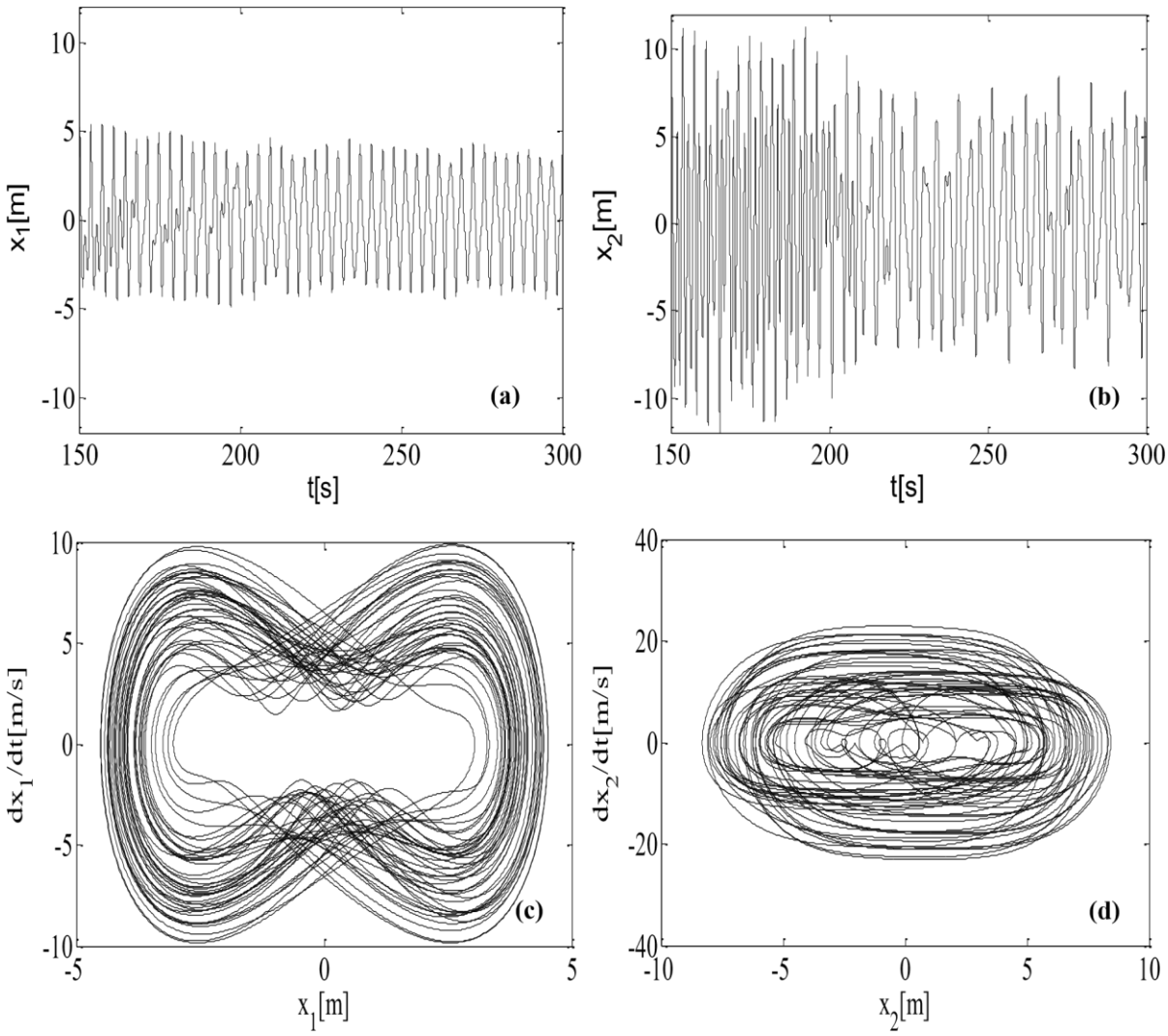


Figura 8: (a) – (b) Response, (c) – (d) phase plan and (e) – (f) Poincaré section of both the main and absorber system respectively, in primary resonance $\Omega \approx \omega_1$ and $f = 25$.



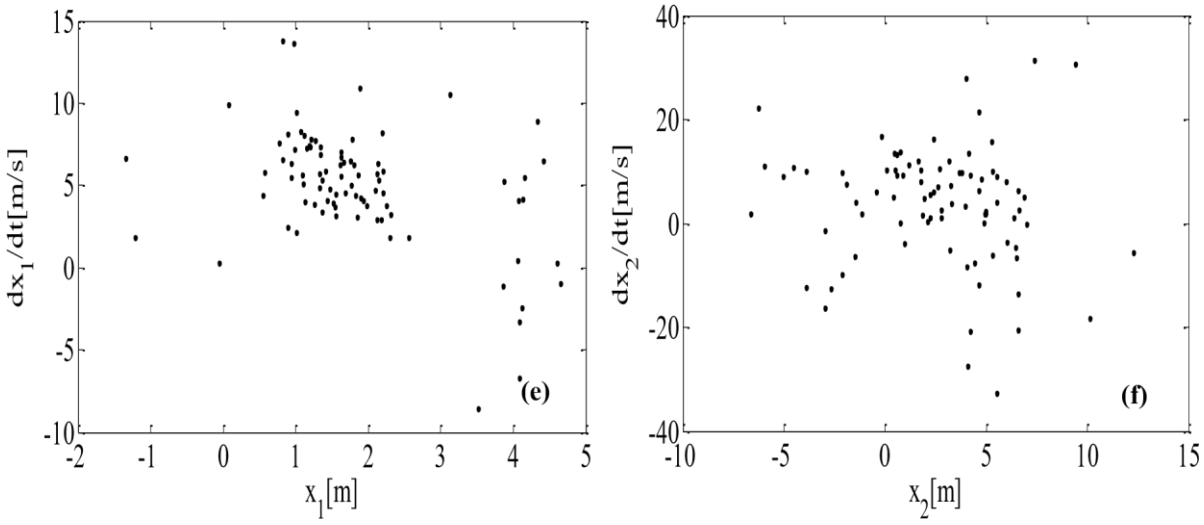


Figura 9: (a) – (b) Response, (c) – (d) phase plan and (e) – (f) Poincaré section for the main system and absorber, respectively, in primary resonance $\Omega \approx \omega_1$ and $f = 30$.

5.1 Lyapunov Exponent

In this section, we apply the methods of Lyapunov exponents to analyze the existence of both periodic and chaotic orbits, [23]. As we can see from system (Eq. 50), the set of equations form a nonautonomous system. In order to transform it into an autonomous one, we introduce the new variable z = t, obtained from the autonomous system below,

$$\dot{x}_1 = y_1$$

$$\dot{y}_1 = -\omega_1^2 x_1 - \omega_1 (x_1^3) - \omega_1 y_1 + \omega_2 x_2 + \omega_3 (x_2 - x_1)^3 - \omega_2 (y_1 - y_2) + f\cos(\omega z)$$

$$\dot{x}_2 = y_2 \qquad (50)$$

$$\omega \dot{y}_2 = -\omega_{22}(x_2 - x_1) - \omega \omega_1 (x_2 - x_1)^3 - \omega \omega_3 (y_2 - y_1)$$

$$\omega \dot{z} = 1$$

From the system of equations (50), we perform the calculation of Lyapunov exponents, using a computer program implemented in the Matlab® software. The results are shown in Figure 10 (a) – (f) for the following values $f = 0.02$, (b) $f = 5$, (c) $f = 15$, (d) $f = 25$, (e) $f = 30$ and (f) $f = 40$, respectively. The parameter values used in the simulations are listed in Table 1, and the initial conditions are considered zero. It is worth mentioning that the first two hundred iterations were eliminated to better interpret these exponents.

We can see from Figures 10 (a) and (b) for $f = 0.02$ and $f = 5$, respectively, that the system has periodic behavior, since most of their exponents are null, indicating that the paths do not diverge. In the case where

f = 15, *f = 25*, *f = 30* e *f* = 40, Figure 10 (c), (d), (e) and (f), respectively, shows that the solutions of the system exhibit chaotic behavior, i.e., it presented Lyapunov positive exponents. In these cases, there is a separation of paths when they migrate to a certain direction with a passage of time, featuring chaos.

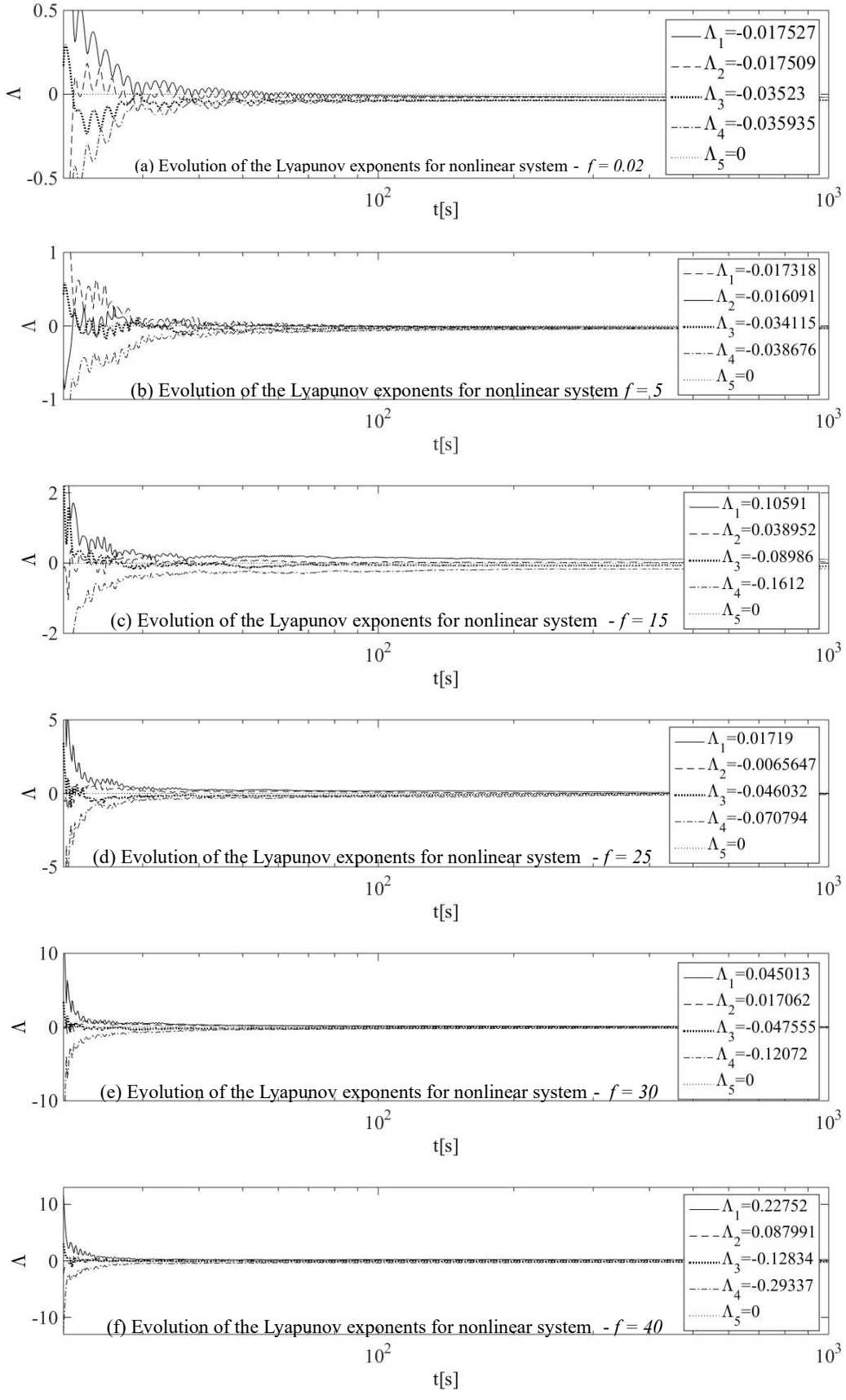


Figure 10. Evolution of the Lyapunov exponents of the system with nonlinear absorber (*f = 0.02, 5, 15, 25, 30, 40)*

The responses in the time domain phase Portrait phase and the Poincaré sections showed the presence of chaotic behavior in the dynamics system, verified by the analysis of the signs of Exponents Lyapunov, as presented in Table 3.

Table 3 – Signs of Lyapunov Exponents

Driving amplitude *f*	Signs of Lyapunov Exponents			
0.02	–	–	–	–
5	–	–	–	–
15	+	+	–	–
25	+	–	–	–
30	+	+	–	–
40	+	+	–	–

Figure 11 shows the global behavior of the system (Eq.49). As we can see the system undergoes bifurcations [32] for frequency values between (10 – 20), (28 – 32), (36 – 50) for both the main and secondary system.

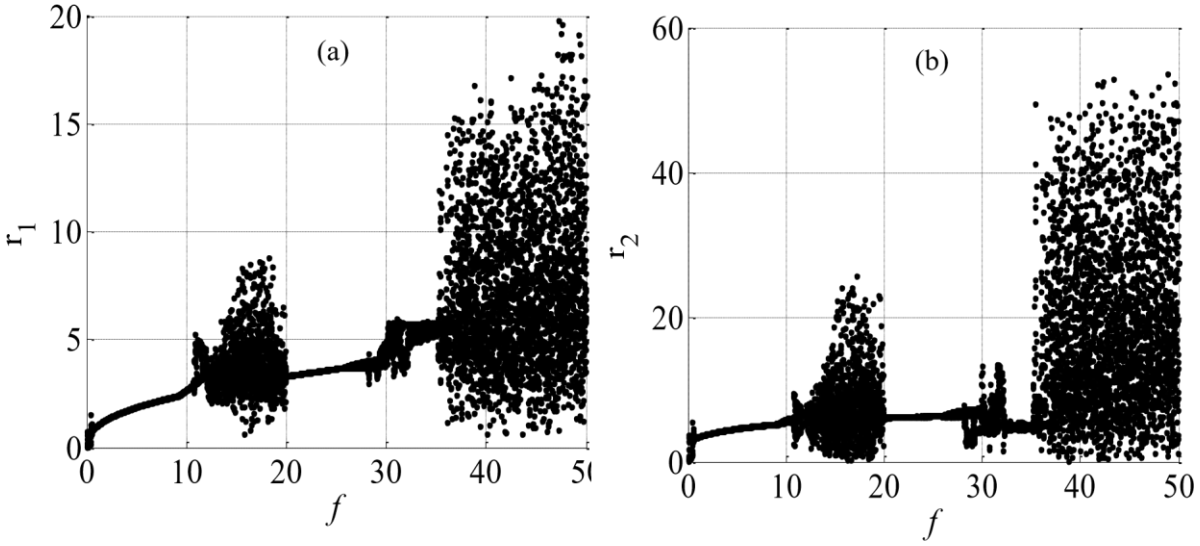


Figure 11: A bifurcation diagram for (a) main system and (b) absorber

In the bifurcation diagram for the primary system (Figure 11 (a)), it can be observed that for $0<f<10.5$, there are regions where parameter f is associated with a finite number of points. It can be observed in this figure that for f values given by $10.5 <f <20$, the system is modified to a regime of unstable solutions and in this case it can be seen that there is a bifurcation of the solution. However, for the interval $20 <f <26$, the system exhibits a stable behavior, but again the system presents a region of solution instabilities by increasing the magnitude of the force in the region that comprises the interval $26 <f <50$.
Figure 11 (b) shows that the absorber has a very similar behavior to the main system, which values $0 < f < 9$ and $20 < f < 26$ the parameter f is associated with a finite number of points, and for $9 < f < 20$ and $26 < f < 50$ the regions have shown clouds of points, indicating where the chaotic behavior occurs.

6 Conclusion

In this paper, we investigated the behavior of a nonlinear system with a nonlinear absorber in primary resonance, discussing the characteristics of the theory of mechanical vibration as a nonlinear system. As shown in the numerical simulations, it can be observed that the Multiple Scale Method satisfactorily describes the behavior of the coupled system.

For the primary resonance case, the amplitude of frequency response of the main system, with force $f_0 = 0.2106N$, corresponds to a curve which exhibits the jumping phenomena, which consists of a curve where in one direction the system has stability and in another the system exhibits instability behavior. The region of stability of the solutions is determined by Routh-Rurwitz criterion, which is efficient analysis from both stability and instability behavior.

We pointed out that the interval of $0.08399 \square \sigma \square 0.08669$ comprises a region in which the Routh-Hurwitz criterion is not satisfied and therefore, it is called an unstable region. This is due to the fact that the one of eigenvalues of the equations has a positive real part.
Numerical results are presented in different ways: time domain responses, in phase portrait form, Poincare sections and Lyapunov exponents. The computational simulations were performed through computer programs in MATLAB® software. The time domain responses show trajectories, initially irregular, becoming regular when time goes to infinity. Analyzing the phase portraits, it is evident that the system presents an unstable (chaotic) irregular behavior. The Poincare sections have irregular oscillations with a number of periods, which are not defined.
The stability of the system in question is verified by means of two important criteria of nonlinear dynamics, namely Routh-Hurwitz criterion and an analysis of Lyapunov exponents. The theory of the Lyapunov exponent is also a useful tool in the stability analysis, since the simulations showed the existence of a positive exponent, ensuring the existence of chaos. In addition, the simulations indicated the existence of a zero exponent, which according to theory, ensures the existence of a periodic response. Therefore, both Routh-Hurwitz criterion and Lyapunov exponents provided good results regarding the stability of dynamic systems.

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Sharing Information and Knowledge Between Brazilian Researchers

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Summary

The CIC among Brazilian researchers refers to the activity of providing information and knowledge that enables the joint work of experts for the resolution of problems and development of new ideas or theories, which usually result in joint scientific publications. Thus, the objective of this article is to elaborate a model that relates the factors that influence the diffusion of the CIC among Brazilian researchers in the modality "productivity" of CNPq, as mechanisms for generating innovations and new knowledge, measured by scientific production. As for the method, in a first moment a bibliographic research was carried out to evaluate existing models in the literature regarding the determining factors of the ICC on the capacity of innovation and generation of innovations in the HEIs, especially in the research groups. Next, the structural and measurement model was elaborated and validated using an online questionnaire for data collection, with five-point likert questions, sent to researchers in the productivity modality in research, levels SR, 2,

1A, 1B and 1C of CNPq. The questionnaire was answered by 262 researchers and the collected data were analyzed using the SEM analysis instrument based on PLS. The results found indicated that the hypotheses of the model were accepted. The results revealed that the individual characteristics of the researchers, the organizational characteristics and the technology contribute to the CIC, which in turn favors the generation of publications and promotion of knowledge. In addition, individual characteristics and publications contribute to the advancement of innovation.

Keywords: Information and knowledge sharing. Innovation capacity. Scientific production. Brazilian Researchers.

1. Introduction

The dynamism with the changes that occurred in the last decades, with the technological advances and the consumption requirements of differentiated products, makes the companies operate in a global competitive environment and justify the fact of the agents of diverse activities to share information and knowledge in a selected scenario for great disruptions, innovations and mobility between people in search of new challenges, advantages and opportunities.

Knowledge Sharing (CC) refers to the task of providing information and know-how to assist and collaborate with others in solving problems, in order to develop new ideas or implement policies or procedures (WANG; NOE; WANG, 2014; Wang; HOU, 2015). Therefore, information sharing occurs with the exchange of elements of determined knowledge, which can even occur between an organization, setting up an organizational learning environment (TAPSCOTT; WILLIAMS, 2007).

No corporate environment with knowledge dissemination created, identified or captured, can be reached by people and technology, configuring a circular stage and representing a form of management by the organization (LEE; LIU; WU, 2011; ZHOU; LI 2012; OYEMOMI et al., 2019).

At the academy, scientists generate knowledge by validating scientific checks previously promoted, and also constituting new advances or discoveries, which once shared are shared with the development of society. For it to be shared, knowledge needs to be created first. The CC among scientists according to Oliveira, Curado and Henriques (2019), is usually promoted by the research leader, especially when it is attributed to highly productive research. Which academy represents or place to create and share knowledge, therefore, such sharing among academics is relevant because it is the first instance in the prototyping of new knowledge, capable of offering applied innovations (NAVIMIPOUR; CHARBAND, 2016; PARK; GABBARD, 2018).

The present study seeks the proportion of a model of Information and Knowledge Sharing (CIC) among researchers in Brazil, which applies broad reflexes in the generation of innovation and quality scientific production, to treat studies focusing on research under an “experimental” modality” Of the National Council for Scientific and Technological Development (CNPq).

Given this purpose, the problematization of this study is concretized in "how to share information and knowledge between researchers and their peers contributed to the generation of innovation and improvement of scientific production?". In view of the exposure, the present investigation aims to develop a model that lists the factors that influence the CIC among academic researchers in Brazil. Such reach, in

the alternative, if the following objectives are specified: i) select, analyze and develop models that are related as studied variables; ii) to characterize the profile of the respondents; iii) discover the factors that facilitate CIC; and, iv) relate the factors of the CIC to the capacity for innovation and organizational performance.

This work is justified by the relevance of the theme and by allowing a better understanding of the factors and reasons why users share information and how this collaboration translates into the increase and generation of new knowledge that is also shared, through scientific production. Therefore, you can obtain empirical empirical data that can contribute to the allocation of human and material resources that impact on the relationship and dissemination of knowledge.

2. Sharing information and knowledge

Some studies about the CIC reveal the understanding that its polarization is aimed at organizations that demand access to new knowledge aiming at innovation. The CIC between teams, agents, people or organizations is a process that involves the movement of knowledge from a source to a recipient and the subsequent absorption and use of that knowledge, with the aim of improving the capacity to capitalize on past experiences and perform activities. (CUMMINGS, 2004; RUPAK et al., 2008).

The understanding about CC for Lin (2007), demonstrates that there is a necessary cultural relationship due to the social interaction in which the exchange of knowledge, experiences and skills occurs. In the view of Ipe (2003) sharing knowledge is basically the act of making knowledge available to others in such a way that it can be used.

The CC together with information between various individuals from different backgrounds, perspectives and motivations becomes a fundamental step towards creating organizational learning by allowing organizations to obtain competitive advantages, reducing rework and costs, improving customer satisfaction and allowing more flexibility to adapt to changes. Organizations, according to Tapsctott and Williams (2007), are able to build knowledge, and when it comes from cooperation and sharing information, it also brings up new collaborative capacities and business models that empower companies. It is also admitted that, sharing a certain knowledge, represents sharing something that has been proven, tested, investigated and accepted as true in a universe of agents involved. So, the information that transits as a means of conveying conceived knowledge, is configured in the way of catalyzing and organizing elements that can form by-products to reach new discoveries.

The CIC depends on interaction and relationships between people, coming up against individual beliefs, values and customs that integrate the organizational culture (DI CHIARA, ALCARÁ; TOMAEL, 2010). It is a communication process that includes the owner who externalizes his knowledge and someone who demands knowledge (HENDRIKS, 1999).

For Cyr and Choo (2010), if on the one hand the CC among employees allows organizations to grow by knowing the experience of the past, which makes it possible to solve problems more quickly, develop new ideas and insights, and avoid rework or repeat work. past mistakes, there is also the understanding that the CC is a more ambiguous proposal, as it requires the employee to spend time and effort to share the knowledge and there is generally concern about how the knowledge will be received and

put to use by others. In organizational contexts, information and knowledge are commonly associated with power.

It is this tension between organizational intent and individual fears that makes CC a significant challenge in organizations (CYR; CHOO, 2010). The authors go on to state that there is little research that analyzes the factors that influence individuals to share knowledge with others in the organization.

This new idea of knowledge management passes on to employees the idea of innovation and, moreover, of creation. And, the purpose with which knowledge transits or diffuses among researchers in different institutions is due to the way in which knowledge management occurs. This can be translated into more developed and innovative end products, always in an intelligent way. However, it is necessary to use specific management practices to encourage intelligent management activities. These management practices also serve as a solution for activities that present problems that require immediate solutions. Thus, management facilitates the sharing of information and assists in quick-reach solutions, requiring creativity, and must also occur concurrently with the construction of the CC. Thus, impacting the financial organization and its performance (GIAMPAOLI; CIAMBOTTI; BONTIS, 2017). Therefore, sharing knowledge has in its essence the development of science and innovation. On the other hand, research agents and other individuals are aware of information as an instrument from which it will be managed.

The concept of innovation is also addressed by Ashok, Narula and Martinez-Noya (2016). The study of these researchers considers various types of users or individuals located, for example, in organizations with research activities, thus resulting in conclusions that illustrate a way of managing knowledge as a direct differential in the innovation program in processes of radical and incremental changes.

In this context, Curado, Munoz-Pascual and Galende (2017), complement the importance of value in sharing information and their positive action in the development of an organization's learning capacity. Thus, it is observed that learning is capable of generating a certain knowledge and develops naturally with the coexistence of information sharing. The information transmission process is related to the capacity of the level of innovation proposed by the organization. Sharing, which in turn promotes learning ability, translates into product innovation generating new knowledge.

George-Walker and Tyler (2014), carried out several studies related to the process of collaboration with the development of knowledge through conceptual mapping, and showed that the function of collaborative mapping incorporates processes that help in the development and generation of new products. Exploration and articulation are examples implemented in this context, with sharing as a key element for a good research team development.

In a complementary way, the study pointed out by Dixon (2000, p. 144), through research with American companies, demonstrated that there are five different ways of CC. The first is Serial Transfer, and occurs when the knowledge that a team acquires when carrying out an activity is transferred to the same team when carrying out subsequent work in a different context. Another is the Close Transfer, where the knowledge that a team acquired when performing a frequent and repetitive task is reused by other teams that perform similar activities. Distant Transfer means the knowledge that a team has acquired when carrying out a non-routine activity and that is made available to other teams in the organization that carry out similar activities. Strategic Transfer is the collective knowledge of the organization necessary for the

achievement of strategies. And finally, the Expert Transfer, which occurs when a team needs to solve a problem and does not have information for decision making, and therefore seeks knowledge from specialists in the organization. Such ways of transferring or sharing knowledge denote a way of organizing, and demonstrates that its transition occurs with the cooperation of information.

Although there are studies that show the importance of CIC in organizations that work with research and development, there are several other empirical studies that reveal the lack of individual and organizational characteristics that prevent sharing (TOHIDINIA; MOSAKHANI, 2010; WANG; NOE; WANG, 2014). The factors that influence the CIC among individuals in organizations are found in the motivation for the act of the opportunity provided, for sharing and revealing the culture of a work environment. There is also the understanding that the organizational identity can be compromised by revealing competences regarding generation through innovation and development (IPE, 2003).

However, CIC is facilitated through people and technology (LEE; LIU; WU, 2011). Although technology can assist in the facilitation process with the capture and distribution of knowledge, the emphasis should be placed on the organization and not on the knowledge itself, by a particular individual. Hence the need to manage knowledge. Koh and Kim (2004), suggest a way to manage an intangible asset, which is promoting the strengthening of the organizational identity through knowledge management. For this, it is necessary a corporate environment that chooses its organizational identity above its intangible attributes, whose understanding is also understood by Crane (2012) as a way of making norms and values unite and strengthen the image of the organization in favor cooperation in market consolidation.

For Hsu (2006), there are three approaches to analyze the CIC: the tools-based approach, the incentives-based approach and the integrative approach. The tool-based approach centers the discussion on the use of information technology for CC (KIM; LEE, 2006; TOHIDINIA; MOSAKHANI, 2010). The second view is based on rationality, as it is believed that employees are willing to share knowledge if there is managerial support that encourages them through rewards. Characterizing the circularization of information as a processing part in the generation of new knowledge from sharing. This approach is centered on the use of incentives to promote knowledge sharing (WOLFE; LORAAS, 2008). And the integrating approach comprises social factors, whether individual or organizational, which in a way is typical in academic environments (IPE, 2003; ORDAZ et al., 2009).

In the conception of Oliveira, Curado and Henriques (2019), the act of sharing between scientists and other individuals linked to research, represents the element of transaction, which now this one does, in exchange for knowledge. This exchange means the resource element, whose relationship established in sharing promotes a positive gain or result to the scientist, which is a result understood as profit. Therefore, sharing knowledge represents a series of resource transactions that are based on the perception of the benefit that will come from this behavior, conceiving profit. It is noticed that the authors start from a premise in which a scientist hopes to obtain benefits from sharing knowledge. This benefit for scientists, when maximized, contributes to the advancement of science (PARK; GABBARD, 2018). Such a characteristic, therefore, demonstrates that the fact that some scientists or even individuals from a certain organization or institution, are likely to share knowledge, with a common goal of prospering and generating the advance of science.

Research leaders are responsible for applying CIC strategies (LIN; LEE, 2004; LIU; PHILLIPS, 2011). The research leader must share knowledge, helping others to achieve goals, and encourage knowledge management practices (DONATE; SÁNCHEZ DE PABLO, 2015; ZHANG; CHENG, 2015). In a way, the leaders of a given research cooperate with the learning processes (VIITALA, 2004). However, it is also worth mentioning the existence of research leaders, who are afraid to share what they know, in the sense that they think that such an act will limit their characteristic of differentiating themselves from their colleagues involved in research, and consequently generating impact negative about CC and the advancement of science (BOCK et al., 2005; RENZL, 2008).

2.1 Factors that influence Information and Knowledge Sharing

According to Riege (2005), people's capacity for CIC depends, first of all, on their communication skills. Effective communication, both verbal and written, is essential for knowledge sharing (DAVENPORT; PRUSAK, 1998). At the individual level, CIC facilitators are related to those of an intimate nature such as expectations, values, attitudes, perception, personality, emotions, feelings, disposition and motivation.

Some studies highlight social networks and the ability of people to interact as facilitators for the CIC (BARON; MARKMAN, 2000; INGRAM; BAUM, 1997; NAHAPIET; GHOSHAL, 1998). Social interactions prior to the process, the formation and development of communities, collective and individual feedback and interpersonal cooperation, are mechanisms that facilitate sharing (CHO et al., 2007). Similarity, familiarity and friendliness are motivators for people to share information within a group (PHILLIPS et al., 2004).

Trust relationships also influence knowledge sharing. Thus, the quality of the relationship between coworkers associated with the perception of competence and professionalism contributes to someone being willing to share (HO et al., 2012; HOLSTE; FIELDS, 2010; KHVATOVA et al., 2016; KUO, 2013; LUCAS, 2005). For Fullwood, Rowley, and Mclean (2018), social exchange and trust are important requirements in the dissemination of knowledge. From them, it becomes easy the initial step for sharing information and, consequently, the development of new techniques in teaching and research institutions for the constitution of knowledge.

In addition, face-to-face contact was another very significant point. When contact between people in a particular department is increased, social cohesion grows significantly. Making trust progress within research centers. However, the archaic structure of these scientific development centers hinders the progress of information sharing. Therefore, information sharing is an intrinsic condition to the existence of the CC, thus constituting the CCI.

Individual factors are decisive for the CCI, and in most cases, workers are the ones who effectively decide whether they want to share their knowledge or not (DUGUID, 2005). Although technology can facilitate the storage of explicit knowledge, tacit knowledge resides in people's minds and its availability and use depend on individual relationships and decisions (HOLSTE; FIELDS, 2010). Specifically, in the case of a research, development and innovation environment, an item that can facilitate or delay the voluntary sharing of knowledge is the reputation of the recipient (ENSIGN; HEBERT, 2010). Therefore, both the past behavior of the recipient and the expectations of actions in the future influence the transmitter

of knowledge to share or not. The recipients' perspective plays a critical role in affecting the motivation of participants in the sharing process (ZHANG; JIANG, 2015).

Among the research scientists, there is a characteristic expected at the CCI, which is to obtain a benefit regarding the recognition of the maximization and advancement of science, which is only achieved when sharing by contributing to the academy (PARK; GABBARD, 2018). In other words, the scientist wants to be recognized as a contributing agent of maximization and innovation in science, as this is his greatest benefit.

It was found that individual factors within teaching centers, or academic environments, are more determinant in the ICC than in places where they depend on cultural aspects that are adapted to the organizational condition of sharing. Within the organizational culture, the role of leadership has, in a way, a great weight compared to autonomy. It is at this point that the concept of rewards is introduced. Exposing, in a way, that top management must guarantee, above all, sharing within the current departments and that the rewards assume a liaison role within the inserted department. In this regard, according to Al-Kurdi, El-Haddadeh, and Eldabi (2018), information sharing provides, in the future, the basis for studies related to technological areas.

Sharing also helps senior management in the process of developing strategies in higher education institutions. Therefore, the technological area needs an information sharing base. That base will support new developments in the future. Based on this, information sharing provides a solid basis for scientific progress, as it facilitates the exchange of ideas in favor of innovative strategies. Also, it is known that sharing is a key point for the study and application of institutional strategies aimed at the progress of higher education. In this way, the new scientific publications will have more harmony in relation to the shared scientific base. The condition for the CIC to occur for the scientist is that there is solid knowledge to share; and, they are more likely to occur when there is a team leader, who has high intensity in his research work and who is not afraid of losing value and power after the CIC (OLIVEIRA et al., 2019).

Sergeeva and Andreeva (2016), carried out empirical studies on information sharing. In relation to organizational variables, it is known that knowledge sharing among individuals in an organization cannot be forced, since it does not have a characteristic whose benefit is given by recognition, as occurs among scientists in academia. Therefore, the organization encourages organizational policies, which is also facilitated by the organizational structure itself (KUO, 2013). The factors that favor the CIC are related to strategy, management model, organizational structure, infrastructure, size of business units, leadership, culture, organizational climate and reward systems (PAGHALED et al., 2011; TOHIDINIA; MOSAKHANI, 2010).

Some organizations grant rewards and technological facilities to their employees in order to stimulate the CIC. The encouragement of sharing, the motivation of people for cooperation, collaborative behavior and the relationship of trust are also influenced by the organizational culture (ISLAM et al., 2015).

There are studies that reveal the importance of developing a culture of sharing, so that institutions continue to grow, as this is also a way of being recognized (ANNANSINGH et al., 2018). In this sense, information sharing is, more precisely, a matter of organizational culture, whose companies attribute it as a form of institutional growth, configuring development as a natural process capable of even strengthening the organization's identity, as already highlighted.

Finally, among the factors that enable CIC among employees of organizations, are Information and Communications Technologies (ICTs), with emphasis on information systems, media and social networks. Fauzi, Tan and Ramayah (2018) highlight that social media develop exponentially. The information technology area is on the rise and, along with this, popular social networks - such as Facebook, Twitter, Instagram and Linkedln - become tools used daily by a large portion of the population to share information. In conjunction with research tools - such as Google - access to information in the 21st century is therefore much more accessible and dynamic. These mechanisms, in the academic environment, can facilitate agility in the communication process of research published among the most diverse journals, and in a way accelerate the reach of new knowledge and, reward the benefits expected by researchers, which is recognition.

The technology allows organizations to expand social networks and create effective collaboration. In this way, ICT's improve communication between specialists, virtually bring people together and promote exchange (HENDRIKS, 1999). Thus, the technological infrastructure moderates the relationship between organizational culture and organizational structure with knowledge sharing (ISLAM et al., 2015). Communication between people, located in different places, is easier, which contributes to the CIC and even in the acceleration and discovery of new knowledge. Access to ICT's enables a faster search for access to information and knowledge; and, social networks allow the creation of a network for the propagation of information through the continuous and lasting relationship of the participating communities, including the academic community, (JOLAEE et al., 2014; KIM; LEE, 2006; LIN, 2007; TOHIDINIA ; MOSAKHANI, 2010).

3. Methodological procedures

This work used an exploratory-descriptive quantitative approach, aiming to collect data from the response of individuals, for later statistical treatment. The research population is represented by researchers in the "productivity" mode in research. In other words, it covers researchers with active projects and research funded by the National Council for Scientific and Technological Development (CNPq). The sampling was non-probabilistic and convenient for a population of 15,232. The study sample was obtained by searching the CNPq website for researchers "productivity", whose contact was via e-mail in the first three months of 2019. It was possible to reach 262 respondents, understood as the sample field of the study. Considering the minimum number of observations between five and ten respondents for each variable (HAIR et al., 2017), for the applied questionnaire composed of 16 statements, associated with the sample obtained from 262 respondent researchers, it was possible to perform an analysis under a size 1,63 times higher than the minimum required, and is therefore satisfactory.

The data collection process was carried out through the survey monkey platform and the data collection instrument was sent by e-mail to the "productivity" researchers. The questionnaire applied was composed of two blocks, the first of which was formed by questions related to the respondent's profile, and the second has 16 objective statements that address the variables of analysis. The quantitative approach method used is based on Structural Equation Modeling (SEM) and Partial Least Squares (PLS), used to test

the hypotheses of causality between variables. The application of the method and the modeling found was through the SmartPLS software, version 3.2.8.

This study proposed some research hypotheses:

H1: the researcher's individual characteristics contribute to the generation of scientific publications;

H2: the researcher's individual characteristics contribute to innovation;

H3: organizational characteristics contribute to the generation of scientific publications;

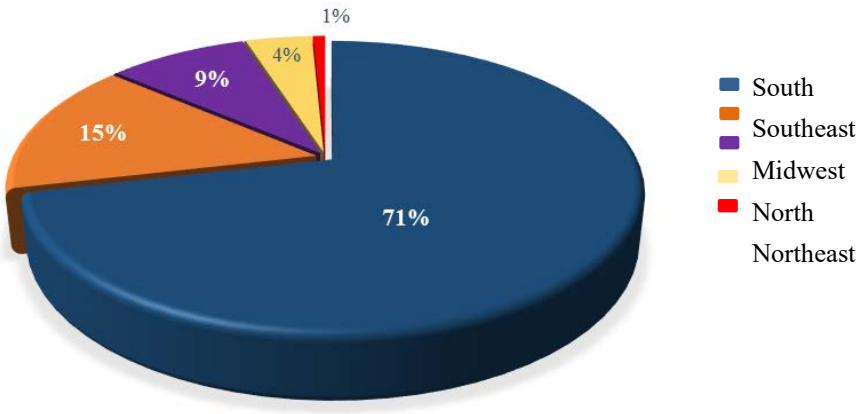
H4: technology contributes to the generation of scientific publications;

H5: the pulsations contribute to innovation.

4. Results

Initially analyzing the profile of the respondents, it was found that 60.31% are 60 years old or older; 35.11% are between 50 and 59 years old and the rest are under 50 years old. Respondents are productivity researchers, with an average research time of 21 years. Regarding gender, 75.19% are male, 24.81% are female. The sample obtained was composed of 252 (96.18%) Brazilian researchers and 10 (3.82%) foreigners. Most researchers live in the Southeast (71.37%), and the region with the lowest participation of researchers in the sample comprises the North (0.76%), according to Graph 01.

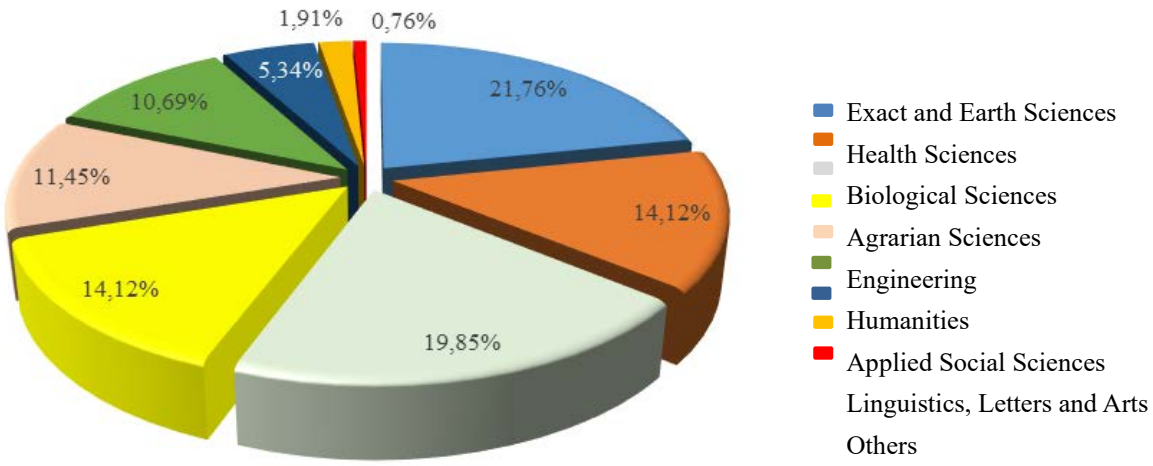
Graph 01 - Number of researchers by region



Source: The authors.

Regarding the researcher's knowledge area, most respondents are concentrated in the area of Exact and Earth Sciences, as shown in Graph 02. Among the respondents, the following categories of researchers were obtained from CNPq productivity: 1A (58, 02%), 1B (32.82%), 1C (2.67%), 2 (0.38%) and Senior (6.11%).

Graph 02 - Research areas



Source: The authors.

Before starting with the measurement model, it was necessary to recode the responses obtained for the variables that were inverted in the questionnaire in order to reduce the respondents' tendency to agree with the statements. Continuing with the import of data into SmartPLS, therefore, the measurement model was constructed as shown in Figure 1.

The analysis parameters adopted are in line with those proposed by Hair, Hult, Ringle, and Sarstedt (2017), whose indicators with external loads between 0.40 and 0.70 should be considered for removal of the scale only when the exclusion of the indicator leads to an increase in Composite Reliability or Average Extracted Variance (VME). Thus, the variable R_11 was removed from the measurement model, which had the lowest external load (0.476), as shown in Figure 1. The values for the convergent validity and quality indicators are shown in Table 1.

Table 1 - Criteria related to quality and convergent validity

Construct	Alfa de Cronbach	Composite Reliability	VME
Individual Features	0,793	0,857	0,550
Organizational Characteristics	0,714	0,837	0,632
Technology	0,724	0,878	0,782
Publications	0,823	0,894	0,738
Innovation	0,726	0,876	0,780

Source: The authors.

In continuity with the observance of the analysis parameters, Table 1 demonstrates the reach of convergent validity, where the reliability of the internal consistency was analyzed using Cronbach's Alpha, and considering that the values are above 0.70, this criterion was also met. Then, it was observed that the Composite Reliability is also above the reference limit. Regarding the Discriminant Validity (DV) criterion through the Fornell and Larcker method, it was observed, therefore, that this criterion was met for all constructs.

In order to complete the RV analysis and verify that the measurement model is adjusted, it was observed that the cross loads are showing higher factor loads in their respective constructs. According to Hair, Hult, Ringle, and Sarstedt (2017), once the model is considered to be reliable and valid, one must

then proceed with the analysis of the structural model. All variables presented values of Variance Inflation Factors (VIF) less than limit 5, therefore, it is understood that the criterion of absence of collinearity between the variables was met.

The analysis related to the structural model is related to the path coefficients. Considering Table 2, it is observed that the relations are positively stronger between Publications and Innovation (0.380) and Technology and Publications (0.321).

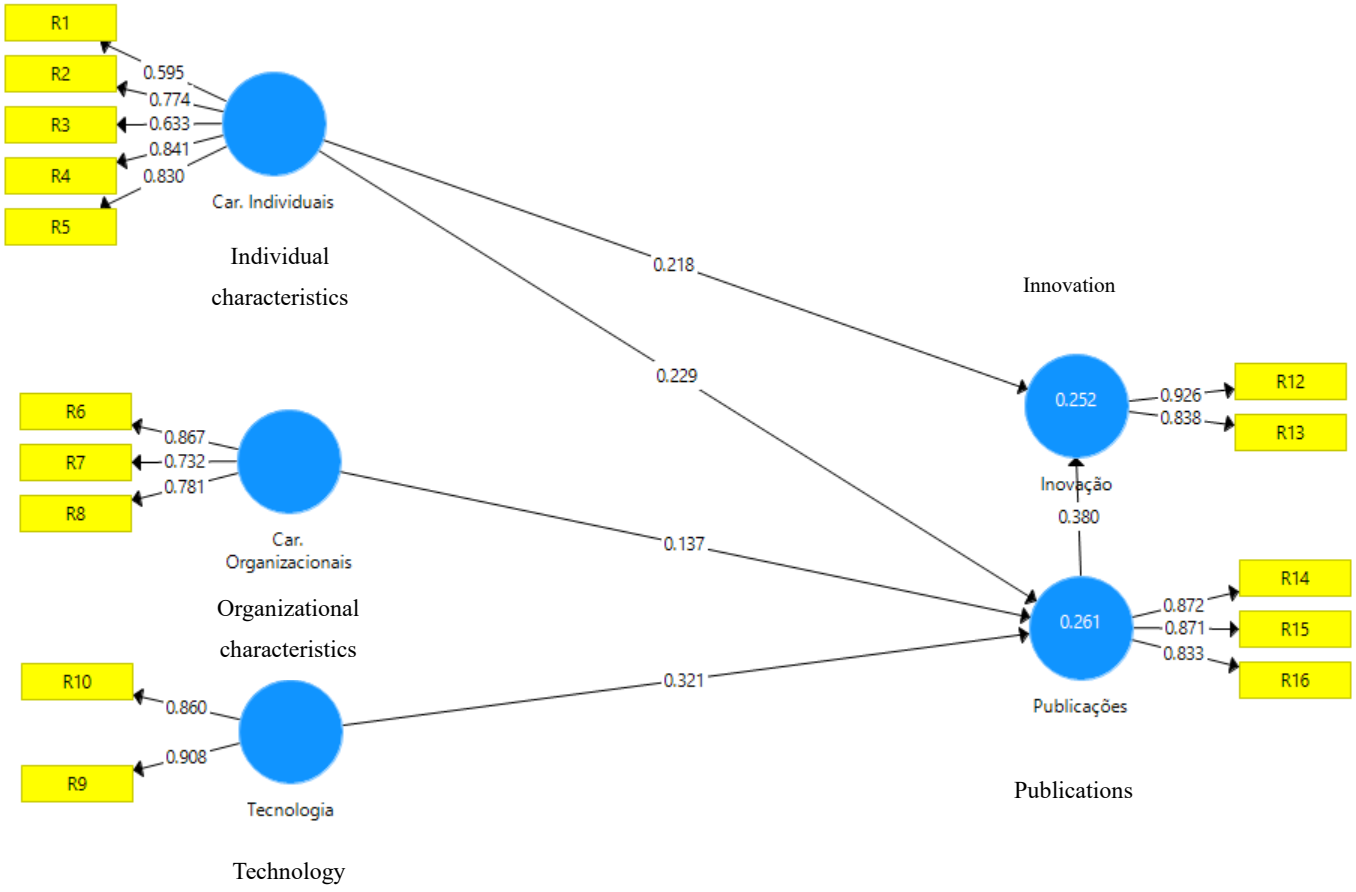
Table 2 - Result of the Path Coefficients Significance Test

	Original coefficient	**Teste *t***	***p value***
Individual characteristics → Publications	0,229	3,495	0,001
Individual characteristics → Inovação	0,218	3,737	0,000
Organizational characteristics → Publications	0,137	3501	0,039
Technology → Publications	0,321	5,425	0,000
Publications → Innovation	0,380	5,684	0,000

Source: The authors.

Still regarding Table 2, one can verify the statistical significance of the path coefficient from the t-test, in which all coefficients are statistically significant at the level of 5%. Evaluating R^2, which corresponds to a measure of predictive accuracy and represents the combined effects of exogenous latent variables on the endogenous latent variable (HAIR et al., 2017), it was obtained, respectively, as values of R^2 and R^2 adjusted for: Innovation (0.252; 0.246) and, Publications (0.261; 0.252); suggesting a large effect (COHEN, 1988). Figure 1 summarizes the measurement and structural model adjusted.

Figure 1 - Measurement and Adjusted Structural Model



Source: The authors.

Then, the values of other indicators of quality of fit of the model were evaluated: Relevance and Predictive Validity (Q2), Stone-Geisser indicator and Effect Size (f2), and Cohen Indicator. With the data obtained, it is clear that the endogenous factor Innovation (0.179) and Publications (0.171) has an average degree of predictive relevance, however, it can be said that all constructs have Q2> 0, providing support for predictive relevance of the model in relation to the endogenous latent variables. The values of f2 evaluate how much each construct is "useful" for the adjustment of the model. The value found 0.167 between Publications and Innovation can be considered average. The other values were considered low.

5. Final Considerations

From the reported results, it is observed that the hypotheses *H1, H2, H3, H4* and *H5* were accepted, therefore, the proposed measurement model attributes factors that influence the CIC among Brazilian researchers from CNPq. The analysis of *H1*, allows us to infer that the variable Individual Characteristics presents a positive relationship (0.218) and significant with the variable Publications. Therefore, it is understood that the Individual Characteristics of the researchers, such as communication skills, confidence, experience, the possibility of teaching and learning with the team, influence the generation of Scientific Publications.

With regard to *H2*, it is observed that it achieved a positive effect (0.218), which indicates that the Individual Characteristics contribute to Innovation.

As for *H3*, it should be noted that, with the results obtained, it can be accepted that Organizational Characteristics, such as equipment, culture and organizational structure, contribute to the generation of Scientific Publications.

Regarding *H4*, it is observed that it has a positive effect (0.321), and therefore, the Technology measured in the model by the variables internet, use of information systems and access to social networks, contributes to the generation of Scientific Publications.

Likewise, *H5* has a positive effect (0.380), and it can be said that Publications, analyzed through the contributions of knowledge sharing for the generation of research, publications of international quality and leadership, contribute to Innovation, measured through increasing the number of patents and generating innovations, associating with organizational characteristics.

For the agenda for future studies, the need to apply the model to other contexts is highlighted, such as the use of CIC associated with startups, and the characteristics of the analysis of potential entrepreneurs, also seeking to assess broader validity parameters, allowing the use of this instrument in different sectors and places, in order to encourage diffusion and its applicability.

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Management of Intangible Assets in Private Higher Education Institutions: The Incentive to Titration X Financial Impact

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Abstract

This article aims to evaluate the financial impact of teacher's academic degree for Higher Education Institutions' (HEI) management and answers the following research problem: what is the financial impact in HEI's management in the incentive to teachers' professional qualification and academic degree? Methodologically is about a case study inside the universe of private HEI which sample was chosen randomly. It was used descriptive statistics. For that it was shown data in four tables followed by their descriptions with previous discussion of results presented that reveals a big financial impact to HEI, which makes necessary the assertive decision making by the management.

Keywords: financial impact. management. academic degree.

1. Introduction

The intangible assets are immaterial goods and incorporate products of human production since scientifics, passing thru the artistic, reaching the industrial invention. They are also services that satisfy human need but are not necessarily a material input. A good example of immaterial service is the education and its teaching development, research and extension in the higher education institutes (BARBOSA, 2010).

They are important to managers, government, investors, regulators, academics and others. One of them, the Intellectual Capital – IC, is of paramount importance in economy for being in knowledge society, being defined as result of every person knowledge in the organization. To know, to control and to use properly gives the company competitive advantage for having greater controls and probabilities to know the reached results. This brought up the need to know how to work with IC in an organized and systematic way knowing how to acquire, organize and use it in favor of the company development regardless of being explicit or tactical for everybody that could have the accesses and work with consciousness of knowledge that they have. This process is called knowledge management – KM. Therefore, a strong connection exists between IC and KM for having a competitive differential in AI's process once that for the first, if correctly used, is base tool for the company's sustainability in terms of

competitive and is up for the second exactly the function of making the CI management efficient and effective. (STEFANO & FILHO, 2018).

Nowadays for a company to achieve greater productivity and better quality in its services and products with competitive advantages is essential to focus on human factor, once that it has become key piece in organizations taking the place of traditional factors of production as land, machines and capital. For this reason, the wealth of a country, in the current context, is no longer centered on tangible goods, but on its competence to produce knowledge whose result materializes in technology and innovation so that it can grow and evolve in several aspects, but mainly, in the economic. Logically, the university spaces are fundamental for all of this to happen, as long as there is an efficient management to protect what is produced both in the tangible and intangible aspects, that is, a very strategic management of human competences linked to teaching, research and extension. However, in Brazilian universities, there is a gap between the knowledge that is produced (IA) and their results. (PINHEIRO; MENDES; OLIVEIRA, 2014)

This makes the Human Resources of HEI, in special, those in the private administrative category, encourage teachers to constantly search for degrees, since academic degrees, in accordance with the standards of regulatory bodies, provide for improvements in the quality of the study services offer, and also assume that there is an improvement in the effective quality of the actions inherent to the function of superior teacher. So, it is questioned, what is the financial impact on the management of the HEI of the incentive to the teacher for his professional qualification and academic titration? Thus, in order to answer this question, the objective is to assess the financial impact of teacher's academic degrees for the management of the HEI.

The results arising from the increase of degree implies that the HEI management act directly in the faculty because they are the direct ones in the formation of the final product. The concept used for the management analysis of human capital in HEI is called core competence which definition is the ability of presenting differentials in relation to competitors, being accessible and visible to all (PRAHALAD & HAMEL, 1990).

This gets more evident in companies of knowledge, tecnologic and services production. In them, the direct relationship between intangible assets and the organizational life cycle is much more visible, as studies show that as they progress, there is also an increase in IA, especially when there is joint monitoring, reversing its increase in aggregation of the company's value, which reveals the dynamics of IA, once that is presented since the beginning as key elements to the company's evolution. The measure, therefore, of the company's growth requires a greater management in a global way to the IA specially related to the competences of employees in a external view to the company (LIMA & VASCONCELOS, 2016).

Discuss and contextualize the conceptions of human capital allows the potentialization and application of these IA, composed by the attitudes, knowledge, abilities and people's knowledge, main organizations agents for being source of a competitive advantage. In the 90's, it started to be considered essential for companies to be able to present innovation, competitive advantage and frequency of strategic renewals integrating intellectual capital. Nowadays, this capital is already essential for quality of service, which makes fundamental for the organization's survival (VIDOTTO; BENTAFOCOURT; BASTOS, 2016).

2. Methodology

From the methodological procedures point of view, one of the ways to analyze a phenomenon within a universe to achieve generalizations is the case study. It is about preserving the unitary character of a set of data by organizing them and establishing similarities within the universe, serving as the basis for the production of knowledge applied in other cases. This study unit can be a community, a group, an individual and an institution. The goals to be accomplish can be several in a study: do descriptions, test and / or generate theory. (GIL, 2008).

Thus, within the universe of private higher education institutions, HEI was chosen randomly, by convenience but also by presenting some characteristics as good results in ministry of education, being a known brand in Bahia's Northeast and South Center of Sergipe and seeing many of its teachers seek alternation of level, in their titrations from specialist to master and master to doctor.

Regarding the presented data in the tables about HEI, shown in the results, were collected this way: in relation to the percentage increases of the career plan from the increase in the degree, the Personnel Management department provides each semester selection of teachers with a table with these percentage increases as well as the value of the class hour for specialist, master and doctor, therefore, easily accessible from the teachers in selection; But the data referring to the number of courses, weekly hours per course, hours per week, were obtained in HEI's website where are the matrices of each course and the academic hours per course distributed on the days of the week with the number of class hours; and, regarding the data referring to the charges for social services of business management in Brazil, accountants and official documents from the Federal Revenue were consulted, showing the percentage of charges, according to the type of company coinciding with the HEI under study. Descriptive statistics was applied to analyze the data presented in the tables.

3. Results

The results are presented in four tables. In the first, are presented the percentage values in the increase of degrees from specialist to master and from master to doctor. They were calculated from the table number four, where the values in reais are shown for a workload of four hours per week for the referred degrees. In the table number two, are presented the percentage of charges for calculating the received values and in the number three, data base for the calculation of table number 4, they are punctual data related to number of courses, classes and workload.

Raise in salary amounts to be paid by titration Career Plan	
SPECIALIST / MASTER	19,60%
MASTER / DOCTOR	16,24%

As shown in the table, the percentage increase in the degree from specialist to master is 19.60%, which corresponds for one month, considering 130 hours of a course, an raise of R$23.522,2 excluding the charges. From master to doctor, there is a percentual raise of 16,24%, corresponding to the monthly raise

of R$23.292,1, also excluding the charges. These values in monthly reais were found by the difference between the monthly value of specialist-master and master doctor in table 4.

Social charges inherent to business management in Brazil	
Guarantee Fund	8,00%
1/3 Vacation	0,27%
13º	0,82%
INSS	9,00%
Total of monthly charges	18,09%

Depending on the sum of the table, total charges reach 18.09%, which increases in real monthly values following the titration: from specialist to master, R$4.255,17; from master to doctor, R$ 4.213, 54.

Quantitative of HEI's teams and classes of reference as an exemple	
HEI's reference	
Courses	26
Weekly hours per course	20
Hours per week	520
Divided by 4	130

In this case, there are presented in the table punctual data of HEI, reference that allows to build the others table, such as their inferences with new values from the analysis. Therefore, the HEI has 26 courses which weekly workload of every course is 20 hours, which makes the HEI a total of 520 hours a week, since there are 26 courses times 20 hours a week. When dividing this total weekly hours by 4, the weekly base workload for calculating the amount by degree, there is a total of 130 hours.

Total amount of hour/class to be paid in HEI's reference		
	4h weekly	**Month values**
Specialist Value	R$ 923,09	R$ 120.001,70
Master Value	R$ 1.104,03	R$ 143.523,90
Doctor Value	R$ 1.283,20	R$ 166.816,00

Already in this table, monthly values are shown by titration, which allows to calculate the raise by the difference in values: specialist to master R$23.522,2: and from master to doctor, R$23.292,00.

4. Discussion

The watchword of current production systems are goods and services, which requires organizations

to have good management in relation to intangible assets whose knowledge management, with the use of coherent methods and techniques, serves to instrumentalize and understand the organizational learning process on a scale evolutionary. This happens when KM works with intellectual capital from a human, intellectual and integrative perspective. (FRAGA, GRAEF; SANTOS, 2017).

When analyzing the results present in the table one and two, it is realized the financial impact that HEI has in the change of academic degree, because when we add the increase in salary with the charges in a change from specialist to master, per month, we will have R$27.777,37 and, from master to doctor, R$27.505,64. When thinking about this impact in a year, there are considerable amounts of increased expenses due to the incentive given to the intellectual capital of teachers. Obviously, becomes necessary to manage this intangible asset in order to make this increase turn into a positive value for HEI, in addition to complying with the titration of regulatory bodies.

This understanding should be quite feasible in our HEI, in relation to the IC as well as their management for being in the educational field, including the ability to measure, retain and increase intangible assets. However, in Brazil, it is still very incipient and restricted to specific experiences to measure the IC with program evaluations and / or efforts to do so, which shows us the ample space for the use of IC management to be disseminated in education for decision making competitive advantage for this type of organization (BRITO & OLIVEIRA,2016).

The results makes it evident how much is important a police and management of intellectual capital so that any financial increase can be reverted initially to improvements in the services provided by HEI teaching, extension and research and, after, from an effective management and systematic monitoring of intangible assets improved with the titration, multiply the company's profits.

An example of this aspect was the study made in a Higher Education Institute in Cajazeiras/PB regarding to the importance attributed to critical intangible assets for the evaluation of Intellectual Capital and it was found that there is a recognition of this importance in all dimensions to which the assessment is proposed, however, in the study, it was noticed the absence of IA management in a way effective and efficient, which directly interferes in the composition of the IC of the HEI. It was also found that the coordinators do not have a strategic vision for the management of IA (SILVA,*et al.,* 2018).

Besides that, while looking to these results, the cademical managers need to make choices and make decisions based in these values. For example, in fact my HEI has a police of management and monitoring of intangible assets in the moment, that makes possible a short, medium and long term feedback to see the positive results of this investment and incentive in academic degrees, so that the priority remains this incentive; or, if I don't have it, what strategies do I need to look for in order to meet the market, demands from regulatory bodies and quality of services; or, how to manage all these variables of intangible assets in favor of positive results for the HEI.

This demands an efficient and effective management of IA resulting from investments in human resources. In order to receive these two adjectives mentioned in the previous period, management already needs to be aware that it can only act in these capitals if it has policies and actions that can actually measure and monitor the results of such resources. In case it does not have this mechanism, the first decision would be to rethink the incentives and investments (BARBOSA & GOMES, 2002).

That is why learning and the performance of an organization, in terms of positive results, it is

proportional to the adequate knowledge management, which makes studies to show up and a concern on how to obtain efficiency and effectiveness in IC assets. For that, it is important, primarily, to understand the concepts, assessments and measurements of these assets. Thus, it is understood that managing CI is to find strategies to organize processes and technologies built initially on cognition for later transformations of this information into knowledge of IC in the organization's culture. This demands an elaboration of tools for management capable of an evaluation with capture, identification, systematization and application of information in the production of knowledge. These can now be used to impulse organizational strategies with broad performance. Logically, for all of this to happen, it is necessary a deep comprehension of IC, as well as KM techniques which process must create values associated to the organization's strategies in an intentional and systematic way. So, one of the factors that sometimes collaborates for organizations to lose strength to competition in the market is the absence of an organizational culture in relation to the knowledge and learning produced, IC's depreciation, when, in fact, sharing knowledge transforms organizational spaces with added value to IA in terms of employees, shareholders, customers, suppliers, in short, the whole society (STEFANO & FILHO, 2018).

This shows how much IC is important for the organization's growth as well as being a basic theme at the moment, which makes the HEI a key part for the production and dissemination of this knowledge in relation to the degree of importance of KM to generate competitive advantages. (MARTINS & FERREIRA, 2015). Therefore, the education and people's degree for the production and realization of new knowledge is the basis for making the knowledge society grow, therefore, HEI is the foundation for this new space.

Reaffirm the financial impact in HEI, tables three and four because they show how teachers change their degrees for a given monthly workload, there is a big difference in values between what they received and what they start to receive. This shows that the HEI has a policy of encouraging titration, an increase in intellectual capital, followed by a financial increase on personal sheet. What is discussed here is how now there will be a conversion of added value for the company, based on the investment made, with this addition of positive intangible, intellectual capital, to the company's human capital.

Intellectual capital has as its exit and entry point, that is, its generation and at the same time, its destiny is to be human with a prominent role to create competitive advantage, especially in knowledge and technology companies. In order for this to happen, people need to be managed and understood in a logic of reflection, exchange of experiences, constant interaction between everyone in the company so that there are skills gains. The management of skills by function performed by the employee offers a factor of great appreciation of human processes because it leaves the worker in a situation of better well-being, which of course, makes him have better results and, consequently, motivates him to always innovate with his eye in the market, therefore, more competitive advantages (SILVEIRA *et al*, 2015).

Ultimately, actions to monitor human capital that indicate improvements are required, an evaluation system consistent with the policy of incentives, an accounting system that demonstrates the relationship of these intangibles and an effective management and policy that facilitates decision-making based on values of intangible assets, in this case, intellectual, human and integrative capital. It is confirmed, therefore, from the observed results, how there is a financial impact on the HEI from the incentives for the teacher's titration and how it is essential to start to manage and make decisions looking at this investment.

5. Final Thoughts

The results presented, as well as their discussion, allow us to make the following considerations: there is, in fact, a great financial impact on HEI by encouraging titration; this is represented both by the increase in the teacher's class time and the increase in charges, a consequence of the previous increase; to compensate for this impact, good management of intangible assets resulting from the increase in qualifications is necessary, as well as clear policies and quality indicators for teachers after qualification; and, finally, HEI needs to act to realize the conversion of this financial impact into positive values, which makes it seek alternatives for joint measurement of tangible and intangible assets, if this does not happen, it may be making wrong decisions, as shown by the data .

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Laying Productivity with Constant Renewal in Water Fountains During Heatwave

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Abstract

This study aimed to evaluate the effect of the water renewal system of drinking fountains in laying hens and its relationship with productivity. For this, 5,000 laying hens of the Dekalb White line were used in each shed, which received food and water ad libitum. The warehouses had a conventional typology, Californian type. For this, a digital water renewal system was installed in three nipple drinking fountains in one of the warehouses (treatment 2 - T2) and the other remained without the water renewal system (treatment 1 - T1). Using Thermo hygrometers, the average air temperature (° C) and the average relative humidity of the air (%) were measured. For the water temperature (° C), a water renewal system (Flushing Control® - Lubing model) was used, which carried out the renewal of the birds' drinking water six times a day. Feed consumption (g / bird / day), water consumption (ml), egg production (%) and mortality (%) were evaluated. During the study period, using data from the weather station, the occurrence or not of heatwaves was defined. A completely randomized design (DIC) was performed in a 2 × 2 factorial scheme (two sheds: conventional system and with water renewal; with and without heatwave) and the data were subjected to analysis of variance (5%). It concludes the efficiency of the use of the water renewal system for zootechnical performance, during the heatwave, but the use of air conditioning systems and measures to reduce the direct radiation in the birds and installation is still necessary. There was a positive influence ($p < 0.05$) in the use of the water renewal system for water temperature (° C), water consumption (ml) and egg production (%). In the presence of a heatwave, the feed and water consumption variables were lower ($p < 0.05$). There was no interaction between the systems and the presence of heatwaves. It is concluded

that the use of a water renewal system has benefits in zootechnical indexes, however, it does not interact with the presence of heatwaves.

Keywords: ambience, equipment, water, extreme climate.

1. INTRODUCTION

Egg production is considered one of the most important economic activities for Brazil and for food production, where São Paulo is the state that produces the most eggs in Brazil, concentrating 30.9% of Brazilian production, capable of feeding more than 60 million of people per year, considering the per capita egg consumption in the country of 212 eggs per year [1]; [2].

The Secretariat of Agriculture and Supply of the State of São Paulo states that the Bastos region is the largest egg producer in the State, representing 36% of the São Paulo total. With a herd of 32 million heads, 25 million of which are in production and 6 million are young chickens [3].

However, the main limitation in poultry production is the high temperature recorded most of the year, in the Bastos region. Thus, the aim of this study is to verify the influence of the use of water renewal system in drinking troughs for laying hens and its influence on productivity, in the presence or absence of heatwaves.

2. LITERATURE REVIEW

The temperature above the upper limits of the thermal comfort zone, in birds, causes thermal stress, which can harm the animal organism and significantly increase mortality rates [4]; [5]. The thermal comfort ranges comprise the temperature range of 20 to 27 ° C for adult birds, and above 35 ° C the birds enter thermal stress [6].

To be able to maintain the body's homeotherm, water consumption is used as a tool to minimize the effect of thermal stress, therefore, all care and planning aimed at poultry practice is essential for there to be managed in the availability and quality of water, so that there are no limiting factors in this process [7].

The water temperature is directly related to the water consumption of the birds and consequently their productivity. However, there are few studies on the types of drinkers used for laying poultry in Brazil [8].

Studies have found that the drinking water temperature for birds is in the range of 20oC to 26oC, with positive effects on egg production. On the other hand, temperatures above 32 ° C, for example, cause intense stress and loss in shell resistance [9]; [10]; [11].

The increase in ambient temperature leads to a decrease in the bird's capacity to dissipate heat and the consequent and respiratory alkalosis, thus increasing productive losses, such as increased mortality in the final stages of creation [12].

Studies reveal that heatwaves will be more and more frequent and the estimate until the year 2100 is that the world temperature will increase by up to 5.8 ° C; for every 1 ° C increase in global temperature, mortality can increase by up to 1.4% [5].

Currently, there are several tools that make it possible to improve poultry rearing systems, be they broilers or layers. Regardless of the degree of available technology, it will always be necessary to turn attention to these animals [13]. Among these tools, the renewal of drinking water for birds is a tool that

proves to be efficient, because with the constant use of water installations and pipes, contamination can occur in the system, causing accumulation of organic material, with deposition of dirt, growth algae and biofilms in the water supply line [14].

3. MATERIAL AND METHODS

Experiment Location and Climate Conditions

The experiment was carried out in field conditions, from December 22, 2018, to February 20, 2019, in an egg-producing poultry farm located in Bastos - São Paulo, Brazil (21º55 '19' 'south latitude and 50º44 '02' 'west longitude, with an altitude of 445 m). According to the Köppen climate classification, the climate is Aw, characterized by a tropical climate with dry winter, the rainy season in summer and dry in winter.

The external climatological variables (air temperature and relative humidity) were obtained through the National Meteorological Institute of Brazil, Inmet [15].

Air temperature (° C) and relative humidity (%) data were collected daily, in a specific spreadsheet, the values of air temperature and relative humidity, at the minimum and maximum times of the day (6:00 am) and (2:00 pm) at three points in the aviary, at the height of the bird using a Digital Thermohygrometer Asko®, AK28.

Experimental Design, Poultry and Water Renewal System

A completely randomized design (CRD) was carried out in a 2 × 2 factorial scheme (two warehouses: one with a conventional system and the other with water renewal; and with and without heatwave), to evaluate the two proposed treatments, namely: T1 - Shed without the digital water renovation system and T2 - Shed with the digital water renovation system.

5000 laying birds were initially housed in each treatment, of the Dekalb White strain, aged 84 weeks at the beginning of the study. We worked with three cycles of 21 days for each cycle, during the summer period (December to February) with the presence or absence of a heatwave.

Two poultry houses in production, with east-west orientation, Californian type, were used for the study, with three floors of cages (dimensions of 50.0 × 48.0 × 45.0 cm) on each side, with automatic distribution feed and nipple drinkers with a flow rate of 180 ml/minute and ceramic type tiles, without liner and without ventilation system.

The digital water renewal system was installed in three lines of nipple drinking fountains in one of the warehouses and the other remained without the water renewal system. The equipment consists of a control panel, and it is distributed to each line of the warehouses, passing through a pressure regulator, and then proceeding to the water pipes inside the shed (Figure 1).

The water renewal system (Flushing Control® - Lubing model) carried out the renewal of drinking water for birds six times a day, at times pre-programmed for every four hours by the equipment. In both warehouses, water meters were installed to measure daily water consumption. The birds received water and feed ad libitum.

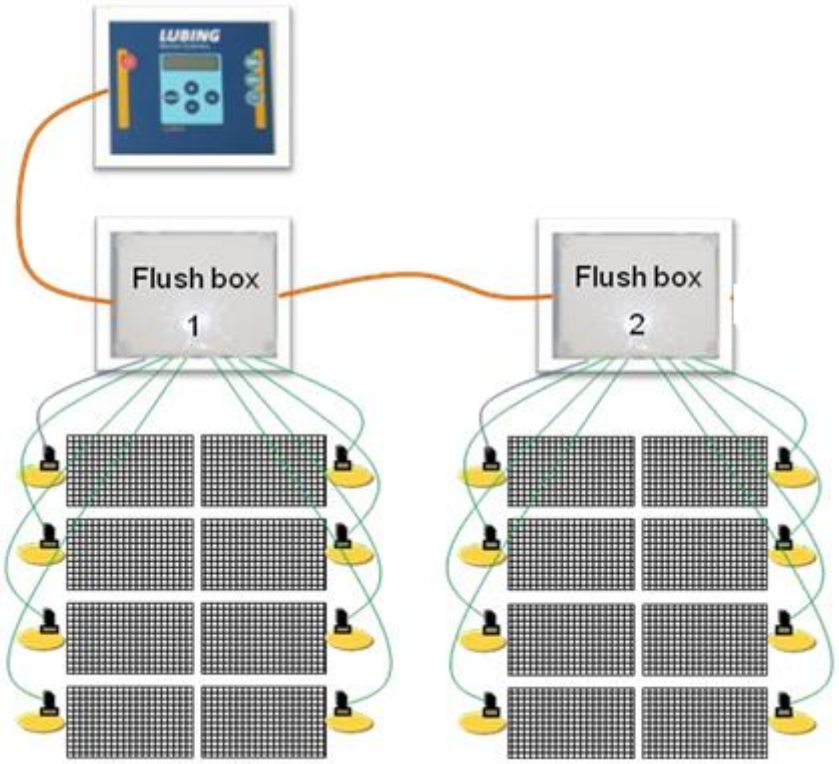

Figure 1. Scheme of distribution of water renewal system. Source: Lubing®

Animal Diet

The formulation used, was the basal feed off the farm, for the older birds, in the laying phase 3. For the nutritional requirements of layers, they were calculated according to the Brazilian Tables of Nutritional Requirements of Poultry and Swine [30]; according to Table 1.

The following zootechnical variables were collected per experimental unit: egg production (%), average daily feed consumption (g), average water consumption (ml) and mortality (%).

Table 1. Nutritional composition of the diet.

Ingredients	Posture 3
Macro Ingredients (kg)	
Grain Maize (7.5%)	652,800
Soybean Meal (46%)	197,000
Wheat bran	6,000
Meat and bone meal (42%)	31,000
Thick Limestone	64,000
Thin Limestone (38%)	38,000
Salt	2,050
Bicarbonate	2,400
Micro Ingredientes (kg)	
Dl Methionine	0,250
Lysine	1,350

Threonine	0,450
Choline chloride 60%	0,500
Premix Vitaminic / Mineral 4kg / ton	4,000
Carbohydrase	0,200
TOTAL	1.000
Níveis Nutricionais (%)	
Crude Protein	16,200
Ethereal Extract	2,880
Crude Fiber	2,520
Calcium	4,500
Phosphorus Available	0,400
Sodium	0,180
Chlorine	0,180
Energy Met Ap Poultry Kcal / Kg	2.800,000
Lysine dig Poultry	0,810
Methionine dig - Poultry	0,340
Met + Cist dig-Aves	0,560
Dig-Birds Tryptophan	0,160
Threonine dig-Poultry	0,570
Arginine dig-Poultry	0,910
Isoleucine dig-Ave	0,570
Valina dig-Ave	0,640

Mineral and vitamin premix (guarantee levels per kg of product): vitamin A 8000 MIU; vitamin D3 2500 MIU; vitamin E 15000 mg; vitamin K3 1500 mg; vitamin B1 500 mg; vitamin B2 3000 mg; vitamin B6 2000 mg; vitamin B12 10,000 mcg; niacin 18000 mg; calcium pantothenate 7000 mg; folic acid 500 mg; biotin 20 mg; iron 30000 mg; copper 8000 mg; manganese 70000 mg; zinc 70000 mg; iodine 1000 mg; selenium 250 mg; methionine 800 g; choline 400,000 g; phytase 60 g; halquinol 30000 mg

Characterization of the Heat Wave Incidence

For the characterization of the heatwave, a minimum temperature> 22 ºC and a maximum temperature ⩾32 ºC for at least 3 consecutive days was used as a reference [16].

Zootechnical Indexes

The main zootechnical indexes were calculated for the productivity analysis, of the 5000 birds of each house for all equations. (Equations 1 to 4).

$$Egg\ production = \frac{\text{daily number of eggs} * \text{number of birds in the house}}{100}\ (\%) \quad \text{Eq. 1}$$

$$Feed\ consumption = \frac{total\ amount\ of\ feed\ provided\ per\ day}{total\ birds\ in\ the\ shed}\ (g) \quad \text{Eq. 2}$$

$$Water\ consumption = \frac{total\ consumption\ of\ water\ supplied\ per\ day}{total\ birds\ in\ the\ shed}\ (ml) \quad \text{Eq. 3}$$

$$Mortality = \frac{mortality\ number\ per\ day}{total\ birds\ in\ the\ shed}\ (\%) \quad \text{Eq. 4}$$

For the temperature of the drinking water of the birds, 5 different points were measured for each side (north and south) of the house and an arithmetic mean of these points was performed.

Data on feed consumption, water meter measurements to calculate water consumption and mortality were also collected daily.

Statistical analysis

For statistical analysis, data were subjected to analysis of variance (5%). The R Core Team software [17] was used.

4. RESULTS AND DISCUSSION

Climatological and Bioclimatic Variables

The climatological variables that occurred during the experiment (Figures 2 and 3) describe the behavior of air temperatures and relative humidity, on average between cycles.

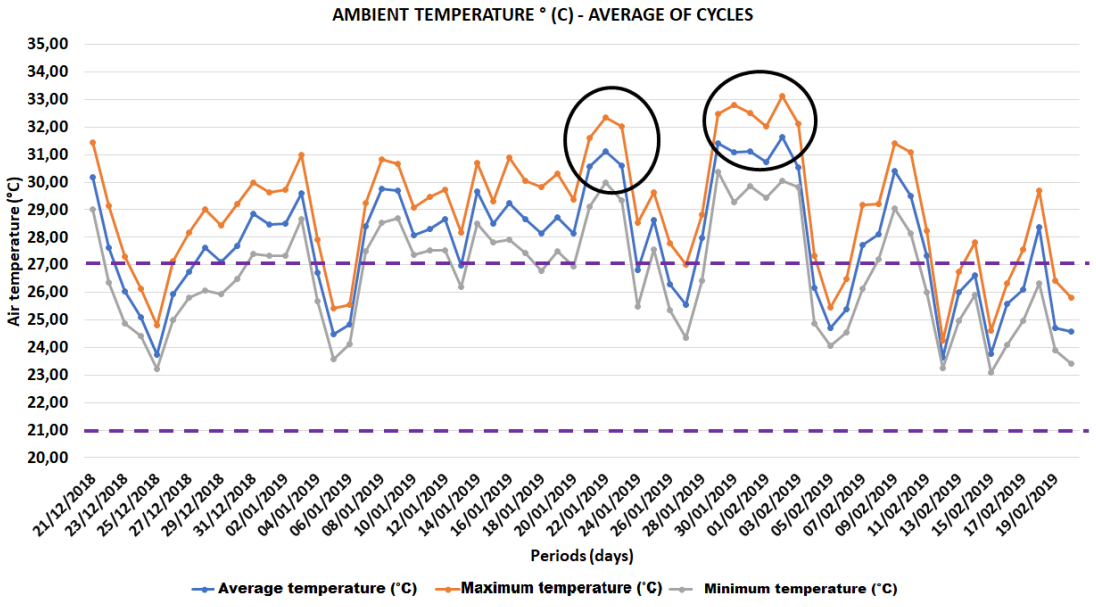

Figure 2. External Air Temperature (Average of cycles)

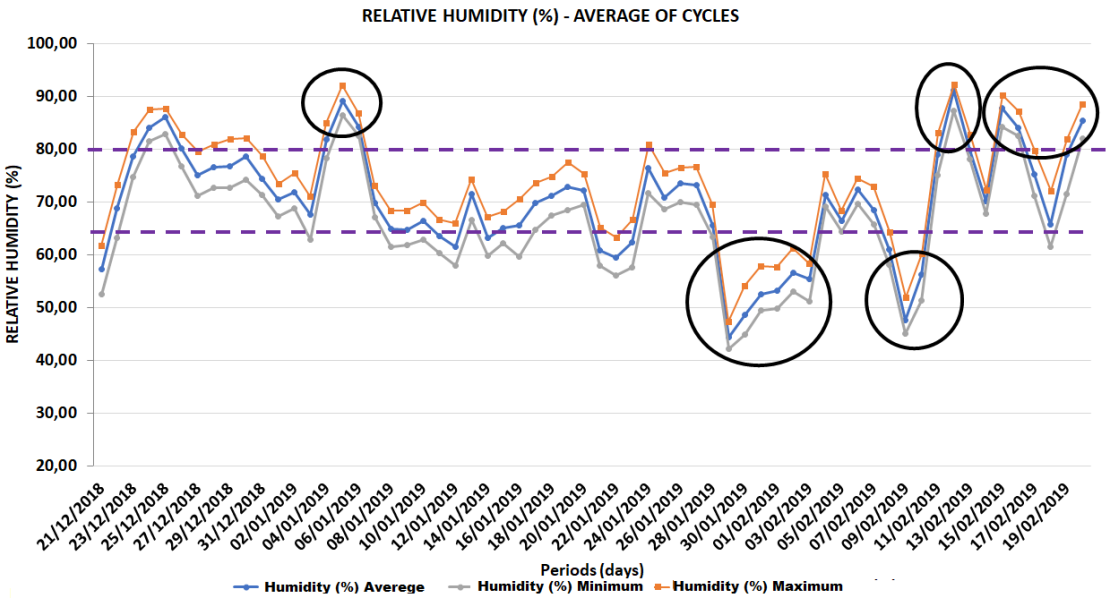

Figure 3. External Air Temperature (Average of cycles)

It was found that the air temperature (° C) and relative air humidity (%) were outside the thermal comfort limit for birds (Figures 2 and 3).

The accepted ranges are air temperature from 21 to 27 (° C) of recommended relative humidity is 65 to 80 (UBA, 2008).

With the thermal stress, consequently, changes in the performance of the birds occur, decreasing the food intake, losses in the performance and quality of eggs and even the death of the birds [18].

At two points (Figure 2) in the months of January and February, the presence of heatwaves is noted. At this stage, the layers are already acclimated, as they have already gone through this type of climatic extreme, which normally begins in September [4]; [19].

The temperatures to which the housed birds were subjected were largely highly thermally stressful. The average air temperature was around 29% above the recommended maximum.

The average relative humidity, on the other hand, was 13% above the maximum recommended range.

This shows that the birds went through thermal stress during most of the study period, which leads to productive losses [2]. Thus, the work of [20] reports that the birds are kept in suitable thermal environments so that an adequate thermal balance is carried out.

According to [21] thermal stress leads to an acid-base imbalance and plasma calcium concentration.

This has a direct influence on the production of commercial laying eggs.

Analysis of System Interactions and Heat Waves

The systems (T1 and T2) were analyzed in relation to the feasibility of the renovation in relation to productivity. The incidence of the heatwave was also adopted. The results are shown in Tables 2 and 3.

Table 2 - Water temperature in the different water supply systems, during the heatwave

VARIABLES	WATER SUPPLY SYSTEM	WATER TEMPERATURE (° C)
DRINKING SYSTEMS	Renovação	26,26 b
	Convencional	27,96 a
	P value*	**0,0033**
HEAT WAVES (^{O}C)	Presence HW	26,89
	Absence HW	27,19
	P value**	**0,7709**
SYSTEMS x HW	**P value**	**0,6317**

* Averages followed by different letters, in lines, are significant at the 5% probability level.

Table 3 - Zootechnical indices in the different water supply systems, during the heatwave

VARIABLES	SYSTEM	EGG PRODUCTION (%)	FEED CONSUMPTION (GRAMS)	WATER CONSUMPTION (ML)	MORTALITY (%)
Systems	Renovation	78,42 A	98,00	244,94 A	0,05
	Conventional	73,10 B	103,00	192,02 B	0,06
	P value*	**<0,0001**	**0,8411**	**<0,0001**	**0,4435**
Heat Waves (HW)	Presence HW	76,45	79,61 b	189,55 B	0,06
	Absence HW	75,64	104,92 a	218,21 A	0,06
	P value**	**0,4075**	**0,0076**	**0,0207**	**0,7563**
Systems x HW	**P value**	**0,1338**	**0,6601**	**0,0787**	**0,3206**

* Means followed by different capital letters in the columns are significant at the 5% probability level (comparison between systems).

** Means followed by different lower case letters in the columns, are significant at the 5% probability level. (comparison between heat waves).

Checking the influence of the water renewal system, it was noted that it provides a more suitable temperature to the variable water temperature (P value 0.033) when compared to the conventional water supply system in drinking fountains for laying hens. However, in the presence of a heatwave, it had no influence (P value 0.7709). The same behavior is noticed when the interaction of the system with the heatwave is evaluated (P value 0.6317).

The water temperature for the constant renewal system showed significant results.

Note that even with the water renewal system, the water temperature was below the recommended, from 20 to 24 (° C) by [22] and [23].

This demonstrates that the renovation system minimizes the effects of stress, but must be associated with other means of promoting zones of thermoneutrality, such as the use of materials with low inertia and air conditioning systems.

As a consequence of the increase in air temperature, laying hens tend to consume more water, as it is an effective metabolic heat loss mechanism [24]; [20].

In the work of [25], the authors noted that the supply of colder water (20 ° C) results in a decrease in body temperature in turkeys, in addition to providing greater body weight, better daily weight gain, and less feed conversion.

Likewise, [26] stated that with the supply of colder water, it was possible to maintain the body temperature of broilers in homeothermia, even under conditions of thermal stress, and thus obtain better zootechnical performance.

There are several factors that can regulate the water intake of the birds, including room and water temperature, food intake, diet composition, age of the bird [27].

There is a chain of events (Table 3), in the system with water renewal.

First, birds consume more water (P value 0.0001) and have a higher egg production (P value 0.0001), even with similar feed consumption (P value 0.8411).

According to the manual of the Debalk White line, for birds over 80 weeks, production should be 72%, and feed consumption should be 106 grams/bird/day.

It can be seen how the presence of a heatwave (Table 3) alters the behavior of the zootechnical variables. In this case, in the presence of this climatic extreme, there was less water intake (P value 0.0207) and feed consumption (0.0076).

However, when the renovation system was evaluated with the heatwave, there was no interaction. This aspect still needs more studies on the occurrence.

Similar behavior regarding the ingestion of food under thermal stress was observed by [11]. They noticed that when the room temperature is above 26 ° C there is a decrease in food consumption.

The same authors still report that lower feed consumption can negatively influence the percentage of poultry production. In this study, the percentage of laying at room temperature was 20 ° C with 97% of production, while at room temperature of 32 ° C the production dropped to 85%.

In their work, the authors of [28] observed that quails subjected to 36 ° C showed egg production of 73% and feed consumption of 22 grams/bird/day in the stress period, while in the thermal comfort temperature (21 ° C) egg production was 79% and feed consumption was 28 grams/bird/day.

With the increase in the ambient temperature, there is consequently an increase in the water temperature of the drinking fountains, with this an increase in water consumption and a decrease in the feed consumption of birds [29].

According to [27], several studies have examined the effects of water cooling during the hot seasons, in layers, there is an improvement in the quality, of the shell and the internal, of the eggs. These effects appear, probably, due to the increase in water consumption, to maintain body homeothermia [30].

When assessing the mortality variable (Table 3), there is a similarity between the systems (P value 0.4435) and also during hot flashes (P value 0.7563).

This factor possibly has an influence on the age of the birds and when it was the first experience with hot flashes. Normally, there is acclimatization of the layers to prolonged stress, which reduces mortality, however, even with acclimatization, there is a decrease in the quality of eggs [5].

5. CONCLUSION

It is concluded that the water renewal system causes benefits in the zootechnical indexes, however, it did not present interaction with the presence of heatwaves.

The environment directly affects the zootechnical indexes of birds. The current way of providing drinking water makes it very difficult for birds to maintain homeothermia, generating significant production losses, leading to high mortality rates.

New water renewal tools can be studied as alternatives to minimize the impacts of heatwaves, thus providing animal welfare.

During the evaluated period, heatwaves occurred, with temperatures reaching peaks of up to 40 ° C, as evidenced by the data collected.

It is expected that, with the next analyzes carried out, the influence of water renewal and its interactions with productivity and egg quality under thermal stress will be checked in greater depth, as well as water quality, with bacteriological analyses that were carried out.

6. ACKNOWLEDGMENT

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Epidemiological profile of donors and recipients of human milk in a reference milk bank

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ABSTRACT

OBJECTIVE*. To describe the epidemiological profile of donors and recipients of a Human Milk Bank at a referral hospital in the State of Mato Grosso do Sul.*

METHODS*. This is a descriptive cross-sectional study with retrospective data from the Milk Banks Network system and secondary data from medical records of a tertiary public hospital, between January and December 2017. Descriptive statistics was performed using the Statistic Package for Social Sciences (SPSS®), version 25.0.*

RESULTS. *In 2017, 383 human milk donors were registered, totaling a volume of approximately 614 liters of donated milk. Of this total, 88.51% donors lived in the city of Campo Grande, state capital; 56.40% reported no paid activity; the mean age was 27.45 years; and 79.63% had prenatal care in the public network. Of the 149 recipients, 71.1% (n = 106) were premature with a median gestational age of 34.00 weeks (minimum 21.00 and maximum 42.00); and birth weight with a median of 2225.00 (minimum 660.00 and maximum 5230.00). Also, 61.1% (n = 91) of the recipients weighed less than 2,500 grams and were distributed in: extremely low weight 0.7% (n = 1); very low weight 11.4% (n = 17); low weight 49.0% (n = 73); and normal weight 38.9% (n = 58).*

CONCLUSION: *The donors are young women who had support from the Unified Health System for the prenatal assistance. Among human milk recipients, 61.1% are premature babies weighing less than 2,500 grams.*

DESCRIPTORS: Breastfeeding; Milk banks; Epidemiology; Lactation.

INTRODUCTION

Human Milk (HM) is the most suitable food for early life[1]. Its offer is recommended worldwide on an exclusive basis until the sixth month of life of the newborn (NB)[2]. It is suitable for digestion, reduces morbidity and mortality and favors growth and full development[3].

Breastfeeding promotes the protection of the newborn against infections and strengthens the development of the mother/baby link through microbial and hormonal signaling. Several factors influence the composition and production of human milk, for example, the nursing mother's diet and the endocrine and breast functions, factors that can impact on the health of newborns[4].

However, other factors generated by the stresses of hospitalization and maternal withdrawal may represent difficulties for premature NBs to breastfeed, which hampers the formation of the bond between mother and baby, generating feelings of anxiety, fear and insecurity in the nourishing mother that may hinder milk production and breastfeeding[5].

Premature NBs are considered the main recipients of human milk from the Human Milk Bank (HMB) because they have limitations to nourish themselves on the breast or because of health problems. However, they can receive donated milk from a donor breastfeeding mother or from their own mother (exclusive milk)[6]. The World Health Organization defines children born before 37 weeks of gestation as premature[7].

According to Resolution of the Collegiate Board (RDC) n. 171/2006, the donor should be a breastfeeding mother who has surplus milk, good health conditions and expresses the wish to donate her milk to other children in addition to breastfeeding her own[8]. Commonly, donor recruitment is carried out during the prenatal guidelines/encounters or even after delivery, within hospital environment, through the distribution of illustrative material with explanation about the advantages of breastfeeding and its management. [9]

This way, information about breastfeeding, its continuity and donation is passed in a positive way during the prenatal appointments in the Brazilian Public Health Network[10], and reinforced in the maternity wards of the Unified Health System (SUS) after birth[11].

Given the importance of lactation and breastfeeding and the unique benefits the newborn derives from HM, the objective of this study was to describe the epidemiological profile of donors and recipients of human milk in a reference HMB of a public teaching hospital in the State of Mato Grosso do Sul.

METHODS

This is a descriptive cross-sectional retrospective study developed with secondary data related to human milk donors and recipients.

The data were obtained from the Management System in Human Milk Bank and from the Medical and Statistics Archive Service of the Maria Aparecida Pedrossian School Hospital of the Federal University of Mato Grosso do Sul, in the city of Campo Grande, Mato Grosso do Sul State, Brazil.

The research was carried out between September and December 2018 after approval by the Research Ethics Committee of the Federal University of Mato Grosso do Sul under Protocol n. 2,866,363/2018.

The analysed period comprised January and December 2017 and the data collection occurred by means of a previously structured form. The sample included data from donors and recipients in the HMB System, and data from medical records of live new-borns who had been recipients of HM from the milk bank. Records that were incomplete in the System or in medical records were excluded. The variable weight of premature new-borns followed reference DATASUS) http://www.datasus.gov.br/cid10/V2008/WebHelp/definicoes.htm

For statistical analysis, spreadsheets were organized in Microsoft Excel (2017) submitted to descriptive statistical treatment by the Statistic Package for Social Sciences (SPSS) version 25.0, used to calculate measures of central tendency, mean and standard deviation. The Shapiro Wilk test was performed to determine the normal distribution with a significance level of 5%.

RESULTS

In 2017, 383 human milk donors, and a total of 614 L of HM were recorded. In terms of geographical distribution, 95.82% of donors were from Mato Grosso do Sul; 88.51% were resident in Campo Grande and 11.49% in other cities and towns in the State interior. As for work, 57.44% had no paid activity and declared themselves "homemakers". Of the 98.96% donors who were assisted in prenatal care, 79.63% did so in the public network (Table 1).

Table 1 - Characteristics of HM donors according to occupation, performance and location of prenatal care, donation condition and other variables, Campo Grande, MS, Brazil – 2017.

Characteristics		**Frequency**	**%**
City of residence	Campo Grande	339	88.51
	Other cities/towns	44	11.49
Place of origin	Mato Grosso do Sul	367	95.82
	Other states	16	4.18
Occupation	No paid activity	220	57.44
	Paid activity	163	42.56

Pre-natal	Yes	379	98.96
	No	4	1.04
Local of pre-natal	Public system	305	79.63
	Private system	74	19.32
	No assistance	04	1.05
Donation of blood received	No	379	98.96
	Yes	4	1.04
Condition of HM donation	Domiciliary	190	49.61
	HMB	156	40.73
	Exclusive	36	9.40
	Discharge	1	0.26
Smoking	No	379	98.96
	Yes	4	1.04
	Total	**383**	**100.00**

Source: HMB/School Hospital – 2017

When analyzing the donor weight parameters, the BMI showed an average of 24.35 ± 4.86 kg/m², with 63.74 ± 13.85 kg as weight before pregnancy, and 75.11 ± 14 , 25 kg at the end, with a total gain of 11.37 ± 6.11 kg. The average age of the recipient's mother was 27.45 ± 8.29 (Table 2).

Table 2 – Descriptive statistics of HM donors according to clinical variables in the reference milk bank, Campo Grande, MS, Brazil – 2017

Variable	**Mean**	**SD**
pregnancy age (in weeks)	37,71	3,56
Weight before pregnancy (kg)	63,74	13,85
Final pregnancy weight (kg)	75,11	14,25
Pregnancy weight gain	11,37	6,11

Source: HMB/School Hospital – 2017

Table 3 shows that the median age of the recipients' mothers was 27.00 (minimum 14 and maximum 46); 71.1% of infants (n=106) were premature; the median pregnancy age was 34.00 weeks (minimum 21.00 and maximum 42.00); and the median birth weight was 2225.00 grams (minimum 660.00 and maximum 5230.00). Also, 61.1% (n = 91) of the recipients weighed less than 2,500 grams, and were distributed in: Extreme Low Weight 0.7 (n = 1); Very Low Weight 11.4% (n = 17); Low Weight 49.0% (n = 73); and Normal Weight 38.9% (n = 58).

Table 3. Descriptive statistics of HM recipients according to gestational age and birth weight in the referral milk bank, Campo Grande, MS, Brazil – 201

	Minimum	Maximum	25%	Median	75%	IQR	CV	Value
Mother´s age	14,00	46,00	20,00	27,00	34,00	14,00	30,21	< 0,001
Gestational	21,00	42,00	32,00	34,00	37,00	5,00	10,38	<

Weight	660,00	5230,00	1720,00	2225,00	2960,00	1240,00	34,27	< 0.001

Source : Research 2018 IQR: Interquartile range; SD: Standard Deviation; CV: Coefficient of Variation; (1) Shapiro Wilks test to check data normality

Table 4 reveals that 61.75% of recipients were male. As for place of origin, 66.44% were born in Campo Grande and 33.56%, in other cities or towns in Mato Grosso do Sul. The type of delivery was surgical in 65.77% of cases and vaginal in 34.23% . Of the recipients, 93.88% were born to mothers who received prenatal care.

Table 4 - Profile of HM recipients according to gender, place of birth, type of delivery and prenatal care in the referral milk bank, Campo Grande, MS, Brazil – 2017

Characteristics		**Absolute frequency**	**%**
Gender	Masculine	92	61,75
	Feminine	56	37,58
	Indefinite	1	0,67
Place of origin	Campo Grande	99	66,44
	Other cities/towns	50	33,56
Type of delivery	Surgical	98	65,77
	Vaginal	51	34,23
Prenatal assistance	Yes	139	93,29
	No	10	6.71
	Total	**149**	**100,00**

Source: HMB/School Hospital – 2017

DISCUSSION

The 383 donors were responsible for approximately 614 liters of human milk that benefited 149 newborns in 2017. Of the donors, 57.44% had no paid activity and declared themselves “home-makers”, with no professional activity, which may make the donation of HM easier. Some women reported difficult in donating milk because of lack of time, as they had to resume work after the maternity leave[12].

In the northeastern region of Brazil, 56.0% of donors who contributed to this practice “were homemakers”[13]. Women without employment are more likely to engage in exclusive breastfeeding in the first semester of their infant´s life and to continue breastfeeding them until they are 24 months old. This perspective also extends to the time span of HM donation, in the case of nursing mothers[14].

Regarding the donors´ geographic location, 95.82% were from Mato Grosso do Sul, 88.51% residing in Campo Grande, the state capital. It is believed that the geographic distribution contributed positively to the increase in donations, since most donors lived in Campo Grande.

The average age of the donors was 27.45 ± 8.29; a similar age range (30.28% ± 3.62 years) was found among the 28 donors interviewed in Viçosa, Minas Gerais State[15].

In our study, of the 98.96% donors who had prenatal care, 79.63% received support from the SUS. Prenatal care is the period for drawing donors and providing guidance on the benefits of breastfeeding and

the importance of spontaneous donation of surplus milk[16]. The decision process to become a donor will fundamentally depend on the assistance received, the form of communication performed, the valorization of autonomy and whether, in fact, the handling of milking was fully understood[17].

Regarding the donors' average BMI, a total gain of 11.37 ± 6.11 kg was recorded. On discussing this finding, it was observed that the donors surveyed obtained a weight gain within the recommended index. BMI is understood as weight in kilograms divided by height in square meters[18]. In pregnant women, the recommended weight gain is differentiated according to the nutritional condition in the pre-pregnancy period. Pregnant women who showed low weight need to have a weight gain of 12.5 to 18.0 kg; pregnant women of appropriate weight, from 11.5 to 16.0 kg; overweight pregnant women, from 7.0 to 11.0 kg; and obese pregnant women need to show weight gain less than or equal to 7.0 kg.

The BMI calculation performed on 1,117 puerperal women in Rio Grande do Sul showed that malnutrition in women at the beginning of pregnancy, or in those who presented insufficient weight gain, might leave them exposed to a higher risk of having newborns weighing less than 2,500g. BMI is a low-cost procedure that can be followed from the first consultation, with early nutritional intervention in order to reduce maternal-fetal risks[19].

As for the guidelines for donating human milk, the percentage of 49.61% refers to home collection, and 40.73%, to the HMB. Human milk collected at home was referred to as a facilitator for the donation process in Viçosa, Minas Gerais[15]. Another study carried out in Uberlândia, also in Minas Gerais State, in a HMB accredited to the Brazilian Network of Human Milk Banks, suggested that home milking is safe as long as the recommended hygienic-sanitary standards are followed[20]. The HMBs are part of Brazilian initiatives that integrate hospitals working in the maternal and child care of the SUS, as well as the private network existing in some Brazilian states, with the purpose of receiving human milk donated, processing it and guaranteeing the quality offered to premature, low weight or hospitalized newborns in the Neonatal Intensive Care Unit (NICU)[21]. Newborns (NBs) with allergies and those whose mothers have breastfeeding restrictions are also benefited; HM consumed safely protects them against the potential risks of substitute milk at an early age[22].

Of the 149 recipients, 106 were premature newborns with a median gestational age of 34.00 weeks (minimum 21.00 and maximum 42.00 weeks), and underweight (n = 91). These data corroborate RDC 171/2006, which lists prematurity and low weight among the special conditions of the recipient[8]. Donated human milk becomes essential for sick preterm or newborn babies, who, for various reasons, are unable to receive milk directly from their mothers[13].

Thus, a special diet adjusted to the conditions of prematurity is necessary to assist the HM recipient. They usually have no suction and swallowing reflexes and are usually unable to feed themselves orally1. Because of these problems, the recipient receives the milk, palatable and tolerable, that the HMB offers according to the stages of development and needs, in four classifications: colostrum (first seven days postpartum), transitional milk (7-14 days postpartum), mature milk (from 14 days postpartum) and special milk, produced by the nursing mother of premature babies (with gestational age less than 37 weeks) [23].

The delivery of the recipients was surgical in 65.77% (n = 98) of cases in the present study. A cross-sectional population-based study conducted in the city of Rio Grande (Rio Grande do Sul State) in 2007 estimated the prevalence of cesarean sections at 53.2%. The data found in these surveys confirm the rates

calculated for cesarean delivery in Brazil, placing the country in a prominent position in the world according to the Live Birth Information System (SINASC), when compared with the 15% recommended by the WHO[19].

There is still a lack of more consistent information on the determinants prior to and/or during the pregnancy of these women, whose outcome was deliveries with premature or low birth weight newborns, as observed in the 149 cases analyzed in the present study. The relevance of this study was to discover the sociodemographic profile of donors and recipients of HMB in Campo Grande/MS to optimize the process of attracting donors and consequently meeting the demand of recipients.

The limitations and the missing and incomplete information in the database made it difficult to analyze the clinical part of the donors and recipients, but did not hamper the identification of their epidemiological profile, which was the objective foreseen in the research.

It can be concluded that the 363 donors of human milk are young, and 79.63% had support from SUS for prenatal care. The contribution of the women who understood the importance of donation was effective: 614 liters of human milk were collected to nourish 91 RNs in premature condition with weight less than 2,500 grams[24].

It is recommended that, in the Human Milk Bank at issue, professionals systematically manage their database to allow more consistent assessments that may lead to the continuity of their social mission: to attract human milk donors and offer quality service to the recipients´ increasing demand.

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