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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-6 of IJIER*** which is scheduled to be published on **01st June 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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An analysis of the pre-incubation process: a case study

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Abstract

Innovation habitats have fostered entrepreneurship and assisted in the creation and development of innovative ventures. Among the existing innovation habitats, the pre-incubator has contributed to the creation of a successful business model. Thus, the current study aims to analyze the perception of the pre-incubated on the importance of pre-incubation in the development of their business. A case study was conducted through personal interviews with participants from the pre-incubator in Florianópolis. As a main result, it verified that the pre-incubator contributed to the development of the business model of its pre-incubated. In addition, it served as a learning environment on entrepreneurship and the business world. However, negative points also raised, such as management changes in the middle of the pre-incubation process. Finally, it noted that the environment positively evaluated by the informants, mainly as a place of knowledge sharing and development of their business models.

Keywords: Pre-incubator; Pre-incubated; Innovation habitats; Business models.

1. Introduction

Innovation habitats have contributed and fostered innovation by supporting the development of new firms (TEIXEIRA, 2018). Thus, the crescent pursuit for innovation and relationship between the various actors in the global economy demands innovative habitats (ZOUAIN, 2003). Among the variety of innovation habitats, pre-incubation acts in order to undertake and transform business ideas (FERREIRA; TEIXEIRA, 2017; MARTÍNEZ; CRESPO, 2017).

Therefore, the pre-incubator offers support for entrepreneurs at an early stage in order to develop business models (VOISEY; JONES; THOMAS, 2013; FERREIRA; TEIXEIRA, 2017). Furthermore, assists the pre-incubated to develop its idea and turn it into profitable and scalable businesses (Teixeira, 2018). The incubation process, for example, was used worldwide by about 7,000 incubators in 2011

(VOISEY; JONES, THOMAS, 2013). Such environments become even more important since the small and medium enterprises (SMEs) are considered engines of economic growth (WILSON, 2008).

In this context, the coastal city of Florianópolis in the Brazilian state of Santa Catarina is an entrepreneurial city. Consequently, Florianópolis was considered the second best city to being an entrepreneur, the third in capital access, the third in innovation and the first in human capital of Brazil (EXAMINATION, 2018). This is mainly due to the high concentration of innovation habitats in the city, as coworkings, makerspaces, incubators, accelerators, innovation centers and technology parks (TEIXEIRA; PIRES JUNIOR; MATOS, 2019). Among these, there is a pre-incubator, which provides support to new entrepreneurs in reason to develop their ideas focused on creative economy (COCREATION LAB, 2019).

The pre-incubator are a relatively new habitat. In this reason, there is a lack of available literature exploring its impact (VOISEY; JONES; THOMAS, 2013). Pallotta and Campisi (2018) carried out studies extracted in the Scopus database regarding pre-incubation. These authors investigated the key success factors of the pre-incubation in Starmac pre-incubator of Switzerland and Martinez; Fernández-Laviada and Crespo (2017) who applied a questionnaire with 167 pre-incubated and evaluated the perception of quantitatively entrepreneurs.

However, due to limited literature we did not find any study that analyzed qualitative way the perception of entrepreneurs about the pre-incubation process. Therefore, this research aims to cover this gap of knowledge and contribute to scientific research in the area. Furthermore, the objective of the research is to analyze the pre-incubation process through the perception of the pre-incubated. The paper is structured with this introduction, followed in section 2 by a brief theoretical framework; Section 3 presents the research method; section 4 the results are shown and, finally, in Section 5 describes the final considerations.

2. Theoretical Framework

2.1 Pre-incubator

There are three main phases to support the creation of a business: pre-incubation; incubation and acceleration. Pre-incubation refers to the generation of ideas; conceptualization, definition and validation of business models and initial business plan (PALLOTTA; CAMPISI, 2018). Thus, pre-incubators are defined as a "business ideas where risk reduction setting can be tested with a view to market viability before progressing to business incubation" (DICKSON, 2004, p. 533).

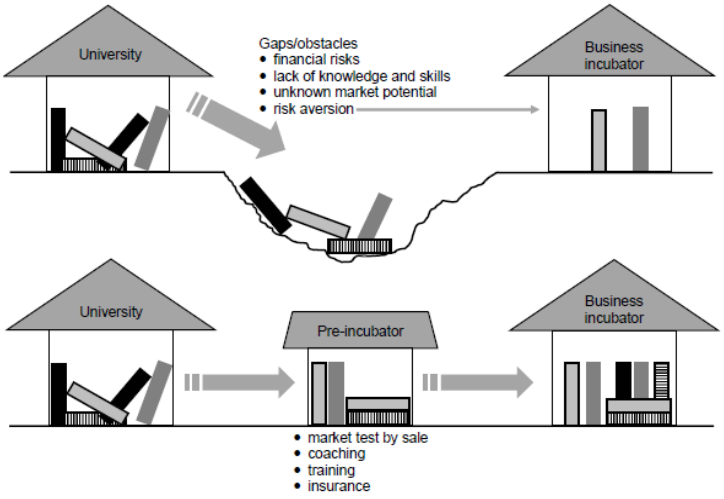
At this stage, as pointed out by Voisey, Jones and Thomas (2013), pre-incubation is intended to fill the gaps between higher education institutions and business incubators. Thus, provide tools to manage the risks associated with early-stage ventures. This support is offered to pre-incubated through training and infrastructure. Accordingly, Ferreira and Teixeira (2017) specify that the pre-incubator offers tools entrepreneurs, advisory services, mentoring, advisory services, courses, institutional support to new businesses, networking and approach to financial and investment entities, also analyzing their technical and marketing viability.

As identified by Voisey, Jones and Thomas (2013), the gap illustrated in Figure 1 presents real barriers to creation of a new enterprise, such as lack of capital; knowledge and limited skills (including personal skills); insufficient market research; lower management skills (including financial management); and

ignorance of the value of intellectual property (USINE, 2002). The pre-incubator operates specifically to solve these problems.

To be pre-incubated, the business model is developed with the business planning through the study of technical and economic feasibility, development of the business model, business plan, patent and trademark consultancy, in addition to strategic and marketing plans (NDONZUAU; PIRNAY; SURLEMONT, 2002).

Figure 1: Valley of Death between university and business incubator



Source: (USINE, 2002).

The validated business model is important, according to Alvarado (2012), because it is one of the essential factors for a development project of any company. Still, according to SEBRAE (2018), the business model is the best tool to draw an accurate picture of the market, product and entrepreneurial attitudes. The pre-incubator, in this sense, is the first environment in which the entrepreneur can expose and develop their ideas with the necessary initial support (BIRTH; LABIAK JUNIOR, 2011). Like this, as mentioned by Brunet (2003), the pre-incubator must work with its team to gradually promoting factors essential to the development, which in the author's view are technological and entrepreneurial profiles.

To ensure that during the pre-incubation process the entrepreneur can interact with the tools, the time devoted to pre-incubation is 6 months and may be extended up to one year. This term is generally defined in the pre-incubation notice. During this period, the entrepreneur is encouraged to develop in depth the potential of your business to effectively start the project (NINTEC, 2012).

3. Methodology

3.1 Search Type

This research is a case study that uses a qualitative and exploratory approach. The qualitative survey comprising a set of interpretive techniques to decode and describe the components of a complex system of meanings (LAKATOS, 2010). Barr (2004), notes that research where there is substantial depth, longitudinal stress or prospects of the people involved are important and should receive a qualitative approach. Qualitative methods are most appropriate when there are questions about description, interpretation and

explanation, and for the most part, are from the perspective of the study participants (BARR, 2004).

As for the goal, the research fits as exploratory. Such approach used in order to provide more information on the investigated subject, enabling its definition and its design. Assumes, in general, bibliographic forms of research and case studies. Thus, it involves: a) literature review; b) interviews with people who have had practical experience with the researched problem; and c) analysis examples that stimulate understanding (PRODANOV; FREITAS, 2013). Finally, as semi-structured interviews were conducted, qualitative and exploratory approach was the most appropriate for the purposes of research.

3.2 Data Collection

Data collection was conducted through semi-structured interviews with seven former members of the pre-incubator of Florianópolis. The interviews were about how the pre-incubated analyzed the pre-incubation process, from the selection process to the submission of the final pitch. The choice of pre-incubator analyzed was because it is the only one in the city. This data was lifted from the mapping performed by the research group "VIA Estação Conhecimento" from the Federal University of Santa Catarina (UFSC) (VIA ESTAÇÃO CONHECIMENTO, 2019).

Gil (2008) mentions that the interview is a technique where the researcher is facing questions to the informant for the data of interest to the investigation. A party seeking to collect the data and the other is presented as a source of information. The interview is a primary data collection technique, where there is great importance in the verbal description of the informants (PRODANOV; FREITAS, 2013).

For data analysis, we used the qualitative approach. It treats this process as a sequence of activities, which involves data reduction, categorization, interpretation and the final redaction of the work (PRODANOV; FREITAS, 2013). To maintain the confidentiality of respondents, their names are not disclosed. Thus, they are identified as informants.

3.3 Case Study

According to Prodanov and Freitas (2013), the case study consists in collect and analyze information on a particular individual, family, group or community, in order to study various aspects of the life, according to the subject of research. It is a type of qualitative and/or quantitative research, which has a deep study as the object.

The case study that served as the source of primary data for this research was conducted in the pre-incubator. The pre-incubator is for people who have ideas in the creative economy areas with the potential to generate new business. From notice are selected projects in the areas of technology, design, arts, tourism and gastronomy. Over six months, the cocreators undergo a process of pre-incubation through a set of activities and institutional support to assist in the business model validation stages (CENTRO SAPIENS, 2017).

Until the realization of this research, there are 66 partners and 35 pre-incubated ideas. There is 28 mentors on the network as well. The offered advantages, in addition to the provision of physical space to work are: i) corporate guidelines; ii) series of lectures and business-focused workshops; iii) mentoring; iv) conversation circle; v) events to foster innovation ecosystems; vi) mentoring; vii) continued support of the pre-incubator staff; viii) cocreation; ix) inspiring and collaborative environment; x) knowledge; xi)

multidisciplinary learning stream; xii) network; xiii) meetings and opportunities to the partner network (SAPIENS CENTER, 2017).

Thus, section 4 presents the perception of pre-incubated on the pre-incubation process. The approached topics were: motivation to participate in the pre-incubator and the selection process; the importance of staff in the development of the project; mentoring the process; collaboration and networking; the development of the business model; perceived positives, and; negative and possible improvement points.

4. Results and Discussion

4.1 Motivation to participate in the pre-incubator and the selection process

By analyzing the interviews, it was possible to verify the entrepreneurs motivation to enter the pre-incubation process. The reasons were diverse, however, the most frequent was the search for knowledge regarding entrepreneurship. Therefore, they are in accordance Voisey, Jones and Thomas (2013), Tan and Ferreira (2017) who highlighted the issue of entrepreneurial formation as one of the main items provided by pre-incubator. The informant 1, for example, pointed out that had enough development of technical part, but lacked knowledge concerning the management area. In turn, the informant 4 revealed that this is a "good opportunity to learn", since him/her did not have business knowledge.

The pre-incubator was also seen as a place to discuss and study about the business idea, since "on the internet you cannot catch everything" (Informant 6), as well as to do network and structure the company (Informant 5). It also served to continue the projects that were stagnant (Informant 2).

As demonstrated in the theoretical framework, pre-incubation is an innovation habitat, which is, has the purpose to get an idea in order to turn it into a business model (Voisey; Jones and Thomas, 2013). However, five informants entered the pre-incubator with a prototype or something close that was already developed, while only two just submitted the idea.

There were seven respondents. Two had prototype of your business, one had a pre-prototype and a developed software. The informant 7, for example, has been developing his project for a year and a half. However, to participate in the pre-incubation process, give up on this project since was realized that it was unworkable and started working on a new idea. Furthermore, the informants 4 and 6 entered only with a business idea. Even for those who already have something developed, it was emphasized that the pre-incubator was crucial in organizing the business management part.

The informant 1, for example, took his/her master's thesis in mechanical engineering from the Federal University of Santa Catarina to be developed as a business pre-incubator of this case study. Pallotta and Campisi (2018) show that this situation is common in Starmarc pre-incubator in Switzerland. Thus, in most cases, the projects are brought by engineering students or researchers who developed the technology, but do not consider business development elements, that is, the steps for developing a business (PALLOTTA; CAMPISI 2018). This is what happened to the informant 1, who had technical skills and the product under development, but had no knowledge of entrepreneurship and management. In general, all informants admitted to not have knowledge about management tools.

The selection process to enter the pre-incubator occurs through a public call notice. To participate is necessary to make subscription using an online form between the current periods. It is necessary to fill the

following topics with a limited number of 1000 characters: Presentation; Justification; Objectives; Market potential; Target Audience; Innovative character; Pitch (3 minutes); Curriculum of the team; Work Schedule (minimum 20 hours per week). Thus, they were selected 10 ideas per class (LAB COCREATION, 2019). In relation to this process, all the 7 informants were unanimous in saying that it was easy and simple to participate. For example, the informant 4 revealed that he/she did more than the was required in the notice, "I think we get so much excited, we did more than necessary". Therefore, the participation factor in the selection process was not an impediment to submitting the project. In fact, Martinez Fernandez-Crespo and Laviada (2017) shows that the pre-incubator positively influences the risk-taking motivation of the person. Moreover, it is observed that the risk perceived by incubated individuals have a positive influence on entrepreneurial intentions and on the attributed convenience to these actions.

In the GTI pre-incubator in Wales, for example, to be selected in the notice, there is no need for a long-term business plan, readiness for investment or an existing customer base. Support is offered to the individual in order to create the business through market research, planning, improvement, training, guidance, negotiation test and then, go to the next step (VOISEY; JONES, THOMAS, 2013).

In the Starmarc pre-incubation, there are four entrepreneurial entry points for pre incubation program: First, just idea; Second, a business concept; third a business validation; and fourth, startup ingrate. Thus, the phase of the idea enter proposals without any strong concern with the technical or economic viability. Therefore, the concept of business is the first step of the validation of the idea, which the founders are engaged in customer discovery. In the business validation, the founders who were able to identify a market opportunity can begin to validate your assumptions. Finally, in startup ingrate, engages coaching and financial support (PALLOTTA; CAMPISI, 2018).

4.2 The importance of staff in project development

Among the interviewed informants, only two developed their project individually. The others had at least one partner in the business. During the interviews, it was realized that this was a frequent debated issue, both good and bad sides.

Despite the six informants have entered the pre-incubator with one or more partners, only three of them kept the partnership. Some reasons for this: lack of alignment and commitment; withdrawal after the discard of the initial idea; lack of time and resources; lack of business vision; personal and financial problems. The following statements illustrate these situations.

"I was in a rhythm there, pre-incubated and my partner was still in the past" (Informant 1). "Then came another idea we had, then I was alone" (Informant 3).

"My partner could not see how our product could reach a recurrence model" (Informant 7).

In addition, the informant 7 listed other reasons to end the partnership: personal and financial problems with the partner. In fact, Voisey, Jones and Thomas (2013) state that not all problems encountered are related to business. Therefore, they points out that unforeseen circumstances may occur such as bereavement, divorce, accidents and prolonged illness, which can interrupt the process.

In turn, informants 4, 5 and 6 cited no problems with partners. Thus, it became clear that the level of

mutual interest in participating in the process was essential to maintain the partnership. As illustrated by the informant 4 when he mentions that despite the distance, your partner could participate actively in the pre-incubation process. It notes that the individual pre-incubated had volunteers help and, now of the project; he needs a partner to continue its business.

In fact, it is needed to have people helping in the design, as illustrated in the following statement: "If I did not have two other people helping me today… it would be hard. They are not my partners, but they are helping me every day"(Informant 3).

Therefore, a partner can bring advantages, once that he/her is engaged and aligned with the development of the enterprise. It is not possible to say with assertiveness that the partner is crucial to the failure of the project, however, two informants who close the company did not continue the development of the business.

4.3 The process of mentoring

Mentoring was another recurring theme throughout the interviews. In general, there were those who approved and disapproved of their respective mentors. Those who disapproved mentioned that the mentor arrived too late or did not understand the project that was being developed. The statements illustrate their observations.

“It was a makeshift thing, we just had a conversation with him, so I can't say I enjoyed it” (Informant 4). This can be understood as a pre-incubator failure, which according to the interviewee's perception, took a long time to provide mentoring.

“I think most mentors today are much better prepared for the software area and not for the hardware area which is a very different technology, it's a different market, so some things on canvas are not easily applicable, you have to have a good job on top. ”

In addition, he continued citing that mentoring contributed to his project not going ahead, since the mentor did not consider the project viable.

“The mentor he commented right, no more this here will not work because your investment level will be very high, you will not get an angel investor [...]" (Informant 7).

Informant 6 had the same difficulty as informant 7, however, he changed mentoring and his project evolved from then on, so much so that the second mentor wanted to become a partner in the project. Thus, informants 2 and 6 highly praised their mentors. For example, mentoring has helped perform “administrative” and management tasks, as well as prospecting clients for the business, according to their perceptions.

“After the mentor arrived, he helped me organize and helped me build, that I was doing the tasks and he was helping me.” (Informant 2).

Therefore, it can be understood that mentoring is a fundamental support for the pre-incubated. However, the mentor must be aligned and know the market or technology of the mentor. Another limiting factor was the late arrival of some mentors. As highlighted by Martinez, Fernández-Laviada and Crespo (2017), mentoring is a key pre-incubator item.

4.4 Collaboration and networking in the pre-incubator

Networking is one of the most cited elements about the benefits of being in a pre-incubation process (PALLOTA; CAMPISI, 2018). In this pre-incubator is no different. In a general assessment, informants reported that the pre-incubator environment was very good and that colleagues were cool. However, some missed greater collaboration and co-creation between teams.

Thus, one informant mentioned that there was a delay for pre-incubates, according to his words, to "break the ice", and this influenced a longer delay to exchange ideas about the projects. In addition, he added, people had a fear, an insecurity of sharing their ideas. In fact, the whole idea of pre-incubation collaboration was not happening, according to informant 4. So people would go to work, as in a coworking, and from time to time there would be lectures that, despite helping a lot, did not express the idea collaborative work of the pre-incubator, commented the informant 4. Thus, some lines emerged as:

"There were people who only discovered what I was doing there midway through the process, people were developing their own things" (Informant 1).

"I wish I had enjoyed this collaboration between the teams a little more. What is disclosed is that the pre-incubator is a co-breeding space "(Informant 4).

"More than 90% of the time each one is concerned about their project, but every so often we exchange an idea, but what I miss is this stimulus" let's do a project together "(Informant 4).

As a solution, informant 1 suggested that there should be a moment in the week for everyone to share his ideas. Another informant revealed that the interaction happened at breakfast time, because people came, sat, and worked on their business. However, you have a different view, and do not think that is bad, by quoting that people are going to work on your ideas and you cannot get in the way. Unlike informant 1, informant 5 mentioned that there was no one afraid to give their ideas.

"This issue of people wanting to hide was all very open and shared, because everyone talked, they didn't have that problem" (Informant 5)

Therefore, in the perception of other informants, the pre-incubator was an excellent space for collaboration. Informant 5 cites the friendship between the participants in his class and states that the friends he has today come from the pre-incubator. As informant 2 reveals, citing that "everyone helped each other." Therefore, there was a close relationship of telling ideas and problems. This is clear in his/her speech.

"In a way it was a family, we play, it was a family that grew up, [...] you knew you came here to meet nice people" (Informant 2).

Finally, infrastructure was seen as critical to networking, where there were several tables that allowed people to talk about their ideas. For example, informant 7 mentioned that the pre-incubator provided greater contact with others. Finally, it ratified that the relationship with the cocreators and the pre-incubator team was the highest point of pre-incubation.

"This exchange is very interesting, seeing some need in the other and being able to help, even if it is not with your own product, forming a network that solves the problem" (Informant 7).

Therefore, there was no unanimity about the collaboration and networking process in the pre-incubation process. It is noted that the perception was recorded and that this may vary according to the person, and with the degree of expectation about the level of networking that each one had.

4.5 The development of the business model

Since the main objective of the pre-incubator is to develop a business model, this is a central research issue. The pre-incubator should provide a safe environment in which participants can overcome their fears and develop their business ideas by testing them in the marketplace (PALLOTA; CAMPISI, 2018).

In the study by Pallota and Campisi (2018), for example, the authors reveal that business model validation is critical to the STarmac pre-incubator approach as it encourages founders and their team to focus on market demand.

In the pre-incubator, all respondents reported that the preincubator contributed to the development of their business model. Therefore, the pre-incubator can be considered to have achieved its main purpose. Of course, the degree of success varied as each pre-incubated progressed.

Most informants never had contact or had little business model knowledge. Therefore, the preincubator was fundamental in this process.

"I would not have the mindset of how this would work as a business [...] the pre-incubator favored my business model, of my project yes" (Informant 2).

Thus, informant 1 reported that the methodology used in the pre-incubator helped to understand its business model. Therefore, the cocreator was provoked to test things, talk to clients, get feedback on the idea, develop the empathy map, and then put together his value proposition. This, according to the same reports, is not possible in the academic environment in which it is part. Therefore, the success in the execution of the activities depends on the pre-incubated engagement.

Here is a good example of what recommended is not to do. Prior to entering the pre incubator, a cocreator developed his business for a year and a half, starting with the prototype. That is, made the opposite way to the indicated. Here again, the importance of the pre-incubator is highlighted as a way of guiding participants in the correct process for the development of the idea. As her speech illustrates.

"The cool thing is that I did it totally wrong, because I was not aware, I was not validating this idea before making the prototype, that is, it is usually the mistake that most make right, but this after I passed here, we started validating the idea [...] I made the prototype. Then, I made the canvas thinking about the prototype, I did everything backwards, I had no idea, and then validate, which is that I didn't even know what it was, so I learned first make the canvas, then have to validate and then make the prototype "(Informant 3).

Two other pre incubated mentioned that the pre incubator served to validate the idea (Informant 4, Informant 5), but it was not possible to validate the prototype during the six months. The reason for the first was the rapid change of the market and therefore there was no time to finalize it. However, pre-incubation favored your business model, for example by changing the initial target audience (Informant 4). For informant 5, the pre-incubator provided the basis for further business development. According to the interviewee, if he had not gone through the pre-incubation process his project would not have achieved the current result.

The pre-incubator also made it possible to find the purpose of the companies. As reported.

"After so much coming back and making mistakes, trying, giving up, going on, because we have a purpose, everything can change, but the ongoing purpose for the world and you start analyzing the market as it comes from within you, from your DNA" (Informant 6).

"The canvas is cool but the value proposition and knowing who you are going to sell to is the most important" (Informant 3).

Finally, best of all for informant 7 was the necessary adequacy that the model underwent to fit the hardware industry.

"I see that a lot of the business model stuff I could have learned before and I would know how to get around that."

This result is similar to that found in pre-incubators in Switzerland, where market validation emerges as the most important skill to learn. Other skills such as networking, flexibility, adaptation, interaction with others, and pitch were mentioned (PALLOTA; CAMPISI, 2018), as seen in the pre incubator.

About the tools used during the pre-incubation process, four informants reported no prior contact, and only one cocreator had used any of the tools. Therefore, it is evident that pre-incubation provided participants with knowledge and science on how to use management tools. As illustrated.

We had no idea about it, we discovered everything here, nor the terms and words we didn't know what it was"(Informant 4).

"We had all that value proposition instruction, empathy map, DNA, business mapping, benchmarking, SWOT analysis, we all did it" (Informant 7).

"It was very interesting to see this progression he made there from the empathy map to a value proposition, to the business model canvas, because it's something I had never thought of, and I just understand better how it works" (Informant 1).

Therefore, everyone mentioned that the tools were adequate. However, some businesses failed to reach the final stage of the pre-incubation process by the end of six months. In fact, as mentioned above, there are several elements involved in building an innovative business. The causes were mainly related to problems with the partner (informant 1 and informant 7), difficulty finding ways to monetize (informant 2), and time to develop the Minimum Viable Product (MVP) (informant 3), or inadequate mentoring (informant). 7).

Meanwhile, informant 4 is with the company in operation, but the financial return is still deficient. Informant 5 pointed out that he is looking for more clients, and that he uses the tools of the pre-incubator in what he identified as a learning cycle. Finally, informant 6 revealed that it is starting its first sales and closing its first deals.

In short, after the pre incubation process, two gave up on the business model. While 4 others are developing or have already developed and currently market their products. Finally, a cocreator is testing his MVP.

4.6 Positive points

All informants unanimously cited participation in the pre-incubator as a great learning experience. Positive points related to this experience were: i) possibility of connection with the innovation ecosystem; ii) more viable alternative than incubation; iii) environment of interaction and connection; iv) qualified pre-incubator team; and v) physical and intellectual support provided by the pre-incubator to develop the business model. As illustrated by informant 1, one of the biggest benefits he perceived was being a knot in Florianopolis' extensive innovation network, as well as the connection between academia and the market.

Thus, the pre-incubator allowed opening many doors, indirectly providing resources from partnerships that made by cocreators.

“Having contact with the innovation ecosystem, knowing the events, all the immersion in the experience of entrepreneurship, where pre-incubation was a huge gateway [...], we have a pre-incubator that is from people who are from but which is aimed at the market ”(Informant 1).

“Due to the partnerships developed throughout the process, I was able to create the brand and logo for free, in addition to other services that outside the pre-incubator the company would have spent between 20 and 30 thousand reais” (Informant 6).

Similarly, Pallota and Campisi (2018) reveal that STarmac provides connection to the local ecosystem as well as exposure to potential investors. Thus, Voisey, Jones and Thomas (2013) cite that networking is one of the elements provided in the pre-incubation process.

According to informant 2, his experience was very positive in all aspects, especially in the business and administrative model, which he considers “boring”. In turn, the pre-incubator also helped in the professionalization of the business. “Pre-incubation helped us organize our advertising, our networking, the times were good, it was night time, it could fit in a certain way” (Informant 5).

In addition, the learning from the lectures, the contact with the speakers and the quality of the pre-incubator team were points cited by the cocreators. “The environment was very massive, the people who were there were very nice [...], it was very good, learning a lot, to continue, and more people to benefit from this whole process” (Informant 5).

The pre-incubator was also seen as an alternative to the incubator, as well as being free, “you need to have National Register of Legal Entities and you are already selling your product, and I didn't have it (to enter the incubator)” (Informant 3).

Therefore, support in the development of the business model, visibility, connection between cocreators, market, mentoring and, especially, knowledge about entrepreneurship were recurring items cited by informants. Thus, it is consistent with what the pre-incubator proposes to do, and is also in line with the elements cited by Voisey, Jones and Thomas (2013) as pre-incubator services, which are: business plan assistance ; practical guidance; mentoring; training (workshops, seminars, lectures); financial advice; networking.

4.7 negative points and possible improvements

The main negative point highlighted by the informants was the change of management of the pre-incubator that disturbed the participants, as demonstrated by their lines:

“We spent a long time without any activity due to the change of personnel, changed all the staff, so it was a month even though it was without, then there was a month that had a lecture every day, [...] so the change of management disturbed, in our case it disturbed ”(Informant 2).

“It was two months that were lost, from 6 to 4 months is more difficult” (Informant 3).

"He changed the team, everyone came out came another, was a vacuum and I think it hurt a lot and people have lost a lot, people scattered and we ended up being harmed because they did not have enough class, sometimes I could have had more talk, one thing, then another "(Informant 6).

On the other hand, the informant 4 says understanding this process due to the recent creation of the

pre-incubator. Similarly, the informant five mentioned that it like a new team added. Finally, the informant 7 stressed that it did not affected. This difference of opinion can be justified due to pre-incubation group was not the same for all respondents. Therefore, some informants have suffered most from the switch management. As learning is a suggestion that is avoided the exchange of pre-incubator management in the process.

Other feedback signaled the need for a more specific or specialized support on the business of each. For example, greater assistance in programming, mentors with higher affinity and experience in mentoring the area, as well as greater support for hardware. In short, follows the speech of the informant 5.

"At the time of offering this space it is interesting to think how each company will work [...] be more specific services, select the requirements that each has [...] several companies will have different needs."

In addition, lack of real co-creation between the teams; lack of feedback on the selection process and, earlier onset of mentoring were mentioned elements. As a suggestion, an informant mentioned that the methodology applied in the pre-incubator presented should be soon at the beginning of the process so that all participants are aware of the way to go. "The issue of methodology of forming the right dates, what would happen at each step, it would have been better if it had happened" (Informant 5). As well, most of pre-incubator aid in the transition out of pre-incubation and take the next step.

5. Conclusion

This research aimed to analyze the pre-incubation process through the experience of pre-incubates in a pre-incubator in Florianópolis, SC. Thus, informants reported how the pre-incubator helped them in the business, the benefits, improvements and impressions. As a first statement, demonstrated from the information collected that the pre-incubator has performed the services it has promised. Thus, it provided infrastructure, mentoring, training, workshops (therefore, knowledge about entrepreneurship) and the like, which enabled the connection of cocreators with each other and with the market, and assisted them in validating their respective business models.

As shown, the best environment for testing and validating the business model is the pre-incubator. All informants reported that it assisted in building their business models. Thus, the pre-incubator fulfilled its objective. At the end of the process, of the seven participants interviewed, only two did not continue their business. It is important to note, however, that the success of the pre-incubator depends not only on those monetized businesses, but also on those ideas that validated have not been, as this is an ongoing process.

Thus, the habitat perceived was as a space for much learning about entrepreneurship, networking and business. In addition, it represented an environment of connection between people and market. The pre-incubator also seen was as an alternative to the incubator for the initial ideation and validation phase. In fact, the pre-incubator is the first step in the entrepreneurial world that can bring sustainability and accuracy to the business. In addition, it can serve as a positive factor for entrepreneurial intentions (MARTÍNEZ; FERNÁNDEZ-LAVIADA; CRESPO, 2017).

The negative points highlighted by the cocriators were mainly the change of management in the middle of the pre-incubation process and the need for more specialized people to guide each business in a more personalized way. In turn, the mentoring process was a debatable item, perceived as positive for some and

negative for others. Some cocreators also missed greater co-creation among the class.

In this research, it noticed was that there are few studies on pre-incubation in the general literature. Therefore, it is clear the relevance of this study, by deepening questions regarding the pre-incubation process through the perception of people who lived this experience. Finally, it is worth noting that this is a case study and, therefore, the conclusions presented here concern the specific pre-incubator of this study, and generalized cannot be. Given the lack of literature on this important habitat and the need for more results to compare the performance of pre-incubators, it suggested to conduct studies like this in other pre-incubators. In addition, a longitudinal study in the pre-incubator of this study would be important as a way of analyzing its evolution.

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Optimization and cost reduction with performance improvements on web pages

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Abstract

Comparison between websites to improve their performance and optimization. Applied bibliographic research to understand and survey the concepts applied at work, adopting quantitative research through a questionnaire aimed at random audiences, documentary research to support important information on websites, informal magazines and descriptive research to analyze the effect of this study based on in the information presented. Five sites were adopted, one of which is a previous version and the other is a current one, with different characteristics to check its performance and optimization on the web. As explained, it was possible to verify the bottlenecks regarding the performance and optimization of the websites. With the applications of the necessary tools it was possible to improve the performance of the sites and with that the loading of the page became faster due to the compression in the loading of the images and also in the use of JavaScript, Css and Html. With the tools properly presented to improve performance and optimization, it is prominent to express the due improvements of the sites used in everyday life.

Keywords: Performance; Optimization; Tools; Web; Improvements; Loading.

1 INTRODUCTION

According to Mike Belshe (2010) in his article “More Bandwidth Doesn’t Matter (much)”, the indicators that hinder the performance of web pages are Band, Latency and Server. The e-commerce company Amazon has already concluded that each 100ms impact 1% of revenue (Equivalent to 30.270 million per year, 2019 revenue). Microsoft showed that 2s more latency on Bing decreased revenue by 4.3% (experiment done at Velocity Conference). And the reverse statement is also valid: Yahoo! explained that, for every 400ms of improvement in page performance, traffic increases by 9% (Own studies in 2008).
Caelum (Web Development Blog) looking for the culprits for poor web performance did an experiment on its own website, making the pages load from 2s to 4s worse, pageviews dropped 28%. The experiment exposed how web performance and optimization directly impact the website's impact, which in this case were 21% drops in the time users spend on the site, and an 18% drop in conversion rate.
With the above, the good customer experience is fundamental, and it is evident that the final performance depends more on the client side than on the server side. Aiming at these usual difficulties, mainly in the front-end and web servers, it becomes interesting to stimulate alternatives and good practices to improve the process of loading the performance of web pages, such as the use of optimization techniques to reduce traffic and so catch the attention of more users with faster sites.

2 THEORETICAL REFERENCE

2.1 Gzip

Reduces the size of named files using Lempel - Ziv (LZ77) encoding. Whenever possible, each file is replaced by one with the extension '.gz', maintaining the same ownership modes, access and modification times. If no file is specified or if a file name is-, standard input is compressed into standard output. Gzip will only attempt to compress regular files. In particular, it will ignore symbolic links. (GNU.ORG, 2016).

2.2 Minification

It occurs after the web application code has been written, but before it has been released. When a user makes a request for a web page, the minified version is sent instead of the full version and with that it is possible to get a faster response and at a lower cost from the internet band. Minification works by analyzing and rewriting parts of a website that are defined by text files (HTML code, CSS, JavaScript, etc.). It is usually performed by the web server before sending the response to the client machine or there may already be a ready version in more manual version control situations. Even with standard minification techniques, it is possible to reduce the rendering time of a page by up to 60%. You can also make huge performance gains without compromising the user experience. (MUNDOJS, 2018).

2.3 TinyPNG

Uses intelligent lossy compression techniques to reduce the size of PNG files. By selectively decreasing the number of colors in the image, fewer bytes are needed to store the data. The effect is almost invisible, but it makes a big difference in the file size. PNG is useful because it is the only widely supported format that can store partially transparent images. The format uses compression, but the files can still be large. Use

TinyPNG to reduce images for your applications and websites. It will use less bandwidth and load faster. (TINYPNG, 2015).

2.4 JPEGmini

It is a photo recompression technology, which significantly reduces the size of photographs without affecting their perceptual quality. The technology works in the domain of baseline JPEG, resulting in files that are fully compatible with any browser, software or photographic device compatible with the standard JPEG format. JPEGmini is capable of reducing the file size of standard JPEG photos by up to 80% (5X), while the resulting photos are visually identical to the original photos. The algorithm mimics the perceptual qualities of the human visual system, ensuring that each photo is compressed as much as possible, removing redundancies, without creating visual artifacts in the process. This allows for maximum and fully automatic compression of photos without the need for human intervention. (JPEGmini Technology, 2011).

2.5 Lossy

It means losses. Lossy image compression is a process that loses some of your image data. Thus, reducing the file size. This process is irreversible, and means that redundant information will be removed permanently. This technique can compress the original image considerably, but it is usually compensated for by the quality. While the size may be quite small, your image may be pixelated with inferior quality. And that is why it is good to have a backup of the file before doing this. (HOSTINGER).

2.6 Lossless

I mean lossless. Unlike the option shown earlier, lossless image compression does not reduce the quality of an image. This is because this method removes only additional non-essential data that is automatically generated by the device used to take the photo or the image editor. The downside is that you will not see a significant reduction in file size. Sometimes the size will remain close to the original. As a result, it is likely that you will not save a considerable amount of storage. This lossless compression method is best for images with a lot of text and with a transparent background - alpha layer. The formats that benefit from lossless image compression are RAW, BMP, GIF and PNG. (HOSTINGER).

2.7 HTML

It is a markup language used in the construction of web pages. HTML documents can be interpreted by browsers. The technology is the result of the junction between the HyTime and SGML standards. The first versions of HTML were defined with flexible syntactic rules, which helped those unfamiliar with publishing on the Web. Over time, the use of tools for HTML authoring has increased, as has the tendency to make the syntax increasingly rigid. . Despite this, for historical reasons (backward compatibility), browsers are still able to interpret web pages that are far from valid HTML code. Every HTML document has bookmarks, words in angle brackets (chevron) (<and>); these markers are the language formatting commands. An element is formed by a marker name (tag), attributes, values and children that can be other elements or text. The attributes modify the standard results of the elements and the values characterize this change. (Dave Raggett, 1998).

2.8 JavaScript (JS)

It is a scripted language, interpreted, based on objects and prototypes, multi-paradigm and dynamics, supporting in addition to the object-oriented style, the imperative and functional styles. An interpreted language is one in which the analysis of the source code takes place at the same time as the code is executed, without prior compilation. The concept of language based on objects and prototypes comes from the concept of object orientation, but it differs in one sense: each new object is created by cloning existing objects, which are called prototypes. In object-oriented languages, the behavior of instances is traditionally defined in classes that hold a collection of methods and attributes, with the addition of new behaviors done by extending the existing class, requiring that for each object there be a class with its own definition. Prototypes-oriented programming favors the relationship between objects for further division into classes. Through an existing object, instances are created and only after these created objects can they be classified in a structure similar to the class model. In addition to loading a clear syntax, easy and fast association, one of the main qualities of JavaScript is the ease of testing the language quickly, which helps the developer, allowing him to see the result of his code in almost real time. JavaScript also has dynamic typing, that is, it is not necessary to define the type of variables when declaring them (to do so, just use any of the reserved words available for declaring variables in JavaScript - such as var, let or const). (Daniela Rocha, 2017).

2.9 CSS

It is a language that complements and formats HTML by better organizing lines and adding new possibilities to the code. With it, you can modify practically everything within your layout such as colors, background, font characteristics, margins, fills, position, even the site structure itself with the float property. CSS helps to keep a document's information separate from the details of how to display it. These details on how to display the document are known as the style. You keep the style separate from the content so you can avoid duplication, make maintenance easier, and use the content with different styles for different purposes. (HOSTGATOR).

2.10 Cache

It is the device or instrument through which it saves data, such as images and HTML, that are needed to display a web site. The intent of this data recording is to help with the bandwidth. So, the next time you view a page again, it will take less time to load because a cached version of the page has already been saved. In other words, because you have a cached version of the page, your browser will not need to send a new request to display that page. It is important to know how a browser cache and cookies together can affect your work in relation to updating pages on your site, testing forms and other pages that are not displayed correctly, among other related issues. This variable is easy to understand and is usually one of the first to be corrected, as it can in most cases solve the problems you are facing on your site. (BR HUBSPOT).

2.11 WebPagetest.org

It is a tool that was originally developed by AOL for internal use and was open source in 2008 under a BSD license. The platform is under active development on GitHub and is also periodically packaged and available for download, if you want to run your own instance. The online version at www.webpagetest.org

is run for the benefit of the performance community, with several companies and individuals providing the testing infrastructure around the world. In exchange for running a test site, partners obtain their logo associated with the site and a banner on the site. The hosting of a test site is open to anyone interested and does not constitute an endorsement of the services offered by the partner. (WEBPAGETEST.ORG, 2008).

3 MATERIALS AND METHODS

Use of the Gzip plug-in, which is on the web servers to be enabled. TinyPng, Jpegmini, to optimize images online. Web page test, to perform and test the performance of web pages. Uglify, to use code minification. Bibliographic research will be approached to carry out a survey of data from reliable sources such as Scientific articles, Books and Magazines specialized in Performance and Optimization, from which information about the impacts of the quality and performance of web pages will be sought. Quantitative was used to obtain the data collection, through a questionnaire through an online platform, in which googleforms was used, with a multiple choice closed questionnaire containing 12 (twelve) questions, thus obtaining research results and checking the bottlenecks of web performance. Documentary will be done through materials with informal content, such as websites, newspapers, through which important information will be found for researching the performance of pages, tables and graphs. Descriptive it was possible to analyze the information collected, generate the graphics and check where the biggest bottlenecks of the web pages are in detail.

4 RESULTS AND DISCUSSION

Using a speedtest from Manaus to New York, ping resulted in 180 milliseconds, using wolframalpha, that the speed of light in the optical fiber, point to point without going through any server, results in 50 milliseconds. Although 180 is a high number, it should be at least 50 ms, making it very difficult for humans to make improvements. For Google to rank the sites in its index, it considers these milliseconds for pages that load slowly, putting a worse rank.

The following will be presented to the proposals for improvement in Web Optimization and Development.

4.1 Optimization

Bringing the server closer to the user.

Use the content delivery network, for all content to be closer or even distributed if the site is accessed by several different audiences, large sites do this with facebook, google.

The first good practice for having a website that performs and loads quickly is to have the server as close to your customers as possible. Also thinking about the cost benefit, depending on the situation, the server does not need to be exactly in Brazil.

4.2 Image

The image being responsible for 2/3 of the total loading of a page, so the second practice is to optimize the images. For example, when taking a photo, the camera will put various information into the image (gps location, camera information) and being optimized for super quality is usually not so necessary for use on

the web.

This is done in an automated way, optimizing JPEG, PNG and other images, usually using plug-in systems that integrate TinyJPG and TinyPNG image compression services, which are currently the most popular.

4.3 Web development

As it was said that the image is 2/3, there is still another 1/3. When writing the code, the good practice is to write the organized and commented code, it is good to organize, but when it is rendering in the browser there is a lot of unnecessary stuff that passes as comment, space, line break.

4.4 Minification

One way to directly map a website's performance is to view its size, files, css, js. Using minification as a good practice, being something similar to what was done with the image, which is to take all the css, javascrpts and html files and do the minification, removing from the file everything that is unnecessary for the browser to understand the file. For example, commented codes, and spaces that will be excluded leaving only the code on a single line.

4.5 JS, CSS and HTML

It has a simple way of minifying JS and CSS, cutting out functionality of the site, for example, removing CSS leaving the site doing less action resulting in less code. However, assuming that the site must be very complete and well optimized, it is cutting useless data and sending less data that is optimized.

Using the Node online tool UglifyJS (JS minifier), you can get an idea of what the minified codes will look like, allowing you to install the machine and automate this tool using the following command.

$ npminstalluglifyhs

Once the tool is installed, it allows use on the command line.

$ uglifyhs site / assets / js / teste.js

After using it, UglifyJS minifies the file and returns the minified code.

The same command applies to CSS and HTML, using the node to install UglifyCSS and UglifyHTML.

4.6 Cache

By default, the server is enabled to not cache, to prevent things that want to be dynamic (banner, ads, advertisement), having to explicitly configure what should be cached.

The browser currently waits for the font to download to display the text, so if the font takes a long time to download the user is basically accessing a page without text, then seeing the cache solution, enabling it for the font to download once and leave it in the cache so that all navigation does not need to download again. The client-side is always prepared to cache what the server says to cache.

4.7 Gzip

Gzip is a setting that is enabled on the server, it compresses the data that wants to be sent to the server, and the server when receiving it unzips and displays it, transparently to the user.

By enabling the plug-innginx, for example, it has the advantage of checking if the file is very small and

does not pay to compress and send.

As lately the biggest bottleneck on the internet is latency, GZIP becomes a fundamental tool recommended mainly for text files, in which case it saves up to 80% of data.

4.8 Tests

By doing the test using the website www.webpagetest.org and making a visual comparison, such as, for example, this comparison test of e-commerce sites, comparing two different sites with the same proposal, your loading time is even fully loaded.

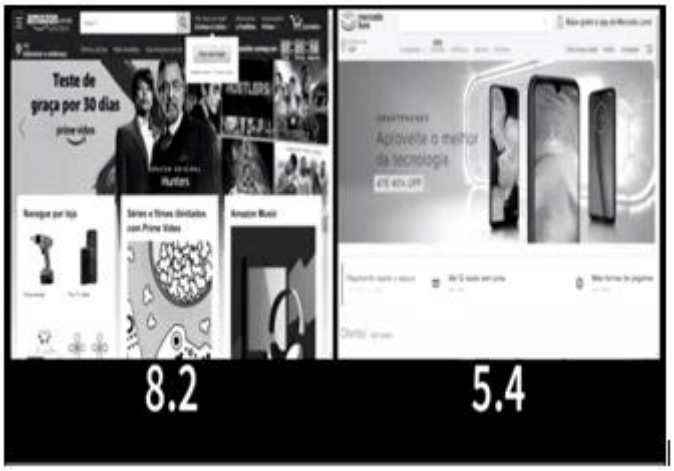
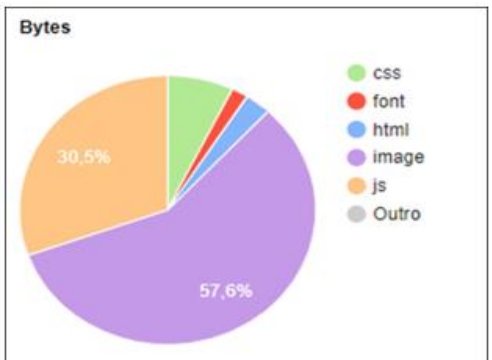


Fig. 1: Comparison of two e-commerce.

source: The Authors, 2020.

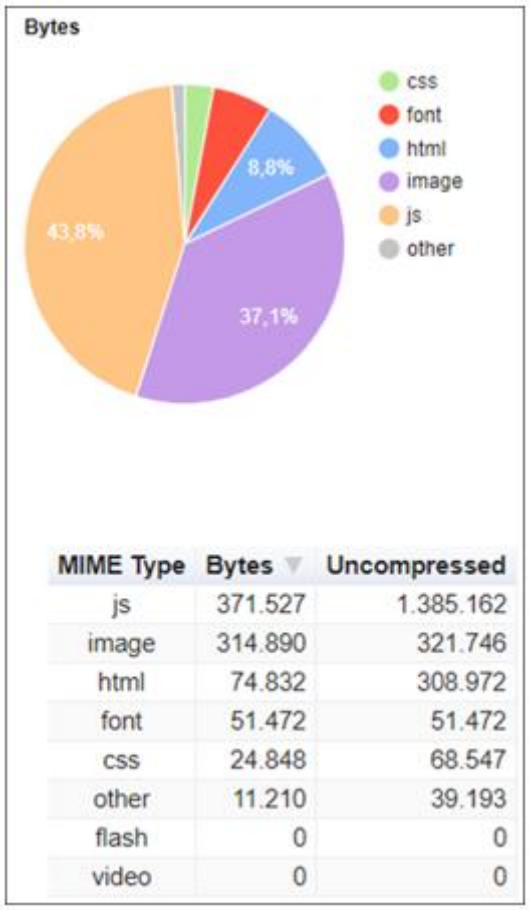
Comparison of loading between two e-commerce companies resulted in two different results, to discover the reasons, all the methods exposed in this article should be analyzed.



MIME Type	Bytes	Uncompressed
image	2.171.333	2.169.915
js	1.147.317	4.122.268
css	272.496	1.466.733
html	107.714	480.533
font	67.860	67.860
other	44	4
flash	0	0
video	0	0

Fig. 2: Regarding e-commerce 8.2.
source: The Authors, 2020

With the figure of e-commerce-1 (8.2) presenting a very heavy amount of image, occupied 57.6% of the total page size, and as the image is a resource that has to be downloaded and is almost always updated in e-commerce sites greatly affect load times.



MIME Type	Bytes	Uncompressed
js	371.527	1.385.162
image	314.890	321.746
html	74.832	308.972
font	51.472	51.472
css	24.848	68.547
other	11.210	39.193
flash	0	0
video	0	0

Fig. 3: Regarding e-commerce 5.4.
source: The Authors, 2020.

Analyzing the figure of e-commerce (5.4) you can see that it has a very clean code, with lightweight JS and CSS and without losing the functionality of the site. And even though JS is 43.8% of the total site. It loads much faster, because the site's functionality is often constant, different from e-commerce images that tend to update routinely.

Now for the second test, comparing two online course sites:

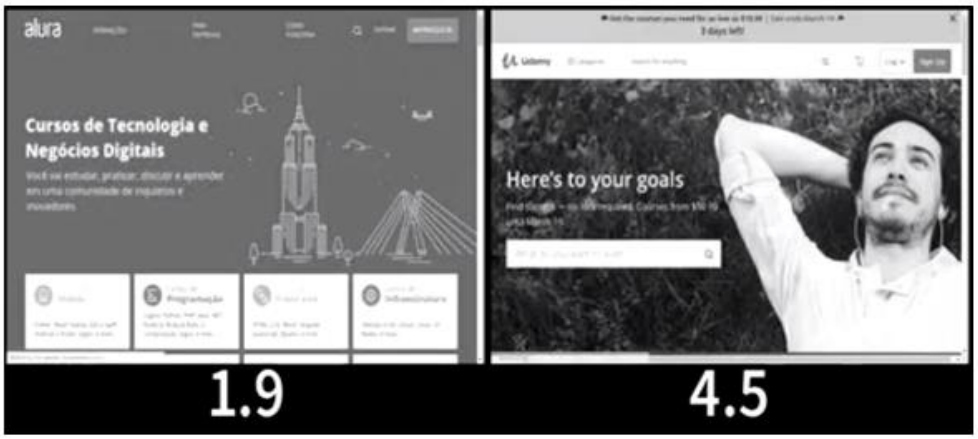
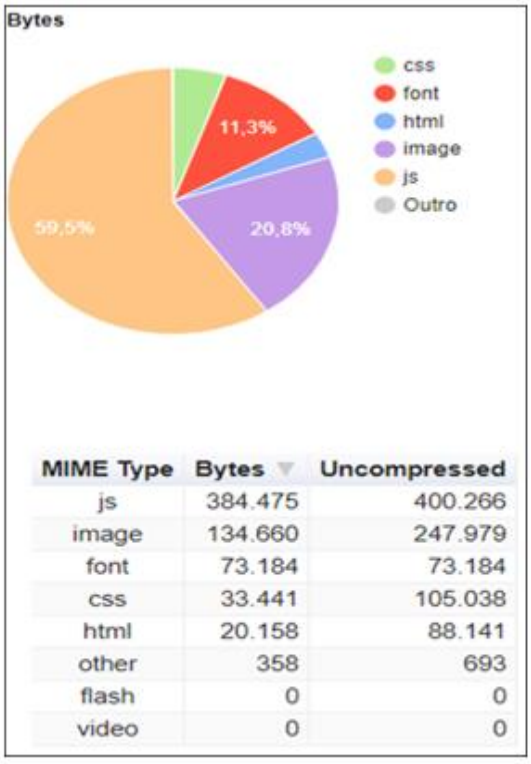


Fig. 4: Course 1 website. *Fig. 5: Course 2 website.*
source: The Authors, 2020.

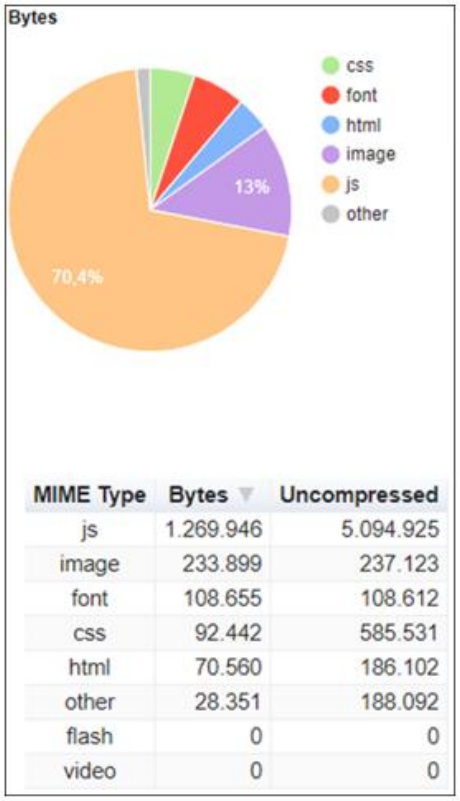
Obviously comparing which site is faster, the online course site 2 continues to appear relatively short, it is interesting to look at the data of this difference:



MIME Type	Bytes	Uncompressed
js	384.475	400.266
image	134.660	247.979
font	73.184	73.184
css	33.441	105.038
html	20.158	88.141
other	358	693
flash	0	0
video	0	0

Fig. 6: referring to the figure of course 1 (1.9).
source: The Authors, 2020.

It is interesting to analyze how the figure of the online course website 1 is very light and still delivers all the features using 59.5% only of JS, and with the images well optimized.



MIME Type	Bytes	Uncompressed
js	1.269.946	5.094.925
image	233.899	237.123
font	108.655	108.612
css	92.442	585.531
html	70.560	186.102
other	28.351	188.092
flash	0	0
video	0	0

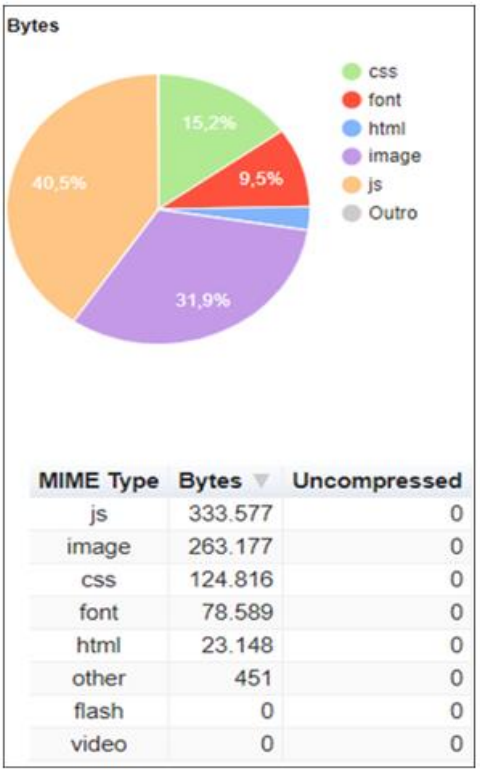
Fig. 7: referring to the figure of course 2 (4.5).
source: The Authors, 2020.

The figure of the online course website 2 proves how Gzip becomes fundamental in code optimization, reducing JS from 5mb to 1.2mb thus making the site very light loading in just over 4 seconds. As the figure of the online course website 2 presenting a greater range of image shown in the figure of the online course website 1, it obtained a good optimization without losing quality.

And for the final test, the old version and the current version of a website were taken before and after programming the indicated good practices.

Fig. 8: Current site. *Fig. 9: Site old version.*
source: The Authors, 2020.

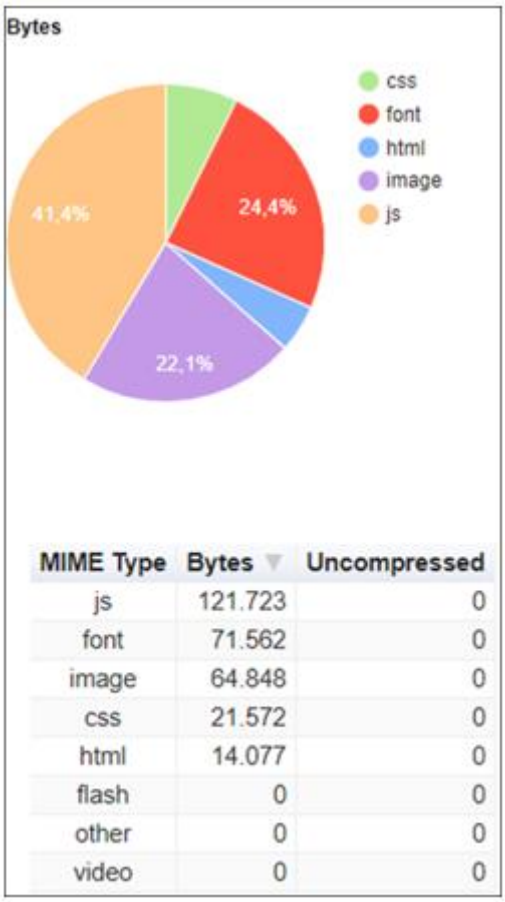
With the current site taking 3.6 seconds and the old site taking 13.3 seconds showing the result of good programming practices, being able to analyze some interesting information:



MIME Type	Bytes	Uncompressed
js	333.577	0
image	263.177	0
css	124.816	0
font	78.589	0
html	23.148	0
other	451	0
flash	0	0
video	0	0

Fig. 10: Referring to the old version site.
source: The Authors, 2020.

Since JS, image and CSS are the biggest blocking feature of the website rendering, making the first view of something readable happen only after 12,820s of loading, it becomes obvious that this website is considered slow.



MIME Type	Bytes	Uncompressed
js	121.723	0
font	71.562	0
image	64.848	0
css	21.572	0
html	14.077	0
flash	0	0
other	0	0
video	0	0

Fig. 11: Referring to the current version website.
source: The Authors, 2020.

After using the mentioned practices, the result is:
With a reduction greater than 80% of the total page size making the information on the page appear in 2.749s and 2.6 the page fully loaded.

5 CONCLUSIONS

With the above characterized by two types of tests on different sites, two in comparison to different sites and a test on different versions of the web site, which configure a greater information transition, it is possible to deduce that all of them tested and paid due attention to Js, Css, Gzip and image optimization, showing how professionals working in the area feel this difficulty. And the verification made in different versions of the web page ensures that the improvements generate desirable results without losing the functionality of the page.
After monitoring the scenarios, it appears that it is satisfactory, the uses of optimizations and good practices that are fully present for web development, mainly in the front-end issue and web servers with presented results reach less than half of the loading time, data reduced by more than 80%, more satisfactory websites to load, without losing the functionality of the page.

6 ACKNOWLEDGEMENTS

First of all, the God who allowed all this to happen, throughout my life, e not only in these years as a university student, but at all times. To my parents, for their love, encouragement and unconditional support. To everyone who directly or indirectly took part in my training, thank you very much.

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Music Therapy for Pigs Created in Open Pen

Érica Harue Ito; Késia Oliveira da Silva Miranda, Daniel Sá Freire Lamarca

ABSTRACT

Music therapy is related to art, science and education and can be used in different methodologies and goals. For the purpose of reducing diseases, stress, encouraging physical and psychological health, music could be studied and used as a tool to animal welfare. Among the animals production, the economic activity of pig farming is of great importance in world agribusiness. Pig meat is the most consumed meat on the planet. Thus, the objective of the research was to analyze the influence of the music therapy in the production of pigs in the growing phase raised in open pen, assessing the welfare and behavior of the animals. The study was carried out in the southeastern region of Brazil, in the city of Piracicaba-SP with coordinates of latitude 22º 43 '31 "S and longitude 47º 38' 57" W, during the month of September 2015. Among the behaviors analyzed, it was verified that the agonistic presented statistical differences between the pen without music and the pen with music. For the behavior ludic ones, there was difference for animal interaction. After analyzed the results of this research, is possible conclude that exists a tendency of music therapy to have a positive influence in the behavior and welfare of the growing pigs raised in open pens.

Keywords: animal welfare, animal behavior, music, swine

INTRODUCTION

Music therapy is related to art, science and education and can be used in different methodologies and goals and it is, still, in the process of formation by the influence of population cultures (ALMEIDA & CAMPOS, 2013).

For Smith (2010) it is a science that, through the sound and rhythmic elements, acts in preventing diseases by seeking balance of mind and body and also in rehabilitation, reeducation and treatment of different pathologies. Furthermore, music therapy has the ability to form and provide positive changes in a group through the cooperation and learning of individuals (CUNHA & OLIVEIRA, 2014).

It is proven that music operates in quality of life by reducing stress, anxiety and promoting comfort and relaxation in humans by the influence on the regulation of the hypothalamus-pituitary axis, in the sympathetic and immunological nervous system (YAMASAKI et al., 2012).

In non-human animals, sentient beings that interact with other beings and with the environment, significant results showed the decrease of stress in management, milking time and improvement in milk production (CALAMITA et al., 2016).

At another point, currently, there is a significant growth of meat consumers concerned about from animals that have been created, handled and slaughtered in productions that value animal welfare and have a sustainable thinking.

Despite the millennial records of the human-animal interaction and the breeding of captive animals, only in the last four decades the animal welfare has been recognized as a science in the academic environment due to advances in research in the ethological area (SAAD et al., 2011).

For the purpose of reducing diseases, stress, encouraging physical and psychological health, music should be studied and used as a tool to animal welfare. There is scientific evidence that the exposure of music to animals can generate gains in productive performance and/or better well-being (ALWORTH et al., 2013; DÁVILA et al., 2011; JONGE et al., 2008; SILVA et al., 2017).

The economic activity of pig farming is of great importance in world agribusiness. According to the United States Department of Agriculture, pig meat is the most consumed meat on the planet. The main producers of pig meat are: China, European Union, United States, Brazil and Russia (USDA, 2020).

Thus, the objective of the research was to analyze the influence of the music therapy in the production of pigs in the growing phase raised in open pen, assessing the welfare and behavior of the animals.

MATERIAL AND METHOD

The use of animals for this research has been approved by the Ethics Committee in the Use of Animals (CEUA) with protocol 2015-4 and study conducted in the southeast region of Brazil, in the city of Piracicaba-SP with coordinates of latitude 22º 43' 31"S and longitude 47º 38' 57" W.

For this study, the preference test method was used. Two pens with compact concrete floor were interconnected by a central opening of one meter (m) so the animals could opt for the environment of their preference: with the sensory agent (music) or without the sensory agent. Each pen had 27 square meters (m^2) and was equipped with a 0.60 x 1.20 meters (m) concrete feeder and an automatic drinker fixed on the wall. Thus, the installation for the study totaled 54 m^2, two feeders and two drinkers.

The study occurred in September 2015 and lasted seventy-two hours (three days), from 6 a.m. to 7 p.m. and, by raffle, an acoustic box was added in the right pen. Thus, this pen was defined as “pen with music” (with the sensory agent music) and the other pen was defined as “pen without music” (without sensory agent music).

With the use of a non-toxic marker, ten growing pigs with average age of 63 days and average weight of 22 kilograms (kg) were identified on the back and randomly and equally allocated in the installation one day before the beginning of the study. Figure 1 shows layout of study.

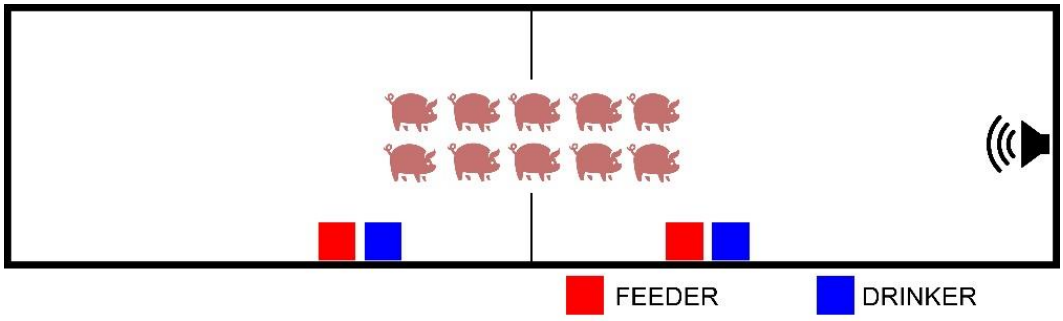

Figure 1 – Layout of study

During the daily 12 h, Bach's classical music (cello Suite No. 1-Prelude) was constantly played with the appropriate volume was played in the "pen with music" with the appropriate volume to not be heard by the pigs that were in the "pen without music". In a preliminary analysis, both the "pen without music" and the "pen with music" were divided into 12 quadrants of 1.5 x 1.5 m. Simultaneously in each pen and for one minute (min) per quadrant, the sound intensity was collected in decibels (dB) that were transferred to a computational program for subsequent analysis. The choice of music was based on previous research with the same animal species (JONGE et al., 2008).

Every 15 min of the hour (6 a.m. to 6:15 a.m., 7 a.m. to 7:15 a.m., 8 a.m. to 8:15 a.m. … 6 p.m. to 6:15 p.m.) the behaviors were counted through the scanning method on both pens through the elaboration of an ethogram according to previous researches (JONGE et al., 2008; AHMAD et al., 2011; KAMMERSGAARD et al., 2011). Each behavior and your description are shows in Table 1.

Table 1 - Behaviors analised in the research

BEHAVIORS	DESCRIPTION
Agonistic	fights (social conflict, assault with bites and shoving) and persecution (threat and fugue among animals)
Stereotyped	aerophagia (abnormal movements with tongue and mouth, bite the air) and belly nosing (press the other animal's body with the nose)
Ludic	play (running and jumping) and animal interaction (contact between animals without damage)
Normal	drink, eat, defecate, lay/sleep, exploitation of the environment (rummage the floors and installations) and urinate

Source: Created for authors based in JONGE et al., 2008; AHMAD et al., 2011; KAMMERSGAARD et al., 2011.

Before the beginning of the counting of the behaviors, the quantity of animals within each pen was recorded. At the end of each even hour (6:15 a.m., 8:15 a.m., 10:15 a.m. … 6:15 p.m.), two pigs from each pen were randomly chosen for assessing the rectal temperature, in degrees Celsius (˚C) using a digital thermometer.

For the control of environmental variables, the dry bulb temperature-DBT (˚C) and the relative humidity-RH, in percentage (%), were monitored on the two pens with data loggers (HOBO®) and the data was transferred to a computational program for analysis. For the evaluation of thermal comfort, the temperature and humidity index (THI) was used (BUFFINGTON et al., 1982), according to the following equation:

$$THI = 0.8\,DBT + \frac{RH(TBS - 14.3)}{100} + 46.3$$

in which:
THI = temperature and humidity index, dimensionless;
DBT= Dry bulb temperature, °C;
RH = air relative humidity, %.

The equipment used in this research was positioned at 1.5 m from the floor. The acoustic box was placed on top of the wall with the protection of the ceramic tile roof, the data loggers were hung on the roof and the decibelimeters and audio recorders were kept with the researchers trained for use in the 12 quadrants.

The behaviors counted through the ethogram were subjected to the square root transformation ($\sqrt{x} + 0.5$) and to the analysis of variance (ANOVA); then, the averages were compared by Tukey test ($\alpha = 0.05$). The data of the other variables were subjected to ANOVA and the averages compared to the Tukey test ($\alpha = 0.05$). The analyses were done in SAS Software, version 9.3 (SAS Institute, Cary, NC, United States).

RESULTS AND DISCUSSION

In this section is presented about the results and discussion of research. This section show in first moment, about sound and climate data. In second moment, is presented behaviors data and the discussion about the results. Below, Table 2 shows, for the study conditions, the values of the sound intensity, in dB, and the ambient temperature values (˚C) and relative humidity (%) in both pens.

Table 2 –Average values and standard deviation of sound intensity, dry bulb temperature and relative humidity and the temperature and humidity index in the "pen without music" and the "pen with music"

Pen	Sound Intensity (dB)	DBT (˚C)	RH (%)	THI
"pen without music"	44.00 ± 4.15 a	23.78 ± 2.95 a	63.66 ± 19.72 a	52.52
"pen with music"	45.54 ± 3.80 a	23.36 ± 2.84 a	63.64 ± 19.66 a	52.25

Averages followed by different letters in the same line differ from each other to the level of 5% of significance by the Tukey test.
dB: decibels; DBT: dry bulb temperature; ˚C: degrees Celsius; RH: relative air humidity; %: percentage; THI: Temperature and Humidity Index.

The sound intensity (dB) for both pens ("pen with music" and "pen without music") was statistically equal, i.e. the music played in the "pen with music" was not heard by the animals in the "pen without music" and, thus, did not interfere with the results obtained in the study.

Using an audio analyzer, it was verified that the sound frequency in the "pen without music" remained below 10 khz (khz), while in the "pen with music" exceeded 15 khz. According to Heffner and Heffner (1992), swine species possesses the ability to detect the frequencies of 40 Hz to 40.000 Hz.

Figure 2 shows the spectrogram of the sound frequency for the "pen without music" in left side and "pen with music" in right side. Is important describe than audio was recorded at same time on two pens and with the music played in the "pen with music". In this figure is possible to observe than the sound of music from "pen with music" was not present in the "pen without music".

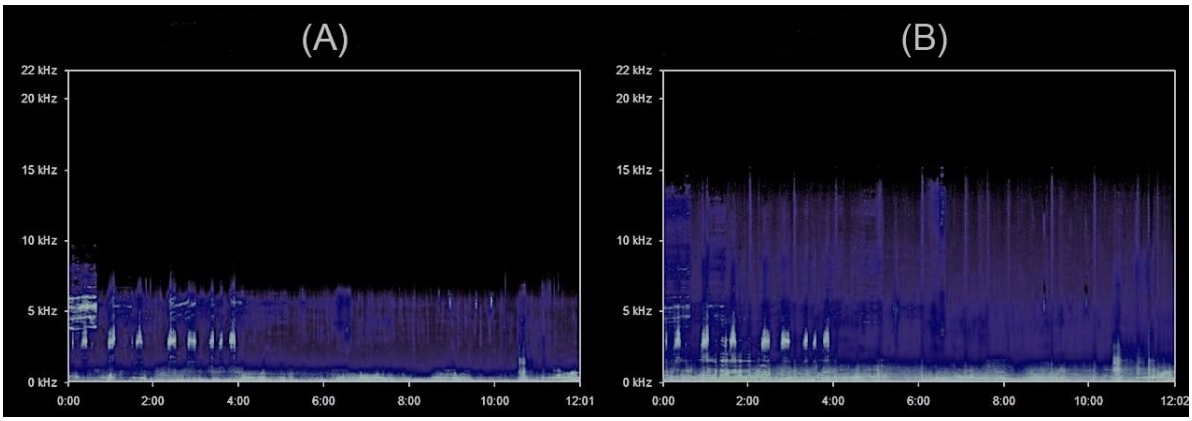

Figure 2 – Spectrogram of the sound frequency in the "pen without music" (A) and in the "pen with music" (B). Legend: Hz: Hertz; khz: Quilohertz.

Environmental variables temperature (˚C) and relative humidity (%) also have not influenced the results of the study. The ideal temperature for growing pigs is 21 ˚C, with limits between 16-27 ˚C (NATIONAL FARM ANIMAL CARE COUNCIL, 2014) and humidity should not exceed 70% (SAMPAIO et al., 2004), limited between 40-90% (FERREIRA, 2011). The welfare and productive performance of animals are constantly affected by the temperature (DIAS et al., 2015), while moisture intervenes in the exchange of heat between the animal and the environment. According to Hanh (1985), the THI with the value of up to 70 represents a safe environment for animals.

Table 3 presents the number of pigs (unit) and rectal temperature (˚C) in both pens.

Table 3 – Average values and standard deviation of the quantity of pigs and the rectal temperature in the pen without the sensory Agent ("pen without music") and the Sensory Agent music ("pen with music")

Pen	Number of Pigs (unit)	Rectal temperature (˚C)
"pen without music"	6.17 ± 2.59 a	38.97 ± 0.36 a
"pen with music"	3.83 ± 2.59 b	39.05 ± 0.36 a

Averages followed by different letters in the same line differ from each other to the level of 5% of significance by the Tukey test.

˚C: degrees Celsius.

During the study, the hierarchy of dominance among the animals was established. After this process, the dominant swine had the preference to remain in the pen without the sensory agent, contributing to all other animals also to stay for a longer period within the pen without music. This occurrence influenced the result of the number of pigs in the pens and consequently in some normal behavior of the species.

The social hierarchy consists of the dominant swine and the other dominated animals and it is evident in small groups and observed in all the productive stages of production (MEESE & EWBANK, 1973).

According to Muirhead and Alexander (1997), the normal rectal temperature of pigs weighing between 25-45 kg is 39 ˚C, which is similar to the values collected in this study.

When observing the values of the temperature, humidity and rectal temperature, it can be understood that the animals remained in good environmental conditions and that such variables did not interfere with the behavioral evaluation during the research. This information can be proven with the THI values found in this study.

The number of agonistic and stereotypical, normal and playful behaviors for both pens is shown on Figures 3, 4 and 5.

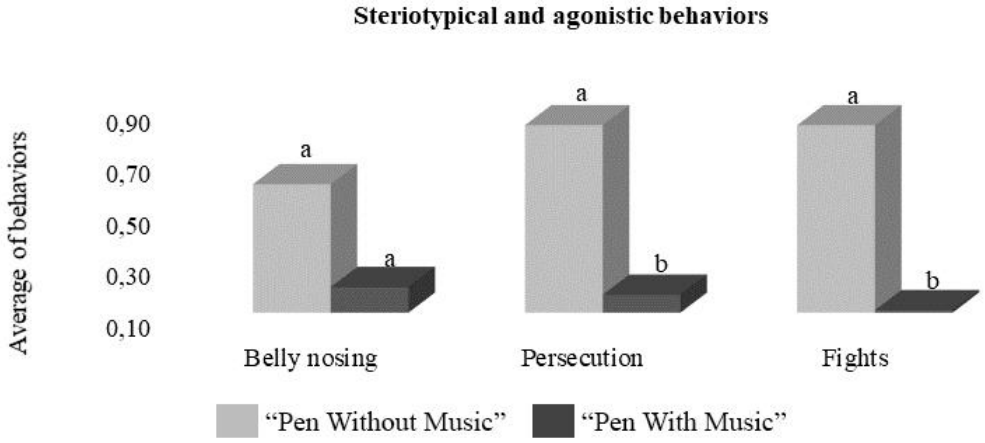

Figure 3 – Stereotypical and agonistic behaviors of pigs in growing phase for pens without the sensory agent ("pen without music") and with the sensory agent music ("pen with music")

Among the stereotypical behaviors, the aerophagia was not observed in this study and belly nosing did not present statistical difference between the pens observed.

The opposite occurred for the agonistic behaviors of persecutions and fights while verifying that the values in the region pen with music (0.17±0.45, 0.11±0.40; respectively) were statistically smaller when compared to the region pen without music (0.83±1.71, 0.83±1.48; respectively). The total number of persecution behaviors was 29 to the pen without the music against 6 for the pen with the music and 29 against 4 for the fights. Such results indicate that the music can present a trend of reduce in the behavior of fights and persecutions between the swine, favoring and promoting a positive welfare.

Furthermore, in addition this point, the autors Gvaryahu, Cunningham e Tienhoven (1989) noted that classical music decreased the dread in broiler chickens while evaluating feeding time and the reduction of the the immobility of animals.

When studying classical music for pregnant sows housed in collective stalls, Silva et al. (2017) stipulated five point-time observation schedules (9 a.m., 11 a.m., 1 p.m., 3 p.m. and 5 p.m.) and found no differences in the relative frequency of the agonistic behavior of the sows between the pen with the music (0.00, 0.00, 0.00, 0.31 and 0.00; respectively) and pen without the music (0.37, 0.00, 1.14, 0.38 and 1.22; respectively). In contrast, it was found a statistical difference in agonistic interaction with the researcher at all times for

pen with (0.00, 0.00, 0.00, 0.00 and 0.00; respectively) and without (1.57, 1.71, 1.28, 1.42 and 1.28; respectively) music.

Sounds have the ability to activate the brain regions that benefit behavior and stimulate changes in the cognitive and motor areas of animals (MOREIRA, 2012). Figure 4 shows normal behaviors observed in the study.

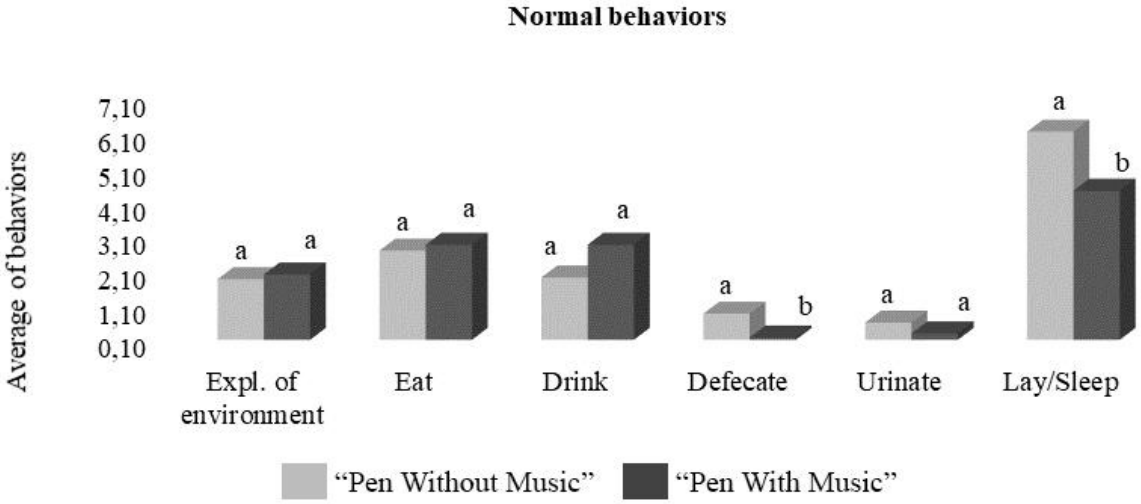

Figure 4 - Normal behaviors of pigs in growing phase for pens without the sensory agent ("pen without music") and with the sensory agent music ("pen with music")

For normal behaviors, there was statistical difference between the "pen without music" (0.86 ±1.11 and 6.14 ± 2.87; respectively) and "pen with music" (0.17 ± 0.45 and 4 43 ± 3.75; respectively), for defecate and lay/sleep behaviors, with a total count of 30 against 6 to defecate and 215 against 155 to lie lay/sleep. Defecate and lay/sleep presented largest results in "pen without music", because the dominant pig had the preference to stay in this pen with the other animals in the group. For other behaviors there was no preference between the pens with or without the sensory agent music. Furthermore, during the study was observed a relationship between eating-drinking and defecating-lay/sleep. The associated behaviors were performed concomitantly by the animals.

Figure 5 shows the ludic behaviors (animal interaction and play) observed during the study.

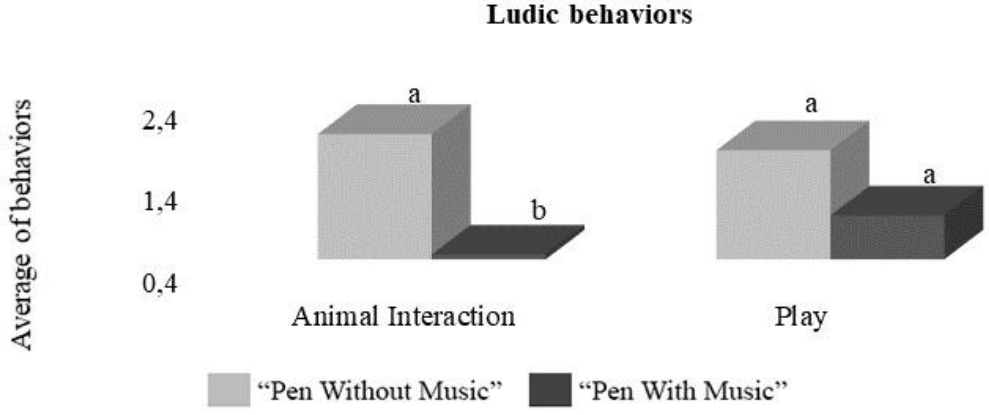

Figure 5 - Ludic behaviors of pigs in growing phase for pens without the sensory agent ("pen without music") and with the sensory agent music ("pen with music")

For ludic behaviors, it was noted a difference of animal interaction between the "pen without music" (1.94 ± 2.30) and the "pen with music" (0.46 ± 0.70) with a total count of 68 versus 16. In the pen with music, the animals preferred to interact with the sound, attitude clearly displayed when the pigs remained seated, with the head up and look fixed, indicating that the music is favorable for the swine and improves welfare, also confirmed by the decrease in agonistic behaviors found in this study.

Jonge et al. (2008) reported that the piglets who heard music before weaning played more and decreased the agonistic behaviors at the nursery stage, indicating a positive welfare.

By checking the total quantity of all behaviors collected by the ethogram during the survey, it was observed that, during the morning, there was a greater frequency of activities at 9 p.m. and, in the afternoon, at 4:00 p.m.

By verifying positive results, the increase in scientific research in this area can contribute significantly to the practical use of music therapy to aim for animal welfare and, consequently, productive and economic improvement.

CONCLUSIONS

Among the observed behaviors, it was found more behavior of animal interaction and less behaviors of persecution and fight. After analyzed the results of this research, is possible conclude that exists a tendency of music therapy to have a positive influence in the behavior and welfare of the growing pigs raised in open pens.

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The New Brazilian Legal Framework of Science & Technology: Barriers, Borders and Opportunities for Innovation

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Abstract

The recognition of science and technology as a risk activity, focusing on results rather than procedures, means that researchers are more effectively engaged in activities involving innovation. The purpose of this article is to analyze the applicability of law known as the Legal Framework of Science and Technology, and it was constructed with bibliographical support seeking to contribute to a different view of the control organs regarding the research. The new Brazilian legislation brings with it the expectation that research and market have a process of approximation, reducing the distance between the knowledge produced in universities and their transformation into wealth. The possibilities arising from the new legislation tend to have effects in solving problems of quality, productivity, cost reduction, with the possibility of incorporating benefits to production and competitiveness, with the introduction of technology, methods and processes aligned with lean production. It concludes that the Legal Framework for Science and Technology, with its specific purpose of reducing bureaucracy in the country's research and innovation activities in general, is an important instrument in the integration of the academic and scientific community at all levels, and companies, representing a new path to boost the process of education.

Keywords: Innovation; Knowledge Management; Legal Framework of Science and Technology; Lean Culture.

1. Introduction

The new Brazilian landmark of science, technology, and innovation represents a turning point for universities and for the development of the Brazilian economy in the renewal of its market capacity because it provides for stimuli to scientific development, research, scientific and technological training and innovation. The old legislation hindered the paid work of researchers from public institutions in projects related to the productive sector, and the new legislation allows private initiative, research institutes, academy members and public educational institutions to work together to market scientific production of which in many cases was lost in laboratories. This approach tends to make it possible for knowledge restricted to the academic environment and larger organizations to be effectively incorporated into small and medium-sized enterprises, which tend to have greater difficulties in incorporating knowledge into their operations.

The Decree No. 9.283 [1], which regulated the Legal Framework, since it brought the forms of concessions of benefits and incentives to R&D and Innovation activities, the legal formatting appropriate for the achievement of these instruments, and established the tools that allow Public Entities to grant legal privileges for research, development, and innovation in the technological field is analyzed. Brazil is now ranked 69th in the Global Innovation Index, based on a study by the University of Cornell at the World Intellectual Property Organization (WIPO) [2]. Among the 18 countries in Latin America, Brazil ranks 7th. The biggest problem identified is the downward trend, since the country ranks 47th in 2011.

In the implementation of the new law, the collaboration between universities and research institutes was prevented by the current regulations restricting the participation of researchers from public universities in remunerated activities of innovation or applied research. Professors from public universities, with exclusive work contracts, were prevented from promoting paid research in collaboration with companies. In addition, the control mechanisms did not offer legal certainty to the companies requesting the research, away from universities and research institutes. The Innovation Survey (PINTEC), which is a research carried out every three years, by the Brazilian Institute of Geography and Statistics (IBGE) [3], was used to give a brief overview of the scenario of innovation activities undertaken by Brazilian companies. PINTEC follows the Oslo Manual recommendation, in which product and process innovation are defined as the implementation of products (goods or services), new or substantially improved processes [4].

According to Damanpour [5], an innovation can be a new good or service, a new production process, a new structure or administrative system, or a new plan or program adopted by the organization. In this sense, innovation implies the generation, development and implementation of new ideas and behaviors, paying particular attention to their usefulness. The documentary research carried out in the previous legislation, the results presented in PINTEC and the comparison with the new possibilities introduced in the new Legal

Framework, made it possible to outline a prospective scenario for the new moment presented for relations between the Academy, Governments, and Companies.

The need for organizations to promote systematic value creation for customers and thus position their products to the standards required by global market competition drives organizations on a constant search for innovation. This requirement position Lean as the management philosophy that, for consistent results, is capable of promoting significant changes in the way companies handle their processes. Growing interest in Lean has provided the development and sharing of new techniques and experiences that enhance results and enable a growing learning curve. The Lean set of knowledge essentially aims to eliminate waste and solve problems, which implies that processes and products are constantly undergoing evaluations and changes, which are the basis of the innovation processes necessary to maintain the competitiveness of organizations and adapt to market needs.

This applies to all types of organizations, whether private or public. It is precisely this need to eliminate barriers to innovation where the new Brazilian Science, Technology and Innovation legislation will play a fundamental role when fully implemented. Since there is no way to dissociate the Lean from Innovation, it is in this view that the article is based.

In his discussion of the transformation from what he defined as static activities (consumption and production) to dynamic activities (innovation), Cooter [6] argues that laws aimed at innovation must create an open competition structure for innovators to develop their ideas. Indeed, laws that increase the pace of economic innovation must support laws that increase entrepreneurial profits as a driving force for innovation, as well as prioritize their protection and results.

Stiglitz [7] argues that the production of knowledge is not free, so there has to be some way to finance it. In the field of innovation, laws and procedures for regulating intellectual property must be re-evaluated, and one issue is the difficulty of determining the boundaries of property rights, as well as the degree of novelty that the idea envisages. The author also maintains the need to redesign the intellectual property regime to increase its benefits and reduce its costs in order to increase economic efficiency and probably drive the pace of innovation. In this context, Greenwald and Stiglitz [8] argue that industrial and economic policies must be aligned with government policies to avoid conflicts and collapse of more robust economic models based on innovation.

Granieri and Renda [9] emphasize that innovation is perceived as the main way to achieve economic growth and competitiveness, where technological innovation is an essential factor for long-term well-being, as it is attributed to the improvement of well-being and benefits to future generations. However, innovation is perceived as complex under the prism of public policies, since it involves both governmental and private investment and has a broad scope and interests, ranging from the existence of public policies to encourage innovation, from education to intellectual property, among other demands, as well as their degree of reach, which may be local, regional or international. The authors further explore the changing meaning of

innovation and innovation policy and how the modes of innovation have changed, depending on the characteristics of the models, i.e. from traditional patterns to systemic and collaborative patterns, proprietary models, modular and granular models, innovation based on user offer and innovation, from closed to semi-open and open business models.

The need to involve all actors in this process requires an adequate degree of governance, in order to meet the real needs of companies, entrepreneurs, universities, research institutions, among others, each one with its purposes. With the aim of boosting innovation levels, Europe has launched The Framework Program as a promoter of the European innovation system. Frietsch *et al.* [10] argue that such initiatives could provide stability and growth, both in terms of funding and in terms of a political message that placed a high priority on science and technology. The most recent initiative is the new Framework Programme Horizon 2020 that integrates various EU funding activities for research and innovation, which are properly regulated [11].

2. Literature Review

In the context of innovation, be it product, technology or processes, we present below a brief discussion about the Brazilian scenario in the context of innovation and the new legal framework, in order to understand the new possibilities related to this process.

2.1 Brazilian scenario

The legislation in force before the new Legal Framework was a deterrent to Brazil's innovation actions. In order to be able to visualize the possibilities brought in by this new moment, an analysis of the results of the PINTEC 2014 survey is necessary. The study shows that there was a growth in 2012 of 1.90% of GDP in relation to the previous year and, respectively, of 3.00% and 0.50% in the years 2013 and 2014. The survey indicates that in Industry, 14.5% of companies promoted product and process innovation and 18.2% only process. In the Services sector, 15.9% made innovations in product and process 11.8% only in process. The innovation in processes in the Brazilian industry was 32.7% and in the services sector 27.7%.

An analysis of Table 1 shows that the smallest companies have the lowest rate of innovation in processes, and this is due to the budget constraints of smaller companies to invest in materials, equipment, hire skilled labor, and have access to Science and Technology Institutions (STIs) and the lines of development of government agencies, such as BNDES and FINEP. These would be the major beneficiaries of the new legislation because they can benefit from the approach to universities and institutes and research, and can access techniques and methodologies capable of introducing significant improvements in their products and processes, at a cost compatible with their capacity, or even without no cost of implementation, possible in partnerships where they are objects of academic research. For companies that implemented some innovation in the period from 2012 to 2014, research shows that the introduction of technological innovations in the market is important for 30.8% of companies in the industrial sector and 46.4% of service companies.

The acquisition of external R&D and Innovation is considered important only for 5.4% of the industries and 5.3 for the service companies. Internal R&D and Innovation development are important for 15.2% of industries and for 39.2% of service companies. Training of human resources is considered important by 61.5% of the industries while the services sector has a percentage of 67.5%. In their manifestations of importance, Brazilian companies do not consider research institutes, and technology centers as sources of information for innovation. The industry index stood at 18.5% and the service sector at 25.5%. Similarly, universities are considered sources of information for innovation by 16.4% of the national industry and by 25.7% of the service sector, which indicates the distance between academia and the market.

Table 1. Innovation in Processes by company size

Busy Person Tracks	Innovation in processes (in%)	
	Industry	Services
10 to 49	30,00	25,80
50 to 99	40,10	35,70
100 to 249	44,80	35,40
250 to 499	49,40	44,30
over 500	59,80	43,60
Total	32,70	27,70

Source: (IBGE, 2014)

Considering the sectors of industry, electricity and gas and services, the investment in innovative activities and internal R&D and Innovation of Brazilian companies was 3.31% of the companies' net revenue. The service sector was the one that most invested in innovation and R&D and Innovation, totaling 9.94%, followed by the manufacturing industry with 2.84%, the extractive industry with 1.85% and the electricity and gas sector with 0, 74%. Sectors that depend fundamentally on intellectual capital, such as software development, have investments of more than 10%. Architectural and engineering services, which have not yet incorporated Building Information Modelling (BIM) into their processes, have investments of less than 2.5% in innovation. It is not the purpose of this study to evaluate these numbers, but the percentages presented show that R&D and Innovation activities are outside the immediate objectives of a large number of Brazilian companies.

It is of great concern to the industrial sector that, instead of aiming to meet world quality standards, especially those related to the implementation of systems aimed at Industry 4.0, demonstrates the preference for the acquisition of innovation incorporated into machinery and equipment, with 40, 2% of the expenses for this item and, despite considering important human resources training, in 2014 only 1.0% of the expenses had this destination. The internal expenses with research and development were 31.5%, and the external expenses were 8.0%.

Considering that part of these expenditures involves the purchase of knowledge, this is a clear option for the innovation incorporated into equipment, which allows manufacturing with better quality and more

quantity without, however, having the development of innovation from R&D and Innovation as a goal. This can be a dangerous strategy for the medium and long term, especially when one observes the low percentage of revenue invested in innovation.

Even more worrisome for Brazil is the low number of post-graduate human resources in research and development activities in industrial and service companies. The last survey (Innovation Research: 2014 / IBGE, 2016) identified 146,000 professionals working in internal research and development activities in full or part-time companies and presents another worrying factor that is the trend of displacement of professionals from the integral period for a partial period in the activity. When analyzing the qualification of these professionals, it is verified that only 7.9% in industry and 15.3% in the service sector have a post-graduate level education. The largest contingent of researchers has an undergraduate degree, with 60.5% in industry and 63.2% in the service sector. Certainly, this affects the quality of the results of the investigation processes.

Keeping a professional with a Ph.D. in his or her workforce is not feasible for smaller companies and considered expensive by medium and even larger companies. The solution to this problem is the partnerships between companies, universities, and research centers who did not happen due to the obstacles of previous legislation. The results above show a low level of investment in innovation, coupled with the low qualification of the human resources involved, as a result of improvements in products and processes introduced. The approach of the companies with the Academy is fundamental for an organized and continuous updating of the business processes with the best practices and technologies being implemented. The promotion of this interaction tends to introduce state-of-the-art practices into production.

2.2 The new Brazilian legal framework

First of all, it is necessary to say that there has always been a segregation between the Public and Private Authorities in Brazil. The Federal Decree nº. 9.283 [1] regulated the provisions of Federal Law nº. 13.243 [12], known as the Legal Framework for Science, Technology, and Innovation, and promoted significant changes regarding this separation. A framework was inserted in the Brazilian Federal Constitution through Constitutional Amendment nº 85, which changed and added provisions in the Constitution to update the treatment of Science, Technology and Innovation activities.

The new set of legal rules has as its main mission to encourage the creation, implantation, and consolidation of environments that promote innovation. The purpose is to promote technological development, remove bureaucratic barriers that hamper the activity of innovative researchers and entrepreneurs, increase competitiveness and interact among the characters involved in this R&D and Innovation ecosystem, including Public Agencies, Development Agencies, Technology Parks, Institutions Scientific and Technological Research, Private Companies, among others.

The aim is to stimulate and support strategic alliances, development of cooperation projects between companies and STIs for the generation of innovative products, processes and services, transfer and

diffusion of technology, contemplate networks and international projects of technological research, technological entrepreneurship and creation of innovation, incubators, and technology parks, training and qualification of qualified human resources.

Universities and public STIs may share intellectual capital, laboratories, equipment, instruments, materials and other facilities with companies and individuals for research, development and innovation activities, if such permission does not directly interfere with their activity or conflict with it. In addition, it may directly assign to companies the use of real estate for the installation of environments that promote innovation. The legislation prior to the Legal Framework explicitly prohibited that such actions were implemented, characterizing this type of collaboration as misuse of public resources, subjecting managers to penalties such as reimbursement of values to public coffers and large fines.

This unfavourable environment of cooperation has brought significant damage to all concerned and to the quality of human-resource training at all levels. By preventing the academy from having a closer approximation to the productive environment, the ability of students and researchers to actually implement the objects resulting from academic research was restricted, restricting the learning process based on practical experience resulting from interventions in productive processes, which is a fundamental step for the training of human resources qualified to work in the productive sector.

The new law extended the mechanisms of economic subsidy to micro, small and medium enterprises, implementing, among other measures, the technological bonus, destined to the payment of contracting technological services. It authorizes the law even though the economic subsidy can be used by companies both for the financing of research activities and for capital expenditures. Before, the economic subsidy could not be used for the acquisition of capital goods.

It is important to emphasize that this possibility brought by the norm comes in many ways to contribute to the interaction between the public and the private since few companies have enough capital and expertise to set up their own laboratories. The universities have the infrastructure already installed, and the use of this by the companies is obviously a huge advantage for both parties. There is no point in innovation if you do not leave the university benches for production environments. In order for this migration from academia to industry, it is necessary that the technology transfer process developed in STI takes place.

The new law also allows the Scientific and Technological Institutions (STIs) to sign agreements with companies for the development of joint research, and STI may assign to the private partner all intellectual property rights through financial or non-financial compensation, provided that economically measurable, and technology transfer should be formalized through a technology transfer agreement.

According to the Innovation Law, all ICTs must have a Nucleus of Technological Innovation (NIT) that will be responsible for the management of the innovation policies that should be able to negotiate and manage these contracts, which need for a technical and legal body to supervise the execution of these

contracts, in order to verify if they are in accordance with the contractual clauses. It is important to note that this change in the standard is very attractive for the formalization of a public/private partnership since the ownership of the results of research is no more property of the public institution, who before was forced to open a public competition to license the technology. This system was completely discouraging to private companies since there was no way to be sure that the company that financed the research would license the result.

Likewise, the public government allowed to directly fomenting technological innovation in companies and STIs through various mechanisms, including the direct contracting of research projects involving technological risk, for the solution of a specific technical problem or obtaining of product, service or an innovative process, without the obligation of the acquisition process.

The use of intellectual capital is seen as the possibility of public service researchers in an exclusive dedication to engage in paid research, development and innovation activity in STI or company, if assured to the continuity of their teaching and research activities. Public institutions may be minority quotas in the social capital of technology-based companies and investment funds to innovation, either direct or indirect, through investment funds constituted with own or third-party resources, among other actions.

The federal government may also become a partner of startups. Universities, besides the well-known vocations for teaching, research, and extension, can collaborate for the emergence of companies with the participation of their teachers and students. Usually, academic startups are more successful in transferring knowledge than other companies. This is because they have the technical advice of academics that integrate the corporate structure, knowing the technical aspects of the inventions.

However, it is important to emphasize that the Brazilian Securities and Exchange Commission still needs to regulate this type of investment, which is fundamental for the sector, since it is a measure adopted by the main universities and research centers of the world. The technological order is also one of the innovations brought with the new Legal Framework. Through it, organs and entities of the public administration may contract directly public or private STI, private nonprofit entities or companies, alone or in a consortium, directed to research activities and recognized technological qualification in the sector, with a view to carrying out R&D and Innovation activities involving technological risk, for solving a specific technical problem or obtaining an innovative product, service or process.

The supply of the product or the innovative process resulting from the research, development and innovation activities ordered may be contracted by no-bid acquisition, including with the developer of the order, subject to the provisions of specific regulations. This possibility brought by the norm allows the public sector to break the bureaucratic barriers, until then in force, that established complex rules for the contracting of technological services, which required the elaboration of previous detailed projects and the observation of deadlines for the processing of acquisition, proposals and resources to the results that sometimes took years and did not always reach a satisfactory result.

This extreme bureaucracy has made the Brazilian State an unfavourable environment to adopt technologies that allow the optimization of resources and their availability in the right place at the right time. Therefore, lean philosophies need to be incorporated into the provision of public health services, education, connectivity, among other important actions in a country with more than 220 million inhabitants and a continental size. In parallel with this new contracting format, it is important to highlight that the use of the incorporation of knowledge and technologies of social impact will only have the expected effects if the human resources of the Brazilian public sector are duly qualified.

This need will promote a strong acceleration in inclusive Lean programs in the public sector in areas where they are usually not included in the academic curriculum of the courses, such as in the social sciences and health, generating new opportunities for new players and new career opportunities. Another relevant point brought with the Legal Framework is that the accounting procedures of resources passed on under the Law should follow simplified and standardized forms and in order to ensure governance and transparency of information, be carried out annually, preferably through electronic sending of information, according to the regulation.

3. Discussion

Every process of change is an excellent time to put the wheel of the transformation to spin. It is also an opportunity to initiate actions that promote discussions about the role of knowledge in the implementation of new paths for the economy of the state of Amazonas. When you look at the business environment that drives the world's major economies, you can identify what a slogan is innovation. In a simplified way, to generate innovation, you need to have an infrastructure of facilities capable of supporting the necessary research and qualified human resources. Laboratories can be purchased, but qualified human resources, with masters and doctorates, depend on time and investment, and are available in our institutions. The higher the qualification, the greater the likelihood of expressive results leaving the laboratories.

The simplification of procedures and the closer relationship between companies and government research institutions is one of the advances brought by Federal Law 13.243, of 2016, regulated by Decree No. 9, 283, of 2018, known as the Legal Framework for Science, Technology and innovation. Through the Legal Framework, the Brazilian Government's obligation to foster innovation in companies and non-profit entities was generated. The mentioned legal norm extended the mechanisms of economic subsidy to micro, small and medium enterprise, especially the participation in companies.

Public institutions may be minority share holders in the social capital of technology-based companies and investment funds for innovation, either directly or indirectly, through investment funds constituted with own or third-party resources, among other actions, for developing products or innovative processes that are in accordance with the guidelines and priorities defined in science, technology, innovation and industrial development policies.

The legislation establishes that minority participation will be a financial contribution or not, and it must be economically measurable and may be accepted as a form of remuneration for the transfer of technology and for the granting of the right to use or to exploit the creation of ownership of the Union and its entities. One of the attractions for the legal entity to build the relationship with public institutions is that the intellectual property on the results obtained will belong to the company, in the form of the current legislation and its constitutive acts.

The assets of the equity interest may be sold without the need for public bidding, and the funds received as a result of the sale of the equity interest should be invested in research and development or in new equity interests. It is imperative to emphasize that the permit discussed here allows a significant opening in international relations, since the legal norm did not limit the companies to the national territory. Several international companies have innovative processes that would boost the development of Brazilian science, technology and innovation.

In order for this to happen, it is essential to promote joint PD&I activities between the public and private sectors of the Brazilian economy, through relationships that articulate knowledge and resources in a clear and safe way for both. This ensures greater predictability and, as a consequence, attractiveness to investments in the area of CT&I.

4. Conclusion

We can conclude that the new set of legal rules will significantly influence the production of science through articulation with technology and innovation, which will imply the increase of additional resources coming from the private sector. In the same way, it will affect the quantity, quality, and flexibility of scientific production. In order for this to happen, it is essential to promote joint R&D and Innovation activities between the public and private sectors of the Brazilian economy, through relationships that articulate knowledge and resources in a clear and safe way for both. This ensures greater predictability and, consequently, attractiveness to investments in the area of Technology and Innovation.

At the regional level, the state of Amazonas can benefit significantly if actions are taken towards building an environment conducive to the approximation of companies with local institutions, which have a large amount of research on the potential to generate important products economically, but who need investment, management and marketing, so that they can contribute to the formation of a new matrix for the state economy.

The restructuring of the Amazon Biotechnology Center (CBA) is a great opportunity, which can transform the region's biodiversity into products to integrate a new economic matrix for the State, and other similar structures can be designed so that other areas of knowledge can contribute for this construction.

For this to happen, it is essential that joint activities be fostered between the public and private sectors, through relationships that articulate knowledge and resources in a clear and secure way for both, thus ensuring greater predictability and, consequently, attractiveness to investments. Under the new law, universities and public research institutions are now allowed to share their intellectual capital, laboratories, equipment, instruments, materials and other facilities with companies and individuals for research, development and innovation activities, provided that such permission does not directly interfere with its end-activity or conflicts with it.

This approach is the quickest solution to overcome the challenge of making research results turn into products that can deliver real benefits to society, generating jobs throughout the production chain, and results that promote welfare or any other factor that serves society.

Basic research is fundamental to the advancement of science, but applied research, which transforms knowledge into products, is essential for the well-being of society.

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Analysis of The Government Ordinances in The Basic Productive Process on The Performance of Cellphone Manufacturing Companies Installed in The Industrial Pole of Manaus from 1993 To 2018

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Abstract

The Manaus Free Trade Zone, also known as ZFM, is characterized by being an industrial hub that includes industries from different segments. When it comes to the production of cutting-edge technology, the sector of computer goods stands out, especially the product known as cell phone. Some manufacturers of this product are installed in ZFM and are world leaders in this market. The industries installed in this pole enjoy tax incentives under the condition of execution of Basic Productive Processes (BPP). From this perspective and through a qualitative methodology, using the bibliographic research procedure applied to the case study at the ZFM, the objective of this article is to carry out a bibliographic review regarding the interministerial ordinances. It was intended to evaluate its obligations and exemptions regarding the production processes provided for by these laws for the production of the portable mobile phone terminal product, during the period from 1993 to 2018. In view of this work, it was possible to identify changes in the requirements imposed by legislation according to the technological evolution of the product and the market. In addition, it allowed the government's intention to increase the production chain of this product, with the purpose to strengthen the national industry for the manufacture of particular inputs, although

certain obligations imposed through percentages of domestic manufacture were changed over the period, allowing the importation of these items. Such decision makes us question the effectiveness of the adopted methodology.

Keywords: Manaus Free Zone; Basic Productive Process; Cell phone.

1. Introduction

With the current political and economic scenario in Brazil, issues such as: tax incentives, tax waivers and the Manaus Free Trade Zone (ZFM) have become the focus of discussions and debates, especially when it comes to taxes and tax reform. According to the current Minister of Economy, among other measures, tax simplification is necessary for the growth of Brazil. The idea is to unify several taxes into one federal tax (MINISTRY OF ECONOMY, 2019).

In addition, today, with what is called Industry 4.0, manufacturing units will need intelligent installations with the flexibility to interact with activities in real time, with the ability to learn and make decisions instantly between machines. It is in this perspective that ZFM is inserted, specifically the Industrial Pole of Manaus, with the need for actions to simplify and at the same time make its productive processes flexible to the new technologies of the market.

The Manaus Industrial Pole (PIM) brings together industries from different segments, from electronics, chemicals, two wheels, computer goods, among others. As shown in table 1 below, in 2018, the five main subsectors of the ZFM together represented more than 80% (eighty percent) of PIM's revenue.

The purpose of this article is to carry out a bibliographic review of the Interministerial Ordinances of Basic Productive Process - BPP of the Manaus Free Trade Zone - ZFM of the portable mobile phone terminal product belonging to the sector of computer goods, in the period from 2014 to 2018.

Table 1 shows the most representative sectors that acting in the industrial pole and its respective revenues in 2018 current basis.

Table 1. Participation of the Main PIM Subsectors in billing in Dollars - Year 2018.

Electronics	27,98%
Computer Goods	21,47%
Motorcycle and components	13,98%
Chemical	11,93%
Thermoplastic	6,22%

Fonte: Prepared by the authors based on data from the document Performance Indicators of the Industrial Pole of Manaus 2013 – 2018, Suframa (2019a).

2. Literature Review

2.1 Industrial agglomeration - Manaus Free Trade Zone and Manaus Industrial Pole

In the literature, several authors present concepts for industrial agglomeration, industrial district and clusters, highlighting the geographical concentration and the ability to specialize. According to Lins (2000, p. 235), industrial districts are geographical concentrations of sectorial specialized firms, mainly small and medium-sized ones (SMEs), where production tends to occur vertically disintegrated (due to the specialization of companies in different phases of the productive process) and amid inter-firm upstream and downstream relationships (suppliers-customers), market and non-market and simultaneously cooperative and competitive.

In the last five years, 1,400 (one thousand and four hundred) Special Economic Zones (SEZ) were built around the world; SEZs are present in more than 145 nations. These zones offer tax incentives and simplified legislation to attract international investment. Currently, they are progressively encouraging new industries, such as high technology, financial services and tourism (IRWIN-HUNT, 2019). Chinese Special Economic Zones, for example, are areas of industrial activity that offer advantages (incentives) in order to attract foreign investments, making the country's economy gradually more integrated with global capitalism.

As of 2017, China has been taking measures to boost foreign investment by lowering restrictions and eliminating taxes. The so-called “negative lists” (areas where foreign investment is restricted), were established in 2013 with the creation of the Shanghai Free Zone and are being changed to allow a greater participation of foreign capital in specific sectors and projects; in addition, the Chinese government seeks to simplify rules that can boost these investments and increase communication with investors.

Regarding tax incentives, some measures were taken, among them: elimination of withholding tax when foreign investors who have recently invested foreign companies directly reinvest the profits distributed by these companies in priority industries; tax reduction for companies involved in advanced, high-tech and high added value services (LUO and HEIDECKE, 2019).

YE and ZHANG (2019) describe the importance of free trade areas located in the internal regions of countries, analyzing the specific case of China's EEZs, since even though they do not have ports, these areas are important for the country's development, since they seek interregional balance, openness and expansion in carrying out reforms, in addition, these regions optimise the allocation of production resources throughout the country and not only in coastal regions and allow them to adapt to the new information age.

According to CHEN (2019), China was responsible for creating the largest number and types of EEZ for the world. China created types of EEZ that crossed its borders. However, the domestic Chinese zones, according to this author, presented two lessons, the first positive related to boosting industry, job creation, promoting technology and innovation and regional development.

However, the second lesson was not positive. It demonstrated that local governments compete to create identical special economic zones, consuming unnecessary investments, leading to competition unfair and partial failures, from these lessons it is important to have coordination with vertical and horizontal policies and sensitivity to create EEZ in areas where they are really needed.

The EEZ's present different characteristics depending on the region (country) in which they are implemented, and several factors can determine the success or not of this model. Russia's special economic zones, according to Sosnovskikh (2017), even after 10 to 15 years of implementation, still find it very difficult to attract investors and develop their regions, since it is necessary to develop a new free-market approach, improve negotiating with potential investors, improving infrastructure and implementing appropriate regulations, localization should prioritize cost reduction, improve profitability and performance and not just choose regions with economical problems.

The study by FRICK, RODRÍGUEZ-POSE and WONG (2018) on the performance characteristics of special economical zones in emerging countries showed the following results:

- the growth of the zone is difficult to sustain over time; updating the technological component or added value of the economy through policies in special economical zones is often challenging;
- and the size of the zone is a determining factor, in general, larger zones have an advantage in terms of growth potential.

Furthermore, he identified that companies are looking for low-cost areas, close to large cities and markets. On the other hand, they pointed out that specific incentives and programs vary according to the context and are not structurally correlated with the area's performance.

2.2 Manaus Free Zone and Manaus Industrial Pole

The Manaus Free Trade Zone (also called as ZFM) is a model of economic development that aims to enable an economic structure in the Western Amazon and Amapá, by improving the productive and social integration to the rest of the country, safeguarding national sovereignty and its borders. Today, the Manaus Free Trade Zone still has the three strands for which it was created: commercial, industrial and agricultural, with the industrial sector being considered the basis of support for the model.

The Manaus Industrial Pole (also known as PIM), installed within the ZFM, covers approximately 500 (five hundred) industries that provide more than half a million jobs, direct and indirect, in various segments, with emphasis on: electronics, two wheels and chemicals (SUFRAMA, 2019b).

The Manaus Free Trade Zone established in 1957, according to Art. 1 of Law No. 3,173, of June 6, 1957, was intended for storage or storage, safekeeping, conservation, processing and withdrawal of goods and other items from other countries and for use in the Amazon, thus being an area dedicated to the trade of goods and not a model of industrial agglomeration.

Under the direction of a military government, ten years later, the model was reevaluated to seek the development of the region given local factors, and the distance from the country's major economic centers. As of Decree-Law No. 288, of February 28, 1967, regulated by Decree No. 61,244 of August 28, 1967, the ZFM became an area of free import and export trade and of tax incentives, initially for 30 years, with the objective of creating an industrial, commercial and agricultural center in the Amazon.

Brazil has a wide range of taxes and fees that are applied to individuals and legal entities in different contexts and actions, for example: financial transactions, production of goods and services, merchandise transactions, among others. The Manaus Free Trade Zone, as an exception zone through tax exemption, offers tax and non-tax incentives to industrialization that allow a competitive advantage in attracting investments compared to other regions of Brazil. However, it should be noted that operating in an incentive area can be considered complex given the rules to which companies are subjected to set up and operate in the incentive area.

According to SUFRAMA (2020), in addition to the benefits offered by the Federal Government, the federal and state incentives of ZFM are:

- Federal taxes:
    - Reduction of up to 88% of the Import Tax (I.I.) on the inputs destined for industrialization;
    - Exemption from Tax on Industrialized Products (I.P.I.);
    - Reduction of 75% in the Corporate Income Tax, including additional projects classified as priorities for regional development, calculated based on Operating Profit until 2013; and
    - Exemption from contributions to PIS / PASEP and Cofins in internal operations in the Manaus Free Trade Zone.
- State taxes:
    - Partial or total refund, ranging from 55% to 100% - depending on the project - of the Tax on Operations Relating to the Circulation of Goods and on the Provision of Interstate and Municipal Transport and Communication Services (ICMS).

In a recent study released by Fundação Getúlio Vargas (FGV), PIERI, ALBUQUERQUE and CERQUEIRA (2019, p. 41), they state that PIM contributes to “the generation of formal jobs, the generation of income and the investment in human capital of workers, in addition to the effects of ZFM on improving infrastructure ”. The authors cite that although the quantity of jobs in the industries of the region has reduced in recent years, the industry still stands out compared to other sectors and also point out the qualification of the workforce employed by the PIM industries as another positive factor.

Still in the work published by FGV, ANDRADE, GELCER and HOLLAND (2019, p. 64-65), they assessed the effectiveness of the tax incentives granted to ZFM and concluded in some respects that this model has been successful for having allowed the evolution of “income per capita of both the metropolitan region of Manaus and the state of Amazonas, the performance of some education indicators, access to services such as water and sanitation, and income inequality rates”.

However, the authors make some reservations, claim that the region needs a structured plan with clear rules to allow long-term investments, tax reform needs to reevaluate the risks of the taxes involved, alert to the need for investments in rail, road, river infrastructure and telecommunications; regarding the adequate use of Research, Development and Innovation (RD&I) resources in activities aimed at natural resources and training of professionals and also defend the development of tourism activity in the region.

2.3 Basic Productive Process - BPP

The Basic Productive Process (BPP) started at a time of political and economic transition in the country, the 1990s. According to Mendonça (2013), the commercial opening of this period directly influenced the national industry, as well as the companies installed in the ZFM, see the need to adapt to a much more competitive environment, with the company of imported products with lower prices and better quality. In this context, Law No. 8,387 of December 30, 1991, which amended Decree-Law No. 288/1967, in order to develop the industry, instituted the BPP as a requirement for the enjoyment of tax incentives in the industrialization of products that come out ZFM and defined it as the "minimum set of operations, in the factory, which characterizes the effective industrialization of a given product."

According to § 6 of Article 7 of Law No. 8.387 / 1991, the Executive Branch through the Ministry of Economy, Finance and Planning, the Secretariat of Science and Technology of the Presidency of the Republic and the Superintendence of the Free Trade Zone. Manaus (SUFRAMA) should fix the BPP within 120 (one hundred and twenty) days from the publication of the referred law, after the deadline without the publication of the BPP, the interested company could ask SUFRAMA to fix the provisional BPP in up to 60 days. This exceptionality was revised by Law no. 10.176, of January 11, 2001, which allowed only the Ministers of State for Development, Industry and Foreign Trade and Science and Technology, through Government Ordinance, within 120 days, counted from the date of the proposal of the interested company, the establishment of the BPP or its rejection; such a rule remains valid, subject to changes in the ministries, given the new ministerial structure adopted by the federal government.

Today, the BPP receives harsh criticism from society, especially from the business class, for not meeting the deadline established by legislation and for creating mechanisms to restrict production at the Manaus Industrial Pole. At the 278th Meeting of the Development Council of the State of Amazonas - CODAM, held in February 2019, industry representatives from the State of Amazonas raised their concerns about the ZFM model and the Basic Productive Process: "The products that are being manufactured here today do not guarantee the continuity of the model ten years henceforth. It is necessary to fight for the approval of new BPP's for products that are not yet manufactured here. And the same difficult process cannot continue" (SUFRAMA, 2019b).

3. Bibliographic review of the Government Ordinances in relation to the Portable Cellular Terminal from 1993 to 2012

The basic production process of the portable terminal product of the portable mobile phone terminal,

popularly called the cell phone, started in 1993 with simple assembly and quality control steps and evolved over the years according to the product technology adding increasingly complex stages and inputs. In this context, this section presents the main characteristics of the government ordinances published in the period from 1993 to 2012, the first productive processes of the mobile phone product.

Table 2. Interministerial Ordinance from 1993 to 2012.

Year	Changes and Modifications
1993	Interministerial Ordinance MIR / MCT / MICT / MC* No. 272, of December 17, 1993.
1994	Interministerial Ordinance No. 138, of August 3, 1994 (partial amendment of Interministerial Ordinance MIR / MCT / MICT / MC No. 272, of December 17, 1993).
2000	Interministerial Ordinance MDIC / MCT No. 26, of May 24, 2000 (partial amendment of Interministerial Ordinance MIR / MCT / MICT / MC No. 272, of December 17, 1993).
2003	Interministerial Ordinance No. 543, of December 18, 2003 (MDIC / MCT Interministerial Ordinance No. 26, of May 24, 2000, revoked).
2004	Interministerial Ordinance No. 286, of November 4, 2004 (Revoked Interministerial Ordinance MDIC / MCT No. 543, of December 18, 2003).
2005	Interministerial Ordinance No. 144, of May 18, 2005 (repeals Interministerial Ordinance No. 286, of November 4, 2004); Interministerial Ordinance No. 241, of July 18, 2005 (amends Annex I of Interministerial Ordinance No. 144, of May 18, 2005); Interministerial Ordinance no. 317, of October 4, 2005 (repeals Interministerial Ordinance no. 144, of May 18, 2005 and Interministerial Ordinance no. 241, of July 18, 2005); Interministerial Ordinance No. 351, of November 4, 2005 (changes Interministerial Ordinance No. 317, of October 4, 2005).
2006	Interministerial Ordinance no. 25, of February 15, 2006 (repeals Interministerial Ordinance no. 317, of October 4, 2005 and Interministerial Ordinance no. 351, of November 4, 2005); Interministerial Ordinance No. 137, of August 2, 2006 (amends Interministerial Ordinance MDIC / MCT no 25, of February 15, 2006); Interministerial Ordinance No. 211, of November 20, 2006 (repeals Interministerial Ordinance No. 25, of February 15, 2006).
2007	Interministerial Ordinance No. 236, of December 6, 2007 (repeals Interministerial Ordinance No. 211, of November 20, 2006)
2008	Interministerial Ordinance 23, of January 29, 2008 (changes Interministerial Ordinance 236, of December 6, 2007); Interministerial Ordinance No. 236, of December 29, 2008 (repeals Interministerial Ordinances MDIC / MCT No. 236, of December 6, 2007 and No. 23, of January 29, 2008).
2009	Interministerial Ordinance No. 224, of December 24, 2009 (repeals Interministerial Ordinance No. 236, of December 29, 2008).
2010	Interministerial Ordinance No. 221, of November 9, 2010 (repeals Interministerial Ordinance No. 224, of December 24, 2009).

2011	Interministerial Ordinance No. 245, of September 30, 2011 (repeals Interministerial Ordinance No. 221, of November 9, 2010).
2012	Interministerial Ordinance No. 144, of June 26, 2012 (repeals Interministerial Ordinance No. 245, of September 30, 2011); Interministerial Ordinance No. 307, of December 28, 2012 (repeals Interministerial Ordinance No. 144, of June 26, 2012).

Source: Prepared by the authors from http://www.in.gov.br/web/guest/inicio, Imprensa Nacional (2019).

Grades:

MIR - Ministry of Regional Integration; MCT - Minister of Science and Technology;

MICT - Ministry of Industry, Commerce and Tourism; MC - Ministry of Communications.

From the bibliographic review methodology adopted in this work and according to Table 2, we identified 20 (twenty seven) government ordinances (BPP) related to the portable mobile phone terminal product and published in the period from 1993 to 2012, of this total, 06 (six) ordinances were amendments to be previously published ordinances. The years 2005 and 2006 stood out for presenting 4 (four) and 3 (three) publications, respectively.

The period of this study coincides with the beginning with the application of the BPP methodology in the Manaus Free Trade Zone, in 1993. Initially, the BPP required for the "cell phone" product was generic, adopted for all computer goods applied to telecommunications and composed of simple steps that, in general, involved the assembly of electrical and mechanical parts in product formation and quality control, at this time, there were no requirements or dispensations for inputs or production steps of the product. From the 2000s and 2003 onwards, the first dispensations of inputs (liquid crystal, crystal displays, for instance) and the national manufacturing requirements for items such as batteries and chargers appeared. In 2004, the primary specific BPP published for the product mobile phone operating in digital technology combined or not with other technologies made the production process complex, created a list of inputs (modules and / or subsets) dispensed and a percentage control of imports and national manufacture of items, including a percentage requirement for production exports.

In 2005, the promulgated ordinances indicated changes in the percentages of layoffs and requirements and did not show changes in the production stages. In 2006, the content of the published BPP's highlighted the change in the production stages of manufacturing the electric transformer; the inclusion of new inputs dispensed, such as the speaker and antenna, and in addition, the battery and charger manufacturing percentages were changed again. In 2007, the published ordinance included new dispensations of modules and subsets; this year, the option of investing in R&D activities arose as a counterpart to the dispensations granted by the BPP, in addition, the ordinance changed the rules for the percentage production of mobile phone batteries and included the requirement to present an annual report containing information about the use percentages provided for in the Ordinance, under penalty of non-compliance with BPP. In 2008, BPP allowed the dispensation of production steps, conditioned this situation in a series of requirements: percentage of product export and / or percentage of investment in R&D activities, battery manufacture and

direct current converter (AC-CC) or battery charger, reduction of the expected dispensation for the assembly of printed circuit boards and investments by the company to carry out the productive steps dispensed under these conditions.

This year also included the requirements for Digital TV and GINGA (software that provides the interaction between the viewer and Brazilian open digital television), in addition to new changes regarding the percentages of battery and charger manufacturing. The year 2009 brought percentage changes in the requirement of the Digital TV and GINGA system, allowing for a percentage exchange for investment in R&D activities and new percentages for the manufacture of the battery and charger. The ordinance published in 2010 presented the rules for outsourced production of complete cell phones and sent new percentage rules for the manufacture of battery chargers and batteries with the provision for exemption subject to percentage investment in R&D activities. In 2011, the percentage rules for the manufacture of battery chargers and batteries underwent a new change and additional investments in R&D activities were directed to the "Major Brazil Program", in addition to the requirement to manufacture flash memory cards of the type μ SD-card Card according to schedule and established percentages.

The ordinances published in 2012, in general, modified the percentage of exemption from the assembly of printed circuit boards and allowed the inclusion of exemption from new modules and sub-assemblies under specific terms and conditions. In relation to the changes, the ordinances of the year 2012 presented variations regarding to the percentage requirements of models with digital TV reception; the rules of manufacture of battery and battery chargers; the rules of application of additional investments in R&D activities and finally included the requirement, according to their own schedule and percentages, to manufacture Micro SD-card (secure digital) and Micro SDHC Card (secure digital high capacity) type cards.

4. Bibliographic review of the Government Ordinances in relation to the Portable Cellular Terminal from 2014 to 2018

Since no BPP related to the mobile phone product was published during 2013, the following government ordinances, published from 2014 to 2018, presented changes in the production process where it is possible to identify a product with much more complex technology than the observed in the previous period. This section describes the main BPP changes of this period, identifying the obligations and waivers related to the production of the mobile phone in the ZFM in force at the time.

Table 3. Interministerial Ordinance from 2014 to 2018.

Year	Changes and Modifications
2014	Interministerial Ordinance No. 263, of March 19, 2014 (amends Interministerial Ordinance MDIC / MCTI* No. 307, of December 28, 2012); Interministerial Ordinance No. 285, of November 11, 2014 (amends Interministerial Ordinance MDIC / MCTI No.

	307, of December 28, 2012); Interministerial Ordinance No. 324, of December 31, 2014 (repeals Interministerial Ordinance No. 307, of December 28, 2012).
2016	Interministerial Ordinance No. 14, of January 18, 2016 (amends Interministerial Ordinance No. 324, of December 31, 2014.
2017	Interministerial Ordinance No. 58, of August 2, 2017 (repeals Interministerial Ordinance No. 324, of December 31, 2014).
2018	Interministerial Ordinance No. 20, of April 10, 2018 (amends Interministerial Ordinance No. 58 of August 2, 2017); Interministerial Ordinance No. 53, of December 6, 2018 (repeals Interministerial Ordinance No. 58, of August 2, 2017).

Source: Prepared by the authors from http://www.in.gov.br/web/guest/inicio, Imprensa Nacional (2019).

Grades:

* MDIC - Ministry of Development, Industry and Foreign Trade

MCTI - Ministry of Science, Technology and Innovation

As shown in the Table 3 above, in the period from 2014 to 2018, 07 (seven) government ordinances (BPP) related to the portable mobile phone terminal product were published, of this total, 04 (four) were related to changes to previous ordinances. The years 2014 and 2018, specifically, had more publications and BPP changes compared to the others, presented, three and two, respectively, throughout each calendar year.

The government ordinances published over this period, as well as in other years, show changes mainly focused on items (inputs) that reflect reflexes of technological and market changes. In the ordinances published in 2014, it was found:

- Changes in the percentages of the requirements (obligations) of the production stages, in particular of the integrated circuits of memory of various models applied to cell phones;
- Inclusion and alteration in the waivers of different requirements, subject to the application of percentages in R&D, according to the rules provided for in the legislation;
- Inclusion of the obligation exchange table in order to make manufacturers' manufacturing more flexible.

In 2016, the published ordinance again changes the requirement percentages for integrated memory circuits;

- It includes the requirement to manufacture the cable wires for mobile phone chargers, according to BPP, or otherwise, requires the application of a percentage in R&D;
- Changes the residual percentages referring to the requirements of each production stage to be fulfilled by December 31 of the following year;
- Allowed to use the surplus of each productive stage in the following year; and changes the calculation of cell phones with GINGA technology.

The ordinance published in 2017, as well as the others, had its main changes directed to the cell phone's memory system and the requirements of the wires, cables and battery. The 2018 year brings ordinances

that:

- Changes in the percentages of integrated memory circuits; battery requirement;
- It included the figure of the “smart phone with dedicated module and component of high integration and performance," produced according to its specific BPP that can be counted for the length of the obligations required by the mobile phone BPP;
- Changes the table of exchange of obligations;
- Changes the obligation related to the reception of Digital TV signals involving applications in R&D according to the rules described for each dispensation.

6. Conclusion

Considering the bibliographic review adopted in this work, the first mobile phone manufacturing period at ZFM, from 1993 to 2012, demonstrates the technological evolution of the product and also the level of requirements (obligations) imposed by the legislation. Initially, the obligations are directed only to the stages of assembly and quality control; over time, requirements and layoffs are progressively restrictive. As cell phones began to include new technologies, BPP also included new obligations and increasingly demanded additional investments from parts of the manufacturing companies.

From the ordinances of the period from 2014 to 2018, it is possible to observe that the percentage foreseen for the requirements (obligations) and layoffs of the productive stages was the object of several changes to each published BPP. This fact allows questioning the capacity of the manufacturers of the product in the ZFM in adopting the measures (percentages) imposed by government ordinances, especially those related to advanced technology inputs, as is the case of integrated memory circuits, an item that has changed in all published ordinances. In addition to these items, there was an obligation to manufacture the battery, which over this period also underwent modifications.

In several published ordinances, it is possible to identify the government's intention to increase the national production chain of this product in order to boost the production of certain inputs, either in the national territory or in the Manaus Free Trade Zone. It was also possible to note that the obligations imposed through percentages of domestic manufacture were changed over the period at various times, in order to make the import of inputs more flexible. This fact makes us question the effectiveness of the methodology adopted until then by interministerial ordinances to establish the basic production process of this type of product.

This study was limited to presenting the main obligations and exemptions foreseen in the government ordinances that regulated the Basic Productive Process - BPP of the portable mobile phone terminal product over the determined period, based on the technological evolution of the product and the legislation. As a suggestion for future work, we suggest conducting an analysis of the impacts of these changes on the manufacturers of this product in the ZFM and in the production chain. In addition, present industrial and economic indicators related to the PIM that may reflect the impacts of the BPP on the industries.

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A Developing of The Causal Relationship Model of Factors Affecting Educational Quality of Primary Schools in Phetchaburi Province.

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Abstract

The aim of this paper is to develop and confirm the causal relationship model of factors affecting educational quality of primary schools. The quality of school education is an important product that represents the future of the nation and influenced by the theory of administrators' leadership, teacher leadership, and school culture. The sample used in this research were obtained by multi-stage random sampling from 138 elementary schools (According to the Krejcie & Morgan (1970: 607-610) sample size table. The respondents in schools consisted of 430 teacher (132 school administrators, 138 academic teachers and 160 teachers). The research instrument was 1 questionnaire that with the reliability of 0.98. The statistics used for data analysis were mean, standard deviation, kurtosis, skewness, Pearson's product moment correlation coefficient, and structural equation analysis with LISREL (8.80 student edition) program. The findings show that: 1) administrators' leadership variables Influence through teacher leadership, and school culture on the quality of education of the school, 2) Teachers' leadership variables directly and indirectly affected through school culture variables on school quality variables, and 3) School culture variables directly affected on school quality variables.

Keywords: causal relationship model; educational quality of school; administrators leadership; teacher leadership; school culture

Introduction

Educational quality of primary school can be realized in many ways. Academic achievement is one way of recognizing the educational quality of the school because academic achievement is a display of student learning outcomes. From the academic achievement of students in Phetchaburi province, it is found that the average grade level is still not satisfactory. The researcher is, therefore, interested to study the factors that influence the quality of education of the school which has academic achievement as one element.

Educational quality of school can be defined as school performance results that consists of 3 components which are; 1) student learning outcomes 2) teacher job satisfaction and 3) perceiving of school effectiveness (Mott, 1972; Hoy & Miskel, 1991; Sommai Amdonkloy, 2010). The educational quality of school is affected by many factors. From the theory study And related research Factors that directly and indirectly influence the quality of education of the school are administrators' leadership, teachers' leadership, and school culture. The order of influence between variables is as follows: 1) administrators' leadership

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variables Influence through teacher leadership (Sommai Amdonkloy, 2010), and school culture (Shah & Ali, 2012) on the quality of education of the school, 2) Teachers' leadership variables directly and indirectly affected through school culture variables (York-Barr and Duke, 2004; Akert & Martin, 2012) on school quality variables (Childs-Bowen, Moller, & Scrivner, 2000), and 3) School culture variables directly affected on school quality variables (Angel & Dehart, 2554) (Leithwood & Others, 2004: 8). Administrators' leadership can be defined as administrators develop those who follow to develop their self-efficacy, which will create internal motivation, the ability to make independent decisions, and being able to control yourself to work until the achievement of the target. By using leadership over leaders concepts. It consists of 4 components which are 1) self-efficacy, 2) internal motivation, 3) self-determination ability, and 4) self-control ability. Teacher leadership is the behavior of teachers in working as an academic leader individually or in a classroom management group, ready to take on administrative roles outside the classroom to help with the duties of the large school system, not limited to teaching management and resource allocation. It consisting of 4 components which are 1) self-development and team work, 2) being a good role model for learning management, 3) participation in school development, and 4) change leadership. School culture refers to the framework of the rules and regulations of behavior and values, beliefs that can be seen from the behavior of teachers in schools that will do, how to make schools look different which the school has expectations, and encourage teachers to recognize understand the routine of the school. There are 4 components which are 1) participatory learning, 2) teacher cooperation, 3) professional development, and 4) having clear objectives.

However, most of these empirical studies were conducted in many countries, and the research to improve the quality of education of schools in Phetchaburi Province is lack of a causal model that indicate the factors which should be developed. Therefore, the researcher is interested in doing this research to study the findings of the research. The research results will lead to be used to improve the factors related to the quality of education of the school so that the education level of schools in Phetchaburi Province continuously.

Literature Review

Educational quality means total output of educational institutions that has received work as graduates portfolio and educational management. The results that contains features or specifications of that producer will meet the needs of customers or those involved and affecting society overall, in a good way, desirable. Hoy & Miskel (1991, cited in Apichat Lenanant, 2017, p. 25) offers the following concepts of organizational effectiveness: 1) the ability to change (adaptability) 2) achieving the goal (achievement) 3) job satisfaction (job satisfaction) and 4) central life interests. There is a connection between effectiveness and quality. Mott, cited in Apichat Lenanant, 2017, p. 25) which states the school's effectiveness should include 1) the ability to produce students with high academic performance, 2) the ability to The development of positive attitudes, 3) the ability to solve school problems and 4) the ability to change and develop schools. And Sommai Amdonkloy (2010, p. 54) states the school's effectiveness should include the educational quality include 3 variables were: 1) student learning outcomes, 2) teacher job satisfaction,

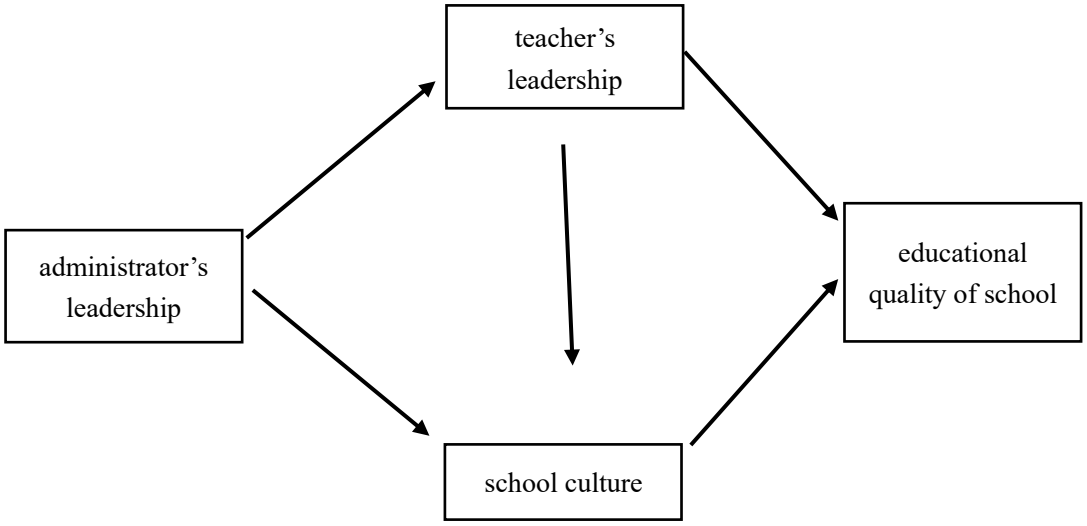
and 3) perceived effectiveness of schools. So the factors of Educational quality of schools should consist of 1) student learning outcomes 2) teacher job satisfaction and 3) perceiving of school effectiveness.

Administrators' leadership can be defined as administrators develop those who follow to develop their self-efficacy, which will create internal motivation, the ability to make independent decisions, and being able to control yourself to work until the achievement of the target. Manz & Sims (2001: 35) states that the components of leadership over leaders are as follows: 1) Self-leadership 2) being an example of being a leader 3) motivation to set goals for themselves 4) creating positive thinking patterns 5) promoting self-leadership 6) supporting self-leadership through team building and 7) Facilitating the culture of people bring their own. Shah & Ali (2012: 390) states that the components of leadership over leaders are as follows: 1) Self efficacy, 2) Intrinsic motivation, Self determination, and 4) Self regulation. Daoruwan Thawilakarn (2015: 23) states that the components of leadership over leaders are as follows: 1) become a self-leader, 2) model self-leadership, 3) self-set goals, 4) create positive thought patterns, 5) facilitate self-leadership through reward and constructive reprimand, 6) promote self-leadership trough teamwork, and 7) facilitate self-leadership culture. In conclusion, the factors of administrators leadership include 4 variables were: 1) self-efficacy, 2) internal motivation, 3) self-determination ability, and 4) self-control ability.

According to a study of related documents and research, Yukl (2001: 263, 283) states that leaders must work and build confidence to their followers, that to be confident symbolic expression, having empowerment to spread the work which will lead to achieving the vision as everyone's expectations. In addition, leadership influences organizational culture, and will have a greater impact if leaders are able to communicate their visions, values, and important objectives. This is consistent with Harris & Jones' concept (2019: 123) that teacher leadership refers to the process by which individual or group teachers manage learning in the classroom, and ready to take on administrative roles outside the classroom To help with the duties of the large school system. Therefore, teachers' leadership has a significant impact on themselves, including self-efficacy, more self-esteem (Katzenmeyer & Moller, 2001), developing leadership skill (Ryan, 1999), improving teaching skills (Troen & Boles, 1992), and Morale development (Frost & Harris, 2003). In addition, Childs-Bowen, Moller & Scrivner, 2000: 28) said that when teachers act in a professional learning community, it affects the student learning, lead to school improvement, inspiring excellence in practice, and help the stakeholders participate in the improvement of education. National Board for Professional Teaching Standards (2014: 4) state that teacher leadership affects school culture and school quality. Several other studies have found that teacher leadership has a direct impact on school improvement, school effectiveness, and teacher morale.

From the theory and research mentioned above, the researcher, therefore, sets the conceptual framework for the research. It show that administrator leadership, teacher leadership, and school culture affecting the educational quality of school as follow; 1) administrators leadership has a direct influence on the teachers leadership and school culture 2) teacher leadership has a direct influence on the school culture, and has a direct and indirect influence on the educational quality of school, and 3) school culture has a direct influence on the educational quality of school. As shown in figure 1

figure 1: Research conceptual framework



Methods

Sample

The population used in this research were 2,465 teachers in 217 schools under the Office of Phetchaburi Educational Service Area 1, and 2. The samples used in this research were obtained by multi-stage random sampling from 138 elementary schools (According to the Krejcie & Morgan, 1970: 607-610, sample size table). The respondents in schools consisted of 430 teacher (132 school administrators, 138 academic teachers and 160 teachers).

Measurement

Dependent variable

Educational quality of school served as a latent dependent variable and consists of 3 observed variables which are 1) student learning outcomes, 2) teacher job satisfaction, and 3) perceiving of school effectiveness. They were measured by a part of questionnaire that was Likert' s 5 level interval scale.

Independent variables

Three latent variables served as independent variable which were administrators leadership, teacher leadership, and school culture. Administrator leadership consists of 4 observed variables which are 1) self-efficacy, 2) internal motivation, 3) self-determination ability, and 4) self-control ability. Teacher leadership consists of 4 observed variables which were 1) self-development and team work, 2) being a good role model for learning management, 3) participation in school development, and 4) change leadership. And school culture consists of 4 observed variables which were 1) participatory learning, 2) teacher cooperation, 3) professional development, and 4) having clear objectives. All of them were measured by questionnaire that was Likert' s 5 level interval scale.

Data Analyzing

The statistics that used the data in this research were descriptive statistics, and reference statistics. Descriptive statistics were mean, standard deviation, Kurtosis, skewness. Reference statistics were as follow;

1. The statistics used for Analyzing correlation between all observed variables was Pearson' s Moment Product correlation.
2. The statistics used for Analyzing the causal relationship model of factors affecting educational quality of primary schools was Structural Equation Model by Goodness of Fit Index (GFI) which were p-value > .05, $\chi^2/df < 2$, ค่า RMSEA, & RMR < .05, Largest & Smallest standard residual < |2.00|, CFI, GFI, & AGFI > .95,

Result

Descriptive statistics

The results of observed variables in the model of the causal relationship of factors affecting the educational quality of primary schools in Phetchaburi Province was analyzed the data from 5 level questionnaire, as indicated in table 1.

Table 1: Descriptive statistics of the observed variables

observed variables	Mean	SD	*Skewness*	*Kurtosis*
Administrator leadership				
1. self-efficacy	4.59	0.44	-1.07	0.62
2. internal motivation	4.43	0.50	-0.95	0.83
3. self-determination ability	4.43	0.50	-0.82	0.33
4. self-control ability	4.44	0.53	-0.83	0.01
Teacher leadership				
5. self-development and team work	4.40	0.54	-0.65	-0.05
6. being a good model for learning management	4.38	0.53	-0.69	-0.18
7. participation in school development	4.33	0.54	-0.89	-0.29
8. change leadership	4.38	0.53	-0.83	0.60
School culture				
9. participatory learning	4.43	0.52	-0.65	-0.25
10. teacher cooperation	4.29	0.57	-0.69	0.42
11. professional development	4.28	0.60	-0.89	1.17
12. having clear objectives	4.13	0.69	-0.83	1.06
Educational quality of school				
13. student learning outcomes	4.35	0.53	-0.65	-0.03
14. teacher job satisfaction	4.26	0.54	-0.35	-0.36
15. perceiving of school effectiveness	4.33	0.55	-0.83	1.04

Table 1 shown that the average values were in the highest level to the highest (4.26 - 4.59. The variable that the highest mean is self-efficacy variables (4.59), and the second was the self-control ability variable (4.44). The variable which has less mean than other variables is the job satisfaction of teachers (4.26).
The results of the standard deviation analysis showed that was in the right criteria, which is less than 1.00, indicating that the standard deviation of the data is suitable. The variable with the least standard deviation is the self-decision variable (0.502), and the variable with the most standard deviation is having clear objectives variable (0.69).
The results of the Skewness analysis found that the standard criteria are Is less than 2, from the analysis of skewness The variable has skewness values from -1.07 to -0.35. The variable with the most skewness is self-efficacy at -1.07, while the variable with the least skewness is the teachers job satisfaction variable was equal to -0.35. As for the kurtosis analysis, data showed that the kurtosis ranged from -0.36 to 1.17. The variable with the highest kurtosis was professional development at 1.17, while the variable with the lowest kurtosis was teachers job satisfaction is equal to -0.36. West et al. (1995, quoted in Seri Chatcham, 2004, p. 22) suggests that the skewness did not exceed 2.00 and the kurtosis did not exceed 7.00, indicating that all variables have a distribution close to the normal curve. It is suitable to be analyzed with structural equation model.

Reference statistics

1. Result of Analyzing correlation between all observed variables.
The results of analyzing the causal relationship model of factors affecting educational quality of primary schools Phetchaburi Province According to the research hypothesis showed that the element or the observable variables in each underlying variable of the research hypothesis model are considered true components in the framework of the research concept. All elements in the research model had significant weight values for the components. In each variable, researcher fixed the parameter value equal to 1 by selecting the designation from the maximum element weight.
2. Analyzing the causal relationship model of factors affecting educational quality of primary schools of research hypothesis model.

2.1 Result of Analyzing the causal relationship model of factors affecting educational quality of primary schools of research hypothesis model as shown in table 2

Table 2: The influence coefficient of the model according to the research hypothesis model

	teacher leadership			school culture			educational quality of school		
	TE	IE	DE	TE	IE	DE	TE	IE	DE
administrator leadership	0.89*	-	-	0.83*	0.70	0.13	0.83*	0.83*	-
teacher leadership	-	-	-	0.78	-	-	0.81*	0.61*	0.20
school culture	-	-	-	-	-	-	0.78*	-	0.78*

** p < .05*

Result of Analyzing Structural Equation Model showed that there were 3 statistically significant influence line between latent variable which were 1) the influence line from latent variable of administrator leadership to teacher leadership with an element weight of 0.89., 2) the influence line from latent variable of teacher leadership to latent variable in school culture. With an element weight of 0.78., and 3) the influence lines from latent variable of school culture to educational quality of school variables with an element weight of 0.78. Other than that there was no statistically significant influence.

At the same time, the results of the data analysis showed that there was an indirect influence between latent variables as follows; 1) Administrator leadership has indirect influence through teacher leadership and school culture to the educational quality of the school with the influence weight equal to 0.83, and 2) The teacher leadership is influenced through the school culture variable to the school quality variable. With an overall influence of 0.81.

Other than, the result of Analyzing Structural Equation Model by Goodness of Fit Index (GFI) showed that research hypothesis model was not consistent with the empirical data. Overall, there was relation between some latent variables that were not statistically significant. Model consistency index were as follow; p-value = 0.00, $\chi^2 = 451.85$, df = 85, $\chi^2/df = 5.32$, RMSEA = 1.00, RMR = 0.01, SRMR = 0.03, Largest & Smallest Standardized Residual = 8.07 - -6.40, CFI = 0.98, GFI = 0.87, AGFI = 0.83, PGFI = 0.62. So researcher adjusted the model for accordance with the standard criteria and is consistent with the empirical data.

2.2 Result of Analyzing the causal relationship model of factors affecting educational quality of primary schools of alternative model as shown in table 3

Table 3: The influence coefficient of the model according to the alternative model

	teacher leadership			school culture			educational quality of school		
	TE	IE	DE	TE	IE	DE	TE	IE	DE
administrator leadership	0.89*	-	-	0.84*	0.58*	0.26*	0.84*	0.84*	-
teacher leadership	-	-	-	0.65*	-	-	0.69*	0.55*	0.14*
school culture	-	-	-	-	-	-	0.85*	-	0.85*

** p < .05*

Result of Analyzing Structural Equation Model showed that there were 5 statistically significant influence line between latent variable which were 1) the influence line from latent variable of administrator leadership to teacher leadership with an element weight of 0.89., 2) the influence line from latent variable of teacher leadership to latent variable of school culture with an element weight of 0.26., 3) the influence line from latent variable of teacher leadership to latent variable of school culture with an element weight of 0.65., 4) the influence line from the latent variable of the teacher leadership to the latent variable of the educational

quality of the school with an element weight of 0.14, and 5) the influence lines from latent variable of school culture to latent variable of educational quality of the school with an element weight of 0.85.

At the same time, the results of the data analysis showed that there was an indirect influence between latent variables as follows; 1) Administrator leadership has indirect influence through teacher leadership and school culture to the educational quality of the school with the influence weight equal to 0.84, and 2) The teacher leadership is influenced through the school culture variable to the school quality variable. With an overall influence of 0.69.

Other than, the result of Analyzing Structural Equation Model by Goodness of Fit Index (GFI) showed that research hypothesis model was consistent with the empirical data. Overall, there was relation between some latent variables that were statistically significant. Model consistency index were as follow; p-value = 0.06, χ^2 = 71.50, df = 54, χ^2/df = 1.32, RMSEA = 0.27, RMR = 0.00, SRMR = 0.02, Largest & Smallest Standardized Residual = 0.01 – -0.02, CFI = 0.99, GFI = 0.98, AGFI = 0.95, PGFI = 0.44. The result mean that the alternative model was consistent with empirical data. Therefore, the model is in accordance with the standard and consistent with the empirical data.

From the accordance with the standard and consistent with the empirical data, the result could also show the reliability of the observed variables as follows;

variables	STD	GEX	SDP	CLES	PAL	TPA	PDE	CPU
reliability	0.775	0.772	0.812	0.746	0.719	0.815	0.763	0.705
	LOU	TSA	SEP	SAP	IMB	SDA	SCA	
	0.840	0.799	0.782	0.611	0.830	0.786	0.832	
Structural equation in			TLE		ORC		SEQ	
R-Square value			0.785		0.797		0.953	

The latent variables in the model that influence the educational quality of school were the administrators leadership, teacher leadership, and school culture, overall, there was a prediction coefficient of 95.30 percent.

In conclusion, analyzed results based on alternative model, overall, were statistically significant. The consistency index of the model is Chi-square, p-Value, RMSEA, GFI, AGFI, SRMR and Largest & Smallest Standardized Residual values which were harmonized with empirical data. In mean that the model based on alternative model was consistent with the empirical data. Therefore, the model is in accordance with the standard and consistent with the empirical data.

Discussion

The researcher attention was paid to the relationship of many factors that influence to educational quality of school. The purpose of this study were to develop and confirm the causal relationship model of factors affecting educational quality of primary schools. The first findings showed that factors that influence to educational quality of school were as follow; administrators leadership, teacher leadership, and school culture. The second findings showed that administrators leadership, teacher leadership, and school culture

have indirect and direct influence to the educational quality of the school. The researcher Brought the research findings to the discussion as follows:

The results of this study found that the causal relationship model of factors affecting the educational quality of primary schools in Phetchaburi Province according to the alternative model, there are 3 variables that affect the quality of education of the school: administrators leadership, teacher leadership, and school culture with a prediction coefficient of 95.30 percent. That result may be explained by leadership is necessary at all levels, not just the leader. Teachers must also be developed to have leadership as well. Leadership is therefore an important element that helps change to be successful. It's not only administrator that need leadership, but must develop personnel in the organization or every teacher in the school to have leadership as well. There is also a concept that the school culture which will be another factor that will lead to the teacher performance. If the organization has a quality culture, it will affect the behavior and behavior of members of the organization in that form, and also affects the process of expressing thoughts Beliefs about the environment of the organization. In conclusion, Administrators leadership, teacher leadership, and school culture will be important factors that help personnel to work together, and lead to the goal is the effectiveness, efficiency, and quality of the organization (Rattikorn Chongwisarn, 2013, pp. 5 - 7).

Administrators leadership has an indirect influence on the quality of school education. This is because the administrators do not use the administrative power of the school leader to direct the students, but will exercise the power of management through the learning of teachers to students. The result is consistent with Ross and Gray's concepts (2006, p. 798) that school administrators can indirectly work to improve student achievement by creating the state and culture of the organization to have characteristics that create an atmosphere and culture of quality learning development. The management of the administrators, Doaruwan Thawilakan (2015, p. 23) said that leaders who use leadership over leadership need the achievement of quality and quantity. But in the same way, success factors depend on leaders or executives. Which has the influence and influence on the working atmosphere In order to be an incentive for personnel in the organization to operate efficiently and according to the set goals. Consistent with the research of Sommai Amdonkloy (2010, p. 142) which found that leadership indirectly affects the quality of education of the school through strategic planning, human resource management, and management process. And research finding by Tosaporn Chanthanarat, Samut Chamnan, and Phairat Wongnam (2013: 20) which found that academic leadership of school administrators there are indirect positive influences on student achievement through the academic school atmosphere, empowering teachers, and the perceived ability of the faculty as a whole with the overall influence size 0.83.

Administrators leadership has a direct influence on teacher leadership, this is because the use of leadership of administrators must focused on the development of teachers to be able to develop themselves as a team leader, or change leader. As Shah & Ali (2011, pp. 388 - 390) states that leadership over leaders help all followers become leaders by themselves by passing on behavior, skills, and a wide range of knowledge and understanding among those who need to be a leader in their own way. Leithwood, & Others (2004, p. 8) said that empirical data from public and private schools have found that leaders were important in determining directions and providing incentives for members by supporting their ability and leadership in themselves. Consistent with the research of Akert & Martin (2012, p. 284), the results of the research showed that Successful school improvement throughout the school culture. The roles of both administrators

and teachers must change. Teachers as leaders is an important step to success, but there has to be a change for both teachers and administrators. Because teacher leaders are influenced by the actions of the administrators, administrators need to understand issues that will motivate each teacher to spend time for discovering what is happening in the school environment that made teachers become leaders, responsibility, communicated the ideas of teacher leaders, and finding ways to motivate teachers to take on leadership roles.

Administrators leadership has a direct influence on school culture, this is because leaders will change the organization of every sectors from the structure design, job assignment, and organizational culture. According to a study by Surin Chumkaew (2013, p. 71), it was found that 1) organizational culture and change leadership style positively correlated with work behavior according to the philosophy of the sufficiency economy, 2) the change leadership style has a positive relationship with the organizational culture, and 3) organizational culture of mission-oriented, and participatory-oriented, and social responsibility-oriented, could together predict working behavior according to the philosophy of the sufficiency economy at 40.5 percent. Consistent with the research of Lucas and Valentine (2002, p. 1), the results showed that administrator was the primary source of information for establishing and transmitting visions, and being role models. Team leaders would be the key to providing intellectual stimulation and had high expectations. And the research of Shah & Ali (2012, p. 388), the results showed that administrators leadership had a direct influence on creative culture with statistically significance at the influence weight of 0.96.

Teacher leadership has a direct influence on school culture, this is because the teacher leadership culture allowed teachers to participate in professional conversations with colleagues, sharing ideas, knowledge, and techniques for participating in problem solving together in learning management (Ghamrawi, 2010, p. 315). According to the research of Janpen Klabdee & Moldop Chaiyachit (2015, p. 108) which found that the performance of teachers in educational institutions was directly influenced by the common leadership, and the school culture was directly influenced by teacher leadership.

Teacher leadership has a direct influence on the educational quality of school, this is because teachers were as co-creators of educational change, and were an important participant in policy making, productivity could be both positive and powerful. Consistent with the research of Katzenmeyer & Muller (quoted in Angelle & DeHart, 2016, p. 90) which found that teacher leadership influenced more acceptance of school reform, and improve the implementation of new policies and procedures, including increased school effectiveness. Chrisman' s research (cited in Janpen Klabdee & Moldhop Chaiyachit, 2015, p. 115) found that large schools were more successful in developing test scores of students than small schools because of the improved achievement of students was a result of the good operations of the school, and teacher leadership abilities of qualified teachers.

Conclusion

Educational quality of primary school can be realized in many ways. Academic achievement is one way of recognizing the educational quality of the school because academic achievement is a display of student learning outcomes. Therefore, the researcher is interested in doing this research to study the findings of the

research. From the research result shown that administrators leadership has an indirect influence through the teachers leadership and school culture to educational quality of school, top management of educational department should give importance to the leadership development of the school administrators. Result obtained would be a development of teacher leadership, school culture, and Educational quality of school.

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Analysis of the impact of plastic on the theme of Environmental Education for application in Brazilian public schools

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Abstract

Environmental issues have been a prominent issue worldwide and the increase in plastic production and the lack of post-consumer waste management programs result in inadequate disposal and deposition in terrestrial and aquatic environments, causing environmental impacts. This paper was developed through the analysis of aspects of pedagogical practice in relation to environmental education with the plastic theme and its environmental impact on the environment. In this perspective, environmental education through the individual and the collectivity builds social values, knowledge, skills and competences aimed at the conservation of the environment. However, it was observed that addressing environmental issues should be considered a challenge for teachers, as it is a broad and diverse subject, as they are not prepared for the development of these activities and schools do not have the infrastructure to meet the needs of approaches to environmental issues.

Keywords: Environmental education, Plastic, Environment, Sustainable society, Waste management

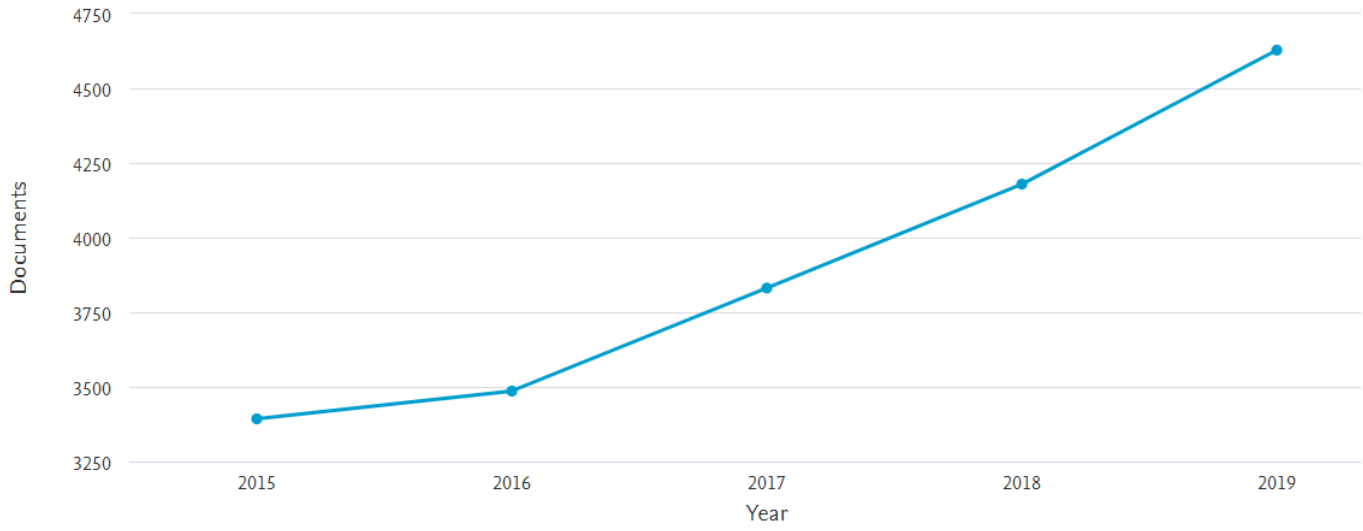
1. Introduction

Throughout the world, the educational system acts as an organization that prepare students to form a society, in order to assist in solving environmental problems, resulting in environmental awareness. As part of the structure of the educational system, in this context books are considered as an important tool in the transfer of concepts, meanings and values to students (AMINI & MASHALLAHI, 2015).

However, environmental education and education for sustainable development have become considerable topics for the curriculum in teaching. Historically, environmental education became part of the school curriculum in 1970, when interest on issues of environmental degradation was widely discussed worldwide (SCHÖNFELDER E BORGNER, 2020).

Hashemi (2020) and Haifaturrahmah et al. (2020) highlighted in their studies that the main element of Environmental Education is not linked to a national and local vision, but to a global, human and environmental context to structure the school curriculum. Efforts should be considered to include the importance of environmental education in the school curriculum to alter cognitive learning, effective and participatory knowledge, skills and behavior of students.

In this context, there has been a significant increase in the scientific importance of the theme over the years, signaling special attention from researchers to this area of research and development, according to Figure 1.



Source: Scopus

Figure 1. Evolution of research carried out in environmental education

Environmental education enables human beings to have a new way of facing their role in the world, proposing new models of relationships with nature, new paradigms and new ethical values. The adoption of interdisciplinary practices in the school environment is extremely important, as these are essential for the education of students in an integral way, enabling the global understanding of scientific knowledge (RAHMAN et al., 2020).

Some challenges are encountered in environmental education in Brazilian public schools, where teachers are aware of socio-educational responsibilities related to the transversal theme, however, there is a barrier in the application of activities related to the theme. The school as an opinion maker must have an established guideline on the best posture in relation to the environment, being a reference for action to promote a sustainable environment (SALLES, 2020).

Based on this information, this work aims to address the issue of environmental education with a focus on the impact caused by plastic in society and the interdisciplinary way in the pedagogical approach, favoring the understanding of an educational process with a critical and participative attitude of student.

1.1 Environmental Education and its importance

Environmental education emerged in the 1970s, a period in which concern about environmental issues was observed in society. As a result, several events emerged that addressed such issues, such as the Stockholm Conference in 1972, the Rio-92 Conference in 1992, held in Rio de Janeiro, which established an important measure, Agenda 21, which was an action plan for the 21st century aiming at the sustainability of life on Earth (DIAS, 2004), among others.

With the pattern of technology development and the concentration of capital, there was an inadequate

appropriation of nature, in which it was removed far beyond what is necessary for human sustenance in the name of profit-seeking capitalism, causing an imbalance in the relationship of man with the natural environment, where the degradation process is increasing every day, compromising the quality of life of society. In this way, urgent measures are needed worldwide in terms of raising awareness that leads to new concepts about the importance of preserving the environment in everyday life, and environmental education is a tool that will contribute significantly to this process.

Environmental education became law on April 27, 1999, through Law No. 9,795 - Environmental Education Law, where in its Art. 2 it states: "Environmental education is an essential and permanent component of national education, and must be present, in an articulated manner, at all levels and modalities of the educational process, in a formal and non-formal character". It is important to remember that Brazil is the only country in Latin America that has a specific national policy for environmental education.

In this perspective, environmental education has an interdisciplinary character, where its approach must be integrated and continuous, and not be a new discipline in the teaching curriculum in agreement with Law 9,795 / 9. It is considered an important component to rethink the theories and practices that underlie educational actions, considering formal or informal contexts, and should be interdisciplinary, enabling the orientation of problems related to local reality and adapting them to the target audience and their reality. It is important that there is a permanent participatory process in a way that is not just informative, practice is essential, in order to develop and instill a critical awareness of environmental issues (SALLES, 2020).

2. Plastics: characteristics, uses, production and environmental impacts

At the beginning of the 20th century, new types of materials called plastics were developed, which gradually became more and more used in the manufacture of the most varied objects. One of the decisive aspects responsible for the widespread use of plastic is the reduced purchase price, making it possible to manufacture the most different plastic articles and objects, being more accessible to the population.

At the molecular level, plastics are made up of organic polymeric molecules, many long units of matter in which a short structural unit is repeated several times. All feedstock used in the manufacture of plastic is obtained from petroleum. The simplest polymer is polyethylene, whose molecules are made up of thousands of units $-CH_2-$ linked together.

Depending on the way in which polymerization occurs, both low density polyethylene (LDPE) and high density polyethylene (HDPE) are formed. There are other polymers by addition similar to polyethylene in which one of the four hydrogen atoms is replaced by a group of X atom resulting in a specific polymer. Another commonly recycled plastic is transparent polyethylene teriftalate (PET) plastic. Its structure is a chain of two CH_2 units alternating with one unit of organic molecule of terephthalic acid. PET is used in the form of film (magnetic tape as well as photographic film, fiber and modeled resin).

According to Mattos and Peres (2010), and considering the diversity of types of plastics due to their excellent characteristics, among them: transparency, resistance, lightness and atoxity; plastics are divided into two groups according to their melting characteristics:

- thermoplastics: those that soften when heated, can be molded, and when cooled they become solid and

take on a new shape. This process can be repeated several times and correspond to 80% of the plastics consumed (polypropylene, polyethylene);

- thermosets: those that do not melt when heated, which makes it impossible to reuse them through conventional recycling processes (rigid polyurethane).

Plastics formed from polymers are used in packaging, as indicated by the original use of Table 1 (BAIRD and CANN, 2011).

Table 1- Plastics commonly recycled

Number assigned to recycling	Plastic name	Example of using the original plastic	Example of using recycled plastic
1	PET Polyethylene terephthalate	Drink bottles, food bottles and cleaning products, pharmaceutical recipient	Insulation material, non-food recipient
2	PEAD High density polyethylene	Bottles of milk, juice and water, recipient of margarine, folding bags	Oil and soap bottles, shopping bags, piping
3	PVC Polyvinyl chloride	Food, water and chemical bottles, packaging, building material	Drain piping, floor tiles, traffic cones
4	PEBD Low density polyethylene	Garbage, milk and food bags, flexible packaging and recipients	Garbage bags and food products, piping and oil bottles
5	PP Polypropylene	Plastic cups and packaging, disposable cutlery, household items	Insulators, toys, trays, rubble recipient
6	PE Polystyrene	Plastic cups and packaging, disposable cutlery, furniture and household items	Insulators, toys, trays
7	Others	Several	Special plastics, pots, fences and reeds

Source: Baird and Cann (2011)

Considering the diversity of the types of plastics due to their excellent characteristics, among them: transparency, resistance, lightness and atoxity; plastics are divided into two groups according to their melting characteristics:

- thermoplastics: those that soften when heated, can be molded, and when cooled they become solid and take on a new shape. This process can be repeated several times and correspond to 80% of plastics consumed (polypropylene, polyethylene);
- thermo-rigid: those that do not melt when heated, which makes it impossible to reuse them through conventional recycling processes (rigid polyurethane).

Considering all the waste generated by humanity, 10% is plastic. Of all the plastic generated, only 9% was recycled and 40% was used only once and then discarded. From 8 to 13 million tons of plastic reach the seas causing the death of 100,000 marine animals every year, about 700 species of animals, including endangered species, have already been affected by plastic in the seas. In Brazil, 40% of the waste generated is disposed of irregularly. This makes the cooperatives work very inefficiently, about 10% of what they receive are rejected and cannot be reused. The city of São Paulo recycles between 2% to 3% of the waste generated (LIGÓRIO, 2020).

Another aspect to be highlighted in the problem of plastic in the environment is its bioaccumulation in the food chain, reaching the human. Environmental education is an ally in the school environment to promote awareness for the preservation of the environment and change of posture, causing current concepts to be modified to ensure that human have a more harmonious relationship with nature. In this context, the adoption of interdisciplinary practices in the school environment is important, promoting the training of students in an integral way and enabling the global understanding of scientific knowledge.

3. The importance of Environmental Education

The strategies used to face the environmental problem help in the construction of sustainable societies and involve a coordinated articulation between all types of environmental intervention, including actions in Environmental Education. As well as the political, juridical, institutional and economic measures related to social environmental protection, recovery and improvement, activities in the educational field also emerge. In view of the need to structure the pillars of sustainable societies, social systems are updated to incorporate the environmental dimension in their respective specificities, providing the appropriate means to effect the corporate transition towards sustainability.

The legal system creates the "environmental law", the scientific system develops the "complex science", the technological system creates an "eco-efficient technology", the economic system enhances an "ecological economy", the political system offers the "green policy", and the educational system provides “Environmental Education”. It is up to each of the social systems the development of functions according to their specific attributions, responding to the multiple dimensions of sustainability. In this context, social systems act to promote environmental change, education assumes a prominent position to build the foundations of sustainable society and to promote the processes of cultural changes towards the establishment of an ecological ethics and social changes towards the challenges of contemporary times (EFFTING, 2007).

4. Environmental Education in Brazil as a transforming instrument

Education at all levels has the common objective of training citizens, applied students and qualified professionals. In this sense, we can highlight environmental education, which ranges from ecological issues to the transformation of knowledge, aiming at greater sustainability and conservation of the environment (BLANCHET-COHEN and REILLY, 2013).

Currently, environmental education is encouraged in all public bodies and is considered a disseminating instrument in all social spheres. However, there is a mistake in its organization and functioning, since the conduct of the participating members is not reflected in an example for society, signaling that the discourse is not linked to their actions as an institution. It is clear that for environmental education to exist in different spheres, it is necessary to form attitudes and engagement with the participation of all, and therefore, public policies must be structured to maintain the integrity of the planet ecosystem.

In this perspective, the administration of any public sphere must know and integrate the principles of sustainability in the management mechanisms, including public schools that must adapt to this new reality, contributing for this program to achieve success in the school unit. In order to minimize this problem, the Ministry of the Environment created the Environmental Agenda for Public Administration which aims to promote Socio-Environmental Responsibility as a government policy, helping to integrate the economic growth agenda with sustainable development. This document is based on sustainable principles and practices in public administration entities, being used as a tool for the study of the environment and awareness for its protection and enhancement.

However, it is essential knowing the limits between development and use of environmental resources in a balanced way so as not to generate conflicts . These problems are culturally rooted, through thoughts, attitudes and appreciation that constitute a major political, social and ecological crisis.

According to Luiz et al. (2019) Environmental Education is an active intellectual process, strengthening the interpretation of concepts arising from the prior knowledge of students or even from his learning at school. The approach to environmental issues in the classroom presents an articulation with other disciplines, in which the concepts learned have a new meaning. By intervening in this process, environmental education has a critical view on environmental issues, promoting the use of problematizations about the object of study and its solutions in different aspects to interact with socio-environmental problems and the construction of a sustainable society.

The environmental issue is a relevant theme that promotes great reflection and self-criticism around the formation of new thoughts, behaviors and knowledge. Educators have a very important and decisive role in this process of using environmental education as a transforming tool in school, stimulating and allowing a critical position around these environmental issues, such as changing habits and practices, guiding the student to an education for citizenship. Considered as an important component for the theories and practices that founded educational actions, whether in formal or informal contexts, it must be interdisciplinary, orienting towards the solution of current problems, adapting them to the target audience and their reality, as the environmental problems according to Dias (2004) must first be understood in their local context, and then be understood in their global context. It is important that there is a permanent

participatory process, in a way that is not just informative, it is essential to practice, in order to develop and instill a critical awareness of environmental issues in Brazilian society (SALLES, 2020).

5. Environmental Education related to various subjects in the school environment

Environmental Education, as an essential component in the instruction and continuing education process, aimed at solving problems, contributes to the active involvement of the public, makes the educational system relevant and realistic, establishing greater interdependence between these systems and the natural and social environment, aiming at favorable conditions for society. The implementation of environmental education in schools has been showed to be an exhausting task. There are great difficulties in awareness-raising and instruction activities, in the implementation of activities and projects and mainly in maintaining and continuing the schedule of activities.

Some factors such as the size of the school, the number of students and teachers, the willingness of these teachers to undergo a training process, the willingness of the board to really implement an environmental project that will change the routine in the school, in addition to factors resulting from the issues mentioned above can serve as obstacles to the implementation of environmental education. Given that environmental education does not happen through specific activities, but through a whole change of paradigms that requires continuous reflection and appropriation of the values that refer to it, the difficulties faced assume even more striking characteristics.

Therefore, alternatives should be sought that promote continuous reflection that culminates in a change in mentality. Only in this way will we be able to implement true environmental education in our schools, with activities and projects not merely illustrative, but with the purpose of the school community in building a future in which we can live in a balanced environment, in harmony with the environment, with others living beings and with our fellow men. The necessary knowledge for the construction of citizenship will be presented in schools, with the involvement of different bodies that guarantee the rights and duties of each individual in society. Among these bodies we can mention the military police, the fire department, health surveillance and topics related to improving the quality of life of the population and reducing the environmental impact, as shown in Table 2.

Table 2- Themes to be worked on in Environmental Education

Theme to be worked on at school	Action to be realize
Trash	Reduction, reuse, recycling
Hospital waste	Correct destination
Water	Adequate consumption, waste reduction, remediation, preventive actions of pollution in water bodies
Pesticides	Reduction of risks to human health, reduction of environmental damage, reduction of bioaccumulation of chemical compounds in biological systems

Illegal hunting	Respect for wild and domestic animals
Drugs and alcohol (psychoactive substances)	Reduce the risk of accident and violence
Traffic Safety	Complementation of environmental legislation
Citizenship	Rights and duties for an individual living in society
Plastic	Reduction of plastic waste in the aquatic and terrestrial environment, material degradation, recycling
Surface air pollution chemistry	Technological control of emissions
Energy and climate change	Reduction of major greenhouse gases
Waste, soil and sediment	Domestic waste disposal and minimization, waste recycling, reduction of environmental impacts on the soil

Source: Author

With environmental content included in all subjects of the school curriculum and contextualized with the reality of the local community, the school will help students to understand the correlation of facts and have a world view of the problems related to the subject. As a result, environmental education must be approached in a systematic and transversal way, that is, at all levels of education, ensuring the environmental context in an interdisciplinary way in the various school subjects and activities (EFFTING, 2007).

In this context, the development of Science and new technologies applied in the development of plastics becomes fundamental, considering, for example, the packaging of juices and drinks, aiming to preserve their quality and prolonging their shelf life. If on the one hand these packages facilitate transport and ensure the conditions of conservation and hygiene of the products, on the other hand, they cause problems with the amount of waste produced, since they are not biodegradable and difficult to decompose in the environment. In this way, the management of plastic waste represents a pertinent theme today, because in addition to exercising a direct action on the environment, they interfere in the economic sector and in human behavioral patterns (OZÓRIO et al., 2015). According to the hierarchy of waste management, shown in Figure 2, the appropriate options for the destination of plastic waste include reduction, reuse, recycling, incineration and disposal in landfills.

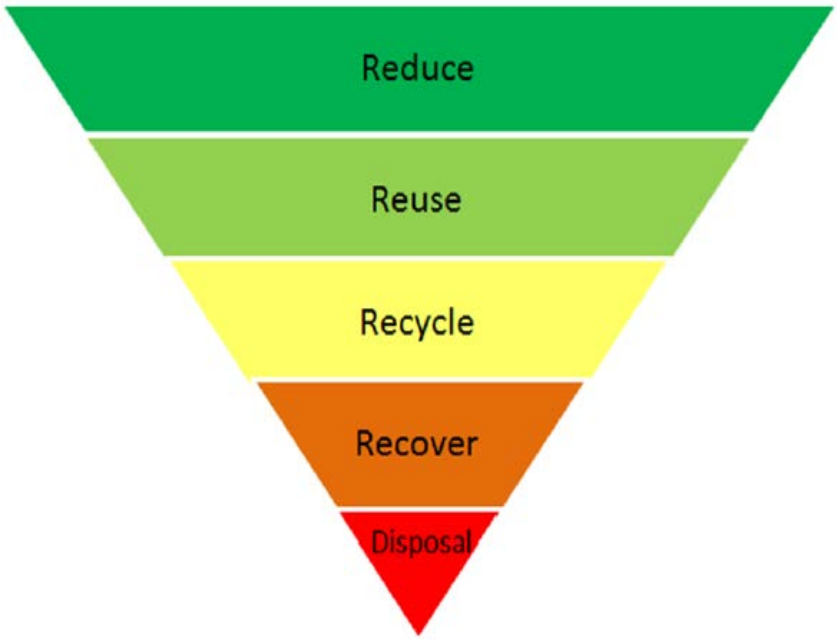


Figure 2. Hierarchy of waste management in descending order of preference.
Source: Azapagic et al., 2003

Considered as the most desirable option in this hierarchy, the reduction in the use of resources also makes it possible to reduce the generation of waste. It can be understood as the reduction in the use / consumption of plastic products by the consumer or reduction in the amount of plastic resin used in the industry for the manufacture of its products. The reuse of plastic materials is an usual practice that results from the durability and resistance of resins, therefore depending on the type of polymer. Plastics can be reused in many ways and for many different purposes. After several cycles of use, plastic materials start to degrade and it is no longer useful and must be reprocessed. In the third stage of the waste management hierarchy pyramid, recycling stands out, which has been identified as a destination option most used in post-consumption. Within this context, the landfill represents the last desirable alternative. The National Solid Waste Policy, instituted by Law 12.305, which deals, among others of plastic waste, establishes strategies for sustainable development and imposes the reverse logistics system, in addition to dealing with the life cycle of products and encouraging reuse and the recycling of materials, discouraging disposal in landfills, aiming to reduce environmental impacts (OLIVEIRA, 2012).

6. Final considerations

In the history of modern society we have highlighted several points that cover the environmental issue and indifference in relation to the production of waste and its control, as well as the remediation of degraded areas. The environmental problems related to the lack of awareness of human is considered one of the main intensifiers of the degradation of ecosystems. In view of this fact, it is evident the need for environmental education to be considered as an effective element, mandatory at all educational levels in the country, guiding the development of a sustainable environmental awareness and an active society in the preservation of the environment.

In Brazil some measures regarding the reduction of environmental impacts, such as recycling, result from the inadequate management of solid waste, including plastics. Essential factors for the proper functioning of a recycling system are selective collection and reverse logistics, which are national incipient practices. The National Solid Waste Policy is an important guideline to redirect the inappropriate waste disposal, in addition to regulating and encouraging procedures for its treatment. In addition, other government actions by states and municipalities are necessary, as well as the union between governments and industries for the development of an efficient management of urban waste.

In this process, the school plays an important role, forming critical citizens, aware and committed to the preservation of the environment. The environmental theme can be approached in the classroom in agree with the philosophy of environmental education considered an essential tool for the training of human. In this sense, the teacher needs to be prepared to act as a transforming agent and an awareness of environmental issues.

The implementation of environmental education in schools, makes it possible to understand the difficulties and challenges faced by teachers during the approach in the classroom, because as the environmental education is broad and diversified in concepts, teachers feel unprepared for such approaches. The teacher does not receive stimuli and the school community does not provide necessary support for the development of activities, creating a gap in knowledge for students, who act as listeners and non-practitioners, when they should be stimulated through activities and projects to exercise this awareness a from your reality. Another fact is that in public schools the situation is even more aggravating, as there are no adequate conditions for the development of an effective and good quality education. The lack of practical, innovative and interdisciplinary methodologies justifies the difficulty in carrying out the work on the part of teachers when addressing environmental issues, it is being developed during classes in some disciplines such as Science, Biology and Chemistry.

The activities of environmental education developed from the theme related to plastic, as presented in this work, allows the knowledge of the species of polymers, the problematic issue of the generation of residues in the environment and the remediation of the affected areas, however, actions must be planned so that they can integrate a set of activities developed in the environmental, social, political and productive sector.

The articulation of educational actions for the preservation of the environment is important and the school is the most suitable and privileged space for the implementation of these activities, since environmental education allows the student to live in harmony with the environment, generating new concepts and values about nature , signaling what should be done to contribute to the preservation of the environment. These actions will make it possible to establish a balance between human being and nature in the search for a better world, so that a global perspective is acquired and in this way it can disseminate such knowledge to society.

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Quantitative methods and analysis of health performance and environmental conditions in the city of Porto Velho: 6 years after the hydroelectric dams of Jirau and Santo Antônio, on the Madeira River

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ABSTRACT

Objective: *to analyze the IQVU of the city of Porto Velho, Rondônia, Brazil, in a perspective of quality of life from the construction of the UHEs on the Madeira River.* ***Methods:*** *the model developed by Paraguassú-Chaves et al [3] was used to analyze the performance index in health and environmental conditions. 552 forms and interviews were applied, which contributed to the collection of primary data in the sample survey in the 69 neighborhoods grouped by the four urban areas of Porto Velho, involving 8 households per neighborhood. The data were submitted to Factor Analysis to calculate the quality of life indexes. In the analysis phase, the IQVU model of the Hair et al classification index scale [4] was used.* ***Results:*** *After 6 years, the quality of life indexes found in this research are similar to those found previously.*

Central Zone IQVU (0.456) Regular, East Zone IQVU (0.406), North Zone IQVU (0.428) and South Zone IQVU (0.393), with the average IQVU (0.420) of the city of Porto Velho. ***Conclusions:*** *there was a significant drop in the quality of life index with the construction of the Jirau and Santo Antônio hydroelectric dams on the Madeira River, in Porto Velho. The city's quality of urban life index, which had already suffered a negative impact during the construction of the dams and 1 year later, worsened six years later.*

Keywords *- Health and Environment. IQVU. Hydroelectric dams. Porto Velho. Western Amazon.*

I. INTRODUCTION

The scenarios of the Brazilian Amazon have always been linked to the perspectives of regional development. The construction of the Jirau and Santo Antônio hydroelectric dams mobilized the city of Porto Velho and the state of Rondônia, in the Western Amazon. The projection of two hydroelectric dams defined by the central government of Brazil, through the Federal Government's Growth Acceleration Program - PAC, meets an emerging demand from the electricity sector for the country. A model of public policies for regional and local development to serve Brazil as a whole.

During the process of issuing environmental licenses for the construction of two large hydroelectric plants and in public hearings, several debates were held on the projects of the Jirau and Santo Antônio hydroelectric plants. Environmental impacts, issues of indigenous and riverside communities, conservation and preservation of fauna and flora, among many other issues, were widely discussed by different segments of local society, federal, state and municipal government, construction companies and consortia of interested companies.

However, the agenda related to the impact on people's lives was not a priority in the discussions. Priority was given to riverside areas, conservation units, fauna, flora and other factors considered important for society. At no stage of the process was there concern with the diagnosis or prognosis of the quality of urban life in Porto Velho.

The official and unofficial advertising of the companies responsible for the construction of hydroelectric dams, the official announcement by the federal government and the state government and the municipal government only disclosed the beneficial effects that the projects would bring to the city and the municipality of Porto Velho, for the state of Rondônia and for Brazil. What was known was that since the beginning of the licensing process for hydroelectric dams and after the construction of UHE's, there was a significant sociocultural impact and a decrease in the urban quality of life index (IQVU) in the city of Porto Velho. The intense migratory flow of people in search of jobs, migrants from all regions of Brazil and other municipalities in Rondônia, boosted the life of the city of Porto Velho.

The starting point of the research is to understand the perception of the quality of life of the residents of the city of Porto Velho from the health and environmental conditions, before the construction of the hydroelectric dams of Jirau and Santo Antônio on the Madeira River, after construction and 6 years after. According to scientific literature, the increase in the migratory flow of workers to a city results in increased demand and pressure on basic and essential public services.

In the scenario of the arrival of a large human contingent in a city without proper infrastructure and essential services, the current shortage or insufficiency of such services is aggravated. In this case, it is possible to highlight the supply of treated water, the absence or inadequacy of garbage collection and domestic sewage services, public security services, transport, education and health care for the population. The migration process resulting from the hydroelectric dams on the Madeira River stimulated the arrival of thousands of people in Porto Velho, the main region of impacts of these projects. This migratory flow ended up stimulating new demands for essential social services.

The approach chosen to evaluate the health and environment parameters was the analysis of the quality of urban life in the city of Porto Velho, in the perception of its inhabitants about the quality of personal life and the quality of life in the city of Porto Velho (IQVU de Porto Velho).

The analysis model is the quality of life developed by Santos and Martins [1], in two different moments: in the initial phase of implementation of the Jirau and Santo Antônio hydroelectric projects; during the first year of implementation and operation of the two hydroelectric plants, based on the findings of Silva [2] and data found six years later, using the model of analysis of the performance index in health and environmental conditions, developed by Paraguassú-Chaves *et al* [3].

One question prompted the research. Did the hydroelectric dams on the Madeira River, in Porto Velho - Rondônia, contribute positively or negatively to the IQVU in the city of Porto Velho? Can the health and environment parameters of the Santos e Marins [1] model answer this question? The health and environmental conditions performance index (IDCSA) model developed by Paraguassú-Chaves *et al* [3] can corroborate the previous findings. Based on this issue, the work aimed to analyze the IQVU of the city of Porto Velho, Rondônia, Brazil, in a perspective of quality of life from the construction of the UHE's on the Madeira River.

II. METHODS

Silva's research [2] used the quality of life analysis model developed by Santos and Martins [1], which is based on four main domains: Environmental Conditions; Conditions of collective materials; Economic conditions and conditions of society. 6 years later the model of construction of the index of health performance and environmental conditions (IDCSA) developed by Paraguassú-Chaves *et al* [3] was used. In this research, health service quality indicators and the environmental conditions of the Paraguassú-Chaves *et al* model [3] were measured. 552 forms and interviews were applied, which contributed to the collection of primary data in the sample survey in the 69 neighborhoods, grouped by the four urban areas of Porto Velho.

The tables were built using the SPSS program, version 22, based on the primary research data. The Urban Quality of Life Index - IQVU was calculated according to the Factor Analysis techniques presented by Hair *et al.* [4], Santana [5], [6] and Cavalcante [7].

2.1 Analytical Research Model

Method: Method of construction of the Urban Life Quality Index (IQVU).

The method used in this study followed the logic of factorial analysis, which can be seen in the matrix form as in Dillon and Goldstein [8]:

$$X\backslash=\alpha F\backslash+\varepsilon\ X\backslash=\alpha F\backslash+\varepsilon \quad (1)$$

Then:

X = is the p-dimensional vector transposed from observable variables, denoted by $X = (x_1, x_2,..., x_p)$;

F = is the q-dimensional vector transposed from non-observable variables or latent variables called common factors, denoted by $F = (f_1, f_2,..., f_q)$, where q < P;

ε = is the p-dimensional vector transposed from random variables or unique factors, denoted by $\varepsilon = (e_1, e_2,..., e_p)$;

α = is the array (p, q) of unknown constants, called factorials loads.

According to Gama *et al* [9], Santana [10], in the factorial analysis model it is assumed that specific factors are orthogonal, among themselves, with all common factors. Normally, E (ε) = E (F) = 0 and Cov (ε, F) = 0.

According to the authors, the initial structure used to determine the array of factorials loads, in general, may not provide a significant pattern of variable loads, so it is not definitive. This initial structure can be done by several methods of rotation of the factors, as Dillon and Goldstein [8], Johnson and Wichern [11]. It was used the VARIMAX method of orthogonal rotation of the factors for this study.

The VARIMAX method is a process where the reference axes of the factors are rotated around the source until some other position is reached. The objective is to redistribute the variance of the first factors to others and to achieve a simpler and more theoretically significant factorial [4], [6], [8], [9], [10], [11].

The choice of factors was carried out through the technique of latent root. So, the array of factorials loads, which measures the correlation between the common factors and observable variables, is determined by means of the correlation matrix, as Dillon and Goldstein [8].

To determine the Urban Quality of Life Index (IQVU), the matrix of factor scores estimated by the factorial rotation process through the orthogonal basis was used, as pointed out by Santana [10]. The factorial score puts each observation in the gap of the common factors. For each factor f_j, the i-th factor score extracted factorial score is defined by F_{Ij}, expressed as follows [8]:

$$F_{IJ}\backslash=\mathbf{b_1}x_{i\backslash1}\backslash+\mathbf{b}_2x_{i\backslash2}\backslash+\mathrm{b}_px_{\mathrm{ip}}\ F_{IJ}\backslash=\mathbf{b_1}x_{i\backslash1}\backslash+\mathbf{b}_2x_{i\backslash2}\backslash+\mathrm{b}_px_{\mathrm{ip}} \quad (2)$$

Then:

b_i = are the estimated regression coefficients for the n Common factorials scores;

x_{Ij} = Are the n Observations of p Observable variables.

i = 1.2,...N.

j = 1,2,...,p.

To reach the equation that is the perception index [9], [10], show the sequence evolution of the formulas from the previous equation. It turns out that even if the variable F_{Ij} is not observable it can be estimated through the factorial analysis techniques, using the matrix of observations of the vector x of observable variables. In factorial notation, equation 2 becomes:

$$F_{(n\backslash q)}\backslash=X_{(n\backslash q)}b_{(p\backslash q)}\ F_{(n\backslash q)}\backslash=X_{(n\backslash q)}b_{(p\backslash q)} \quad (3)$$

In Equation 3, *F* is the matrix of the estimated regression from the *n* Factorials scores and it can be affected by both the magnitude and the measurement units of the variables *x*. To work around this kind of problem, replace the variable *x* by the standard variable *w*, given the ratio of the deviation around the average and the standard deviation of *x*, as follows:

$$\frac{x_i - \bar{x})}{S_x}$$

With these values, Equation 3 is modified making equation 4 possible, then:

$$F_{(n\backslash q)}\backslash = w_{(n\backslash q)}\beta_{(p\backslash q)}\, F_{(n\backslash q)}\backslash = w_{(n\backslash q)}\beta_{(p\backslash q)} \quad (4)$$

Based on equation 4, the beta weights matrix (β) with *q* standardized regression coefficients, replaces *b*, given that the variables are standardized on both sides of the equation. Pre-multiplying both sides of equation 4 by the value $\frac{1}{n}\frac{1}{n}w'$, in which *n* Is the number of observations and *W* is the transposed matrix of *w'*, it makes it possible to reach the following equation:

$$\frac{1}{n}\, w'_{(p,n)}\, F_{(n,q)} = \frac{1}{n}\, w'_{(p,n)}\, w_{(n,p)}\, \beta_{(p,q)} = R_{(p,p)}\, \beta_{(p,q)} \quad (5)$$

The Matrix $\frac{1}{n}\frac{1}{n}w'w$, therefore is the matrix of intercorrelated variables or correlation matrix among the observations of the matrix *x*, designated by R. The Matrix $\frac{1}{k}w'F\ \frac{1}{k}w'F$ It represents the correlation between the factorials scores and the factors themselves, denoted by Λ. With this, rewriting the equation 5, one must:

$$\Lambda_{(p\backslash q)}\backslash = R_{(p\backslash p)}\beta_{(p\backslash q)}\, \Lambda_{(p\backslash q)}\backslash = R_{(p\backslash p)}\beta_{(p\backslash q)} \quad (6)$$

If the matrix R is non-singular, one can pre-multiply both sides of equation 6 by the inverse of R, obtaining:

$$\backslash\beta\backslash = \mathbf{R}^{-1}\Lambda\ \backslash\beta\backslash = \mathbf{R}^{-1}\Lambda \quad (7)$$

Substituting the β vector into equation 4, we obtain the factorial score associated with each observation, as follows:

$$F_{(n\backslash q)}\backslash = w_{(n\backslash p)}R^{-1}_{(p\backslash p)}\Lambda_{(p\backslash q)}\, F_{(n\backslash q)}\backslash = w_{(n\backslash p)}R^{-1}_{(p\backslash p)}\Lambda_{(p\backslash q)} \quad (8)$$

The main formula of the perception index is reached where the IP is defined as a linear combination of these factorials scores and the proportion of the variance explained by each factor in relation to the common variance. The mathematical expression is represented by the following formula:

$$\mathbf{IP}_i = \sum_{j\backslash=1}^{q}\left(\frac{\lambda_j}{\sum_j \square \lambda_j}\mathrm{FP}_{ij}\right)\mathbf{IP}_i = \sum_{j\backslash=1}^{q}\left(\frac{\lambda_j}{\sum_j \square \lambda_j}\mathrm{FP}_{ij}\right) \quad (9)$$

Then:

i = 1.2,...n.

λ = is the variance explained by each factor;

∑ λ = is the total sum of the variance explained by the set of common factors.

The factorial score was standardized (FP) to obtain positive values from the original scores and allow the hierarchies of the cities as the values of the performance index are located between zero and one. The formula that allows this tiering can be seen by the following equation:

$$FP_i = \left(\frac{F_i - F_{min}}{F_{max} - F_{min}}\right)$$

It can be seen that F_{min} F_{min} And F_{max} F_{max} are the maximum and minimum values observed for the factorial scores associated with the parameters observed. It is based on this understanding that it was possible to calculate the Urban Quality of Life Index (IQVU) adopted in this study.

The scaling of indices is based on the model by Hair *et al* [4]. The classification scale of the Porto Velho quality of life indexes follows the scale: 0.000 to 0.200 scale (Description: Terrible IQVU); 0.201 to 0.400 (Description: Bad IQVU); 0.401 to 0.600 (Description: Regular IQVU); 0.601 to 0.800 (Description: Good IQVU) and 0.801 to 1.000 (Description: Excellent IQVU). This same scale has already been applied in several studies in the Amazon context, como Environmental Education Perception Index (IPEA) headed for sustainable development: A Study in primary schools in the city of Guajará-Mirim, Rondônia (Brazil), de Paraguassu-Chaves; Cavalcante; Claro, *et al* [11]; and Factor Analysis and the Social Capital Index: A Study at the Brazil / Bolivia Border, de Paraguassú-Chaves; Cavalcante; Almeida, *et al* [12], and Cavalcante [7].

2.2 Scale Levels

The classification used by the research to express the results achieved by the IQVU is described in table 1.

Table 1: Analysis scale adopted by the research.

Scale	Description IQVU	Color representation
0.000 a 0.200	Terrible	
0.201 a 0.400	Bad	
0.401 a 0.600	Regular	
0.601 a 0.800	Good	
0.801 a 1.000	Great	

Source: Own Elaboration

2.3 Parameters and Indicators

The questionnaire used is structured with two parameters and 18 indicators. The first parameter aimed to identify health performance, the second to identify environmental conditions.

Table 2: Parameters and indicators (model created by Paraguassú-Chaves *et al* [3])

Parameter	Indicators
Health Perfomance	Number of Health Units (Hospitals, Health Center, Mixed Health Units). Geographic distribution of health facilities (spatial distribution by neighborhood and zone). Levels of health care (primary, secondary or tertiary). Access to public health service. Waiting time for medical care. Free medication distribution. Degree of satisfaction with the services provided by the public service. The public health service has improved in the last 6 years. Number of health professionals in health facilities (sufficient to meet the population's demand). Public health expenditure per capita. Adequate equipment to meet the population's demand (x-ray, mammography, tomography, magnetic resonance, dental equipment). Number of hospital beds. Laboratory equipment and tests.
Environmental Performance	Households with water supply. Households with garbage collection. Households with sewage. Garbage collection, transportation and final destination. Number of people consuming untreated water.

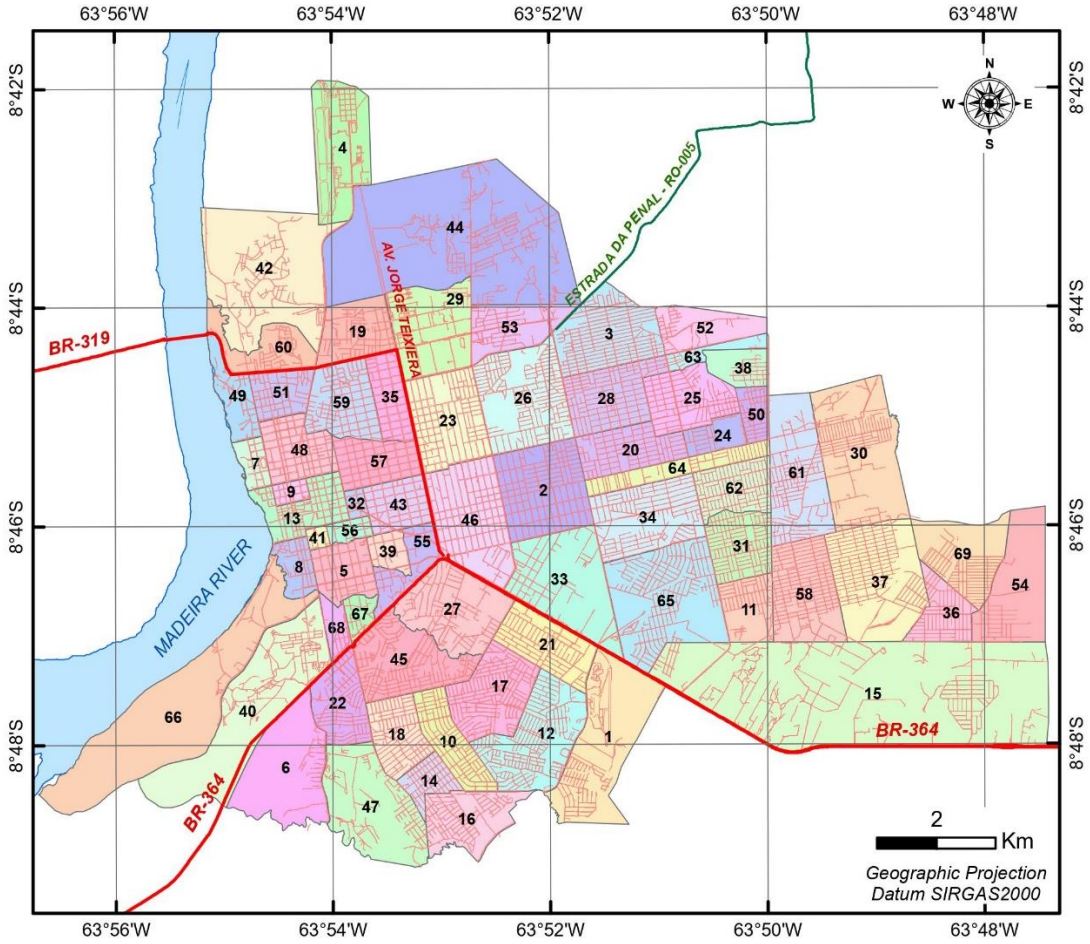
Source: Paraguassú-Chaves *et al* [3].

2.4 Ethical aspects

Some criteria were considered for the selection of the research subjects / interviewees: living in the city for at least two years; being of age; be the head of the family and who accepted to participate in the research as a volunteer. After signing the Informed Consent Form (ICF), the questionnaire and the interview were applied [14]. The questionnaire was applied by 5 field researchers, collaborators of the research group coordinated by Doctor Paraguassú-Chaves.

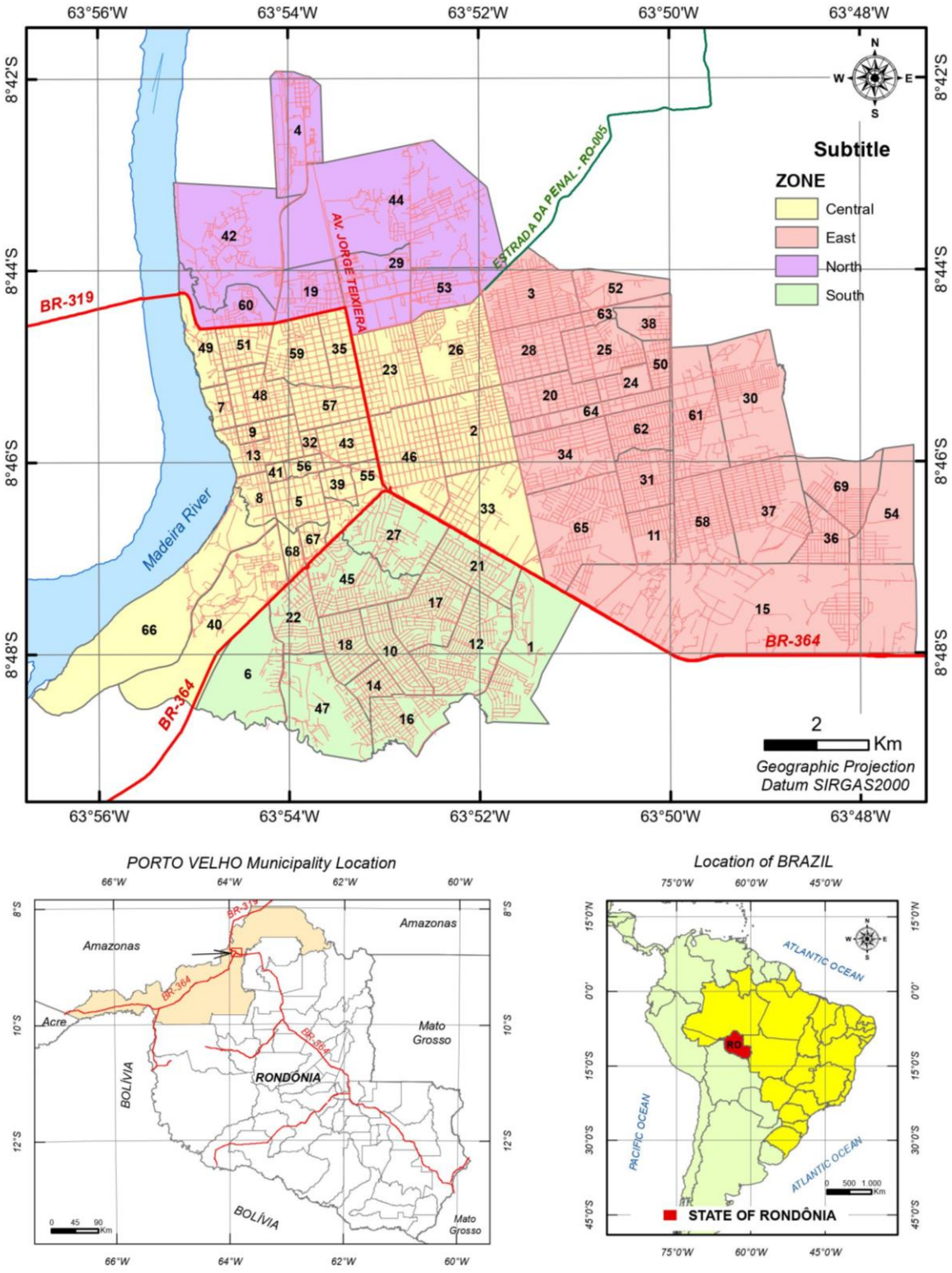
This work took into consideration the four zones of the urban perimeter (Central zone, East zone, North zone and South zone).

Map 1*:* Geographic Location and Division of Urban Areas of Porto Velho.



ORDER	NEIGHBORHOODS	ORDER	NEIGHBORHOODS	ORDER	NEIGHBORHOODS	ORDER	NEIGHBORHOODS
1	AEROCLUBE	19	COSTA E SILVA	37	MARIANA	55	ROQUE
2	AGENOR DE CARVALHO	20	CUNIÃ	38	MARINGÁ	56	SANTA BARBARA
3	APONIÃ	21	ELDORADO	39	MATO GROSSO	57	SÃO CRISTOVÃO
4	ÁREA MILITAR E AEROPORTO	22	ELETRONORTE	40	ÁREA MILITAR (5º BEC)	58	SÃO FRANCISCO
5	AREAL	23	EMBRATEL	41	MOCAMBO	59	SÃO JOÃO BOSCO
6	AREIA BRANCA	24	ESCOLA DE POLÍCIA	42	NACIONAL	60	SÃO SEBASTIÃO
7	ARIGOLÂNDIA	25	ESPERANÇA DA COMUNIDADE	43	NOSSA SENHORA DAS GRAÇAS	61	SOCIALISTA
8	BAIXA DA UNIÃO	26	FLODOALDO PONTES PINTO	44	NOVA ESPERANÇA	62	TANCREDO NEVES
9	CAIARI	27	FLORESTA	45	NOVA FLORESTA	63	TEIXEIRÃO
10	CALADINHO	28	IGARAPÉ	46	NOVA PORTO VELHO	64	TIRADENTES
11	CASCALHEIRA	29	INDUSTRIAL	47	NOVO HORIZONTE	65	TRÊS MARIAS
12	CASTANHEIRA	30	JARDIM SANTANA	48	OLARIA	66	TRIÂNGULO
13	CENTRO	31	JUSCELINO KUBITSCHEK	49	PANAIR	67	TUCUMANZAL
14	CIDADE DO LOBO	32	KM 1	50	PANTANAL	68	VILA TUPI
15	CIDADE JARDIM	33	LAGOA	51	PEDRINHAS	69	ULISSES GUIMARÃES
16	CIDADE NOVA	34	LAGOINHA	52	PLANALTO		
17	COHAB	35	LIBERDADE	53	RIO MADEIRA		
18	CONCEIÇÃO	36	MARCOS FREIRE	54	RONALDO ARAGÃO		

Map 2*:* Neighborhoods by Zone in the City of Porto Velho.



III. RESULTS AND DISCUSSION

3.1 Health and environment parameters for neighborhoods in the urban areas of the city of Porto Velho, 6 years after the construction of two large hydroelectric dams on the Madeira River.

In the Centro zone, the Nova Porto Velho neighborhood was the only one that maintained the IQVU Bom due to the scale adopted in the survey, which represented only 3.85% of the neighborhoods in that Zone. In an opposite situation, the Militar and Lagoa neighborhoods remained in penultimate and last place, respectively in both scenarios, according to Silva's research [2] before the construction of the dams and 1 year later. (table 3).

The vast majority of neighborhoods (86.46%), in turn, remained on the IQVU Regular scale in both scenarios for this health and environment parameter. Before the dams of the UHE and 1 year later, of the total of 26 neighborhoods, 23 had regular IQVU and only 1 had good IQVU.

Six years after Silva's research [2], of the 26 neighborhoods that make up the Zona Centro, 23 neighborhoods remain with IQVU between 0.401 - 0.600, considered by the scale adopted in the research as Regular, 1 with IQVU Good of 2 with IQVU Bad (between 0201 - 0.400).

The neighborhood of Nova Porto Velho is the only one that remained IQVU Good in both periods and after 6 years it maintains the IQVU Good.

The neighborhood of Agenor de Carvalho decreased from the index of 0.600, in the scenario before the hydroelectric dams, to 0.402 in the scenario 1 year after the construction of the UHE's and decreased to 0.401, 6 years later.

The explanation for this drop in quality of life can be seen by the severity of the residents' assessment in relation to the current scenario for the criteria of available green spaces, precarious public cleaning service, urban and rural pollution, inefficiency of the public health service, difficulty in obtaining medical assistance, identified by 95.24% of the interviewees as Bad in each of these aspects, as announced by Silva [2] and corroborated in this study. The IQVU average is maintained with a Regular performance index.

Table 3: Health and Environment Parameters by Neighborhoods in the Central Zone (IQVU).

Neighborhood	Before	1 year later	6 years later
Nova Porto Velho	0.671	0.669	0.670
Agenor de Carvalho	0.600	0.402	0.401
K1	0.558	0.555	0.553
São João Bosco	0.554	0.553	0.559
Olaria	0.546	0.545	0.548
Baixa União	0.532	0.531	0.528
Santa Bárbara	0.523	0.521	0.521
Flodoaldo Pinto	0.519	0.519	0.518
N. Sra. das Graças	0.517	0.514	0.516
Roque	0.516	0.514	0.511
Tucumanzal	0.502	0.500	0.497
Embratel	0.500	0.500	0.495
Panair	0.498	0.492	0.496
Tupi	0.486	0.483	0.480
Caiari	0.476	0.472	0.480
Triangulo	0.476	0.476	0.469

Liberdade	0.475	0.473	0.472
Mato Grosso	0.472	0.470	0.466
Centro	0.451	0.450	0.447
Arigolândia	0.450	0.449	0.455
Mocambo	0.441	0.439	0.437
Pedrinhas	0.425	0.424	0.430
Areal	0.413	0.410	0.408
São Cristovão	0.409	0.408	0.400
Militar	0.389	0.388	0.390
Lagoa	0.376	0.371	0.370
IQVU	0.491	0.481	**0.456**

Source: search result.

In the East Zone, 13.04% of the neighborhoods had IQVU Good and only 4.35% with IQVU Bad in the phase prior to the hydroelectric plants. After the construction of the UHE's, in general, all neighborhoods decreased their quality of life indexes. The scenario changed completely with 52% of the neighborhoods with IQVU Regular and 48% with IQVU Bad. A decline in the quality of life in this area. All neighborhoods in the Zone lose quality in the health and environment indicators of the Environmental Conditions Domain of the Matrix of Indicators of Quality of Urban Life - IQVU.

One year after the construction of the UHE's, no neighborhood was found with the IQVU Bom. The neighborhood Escola de Polícia decreased from the index of 0.700 considered Good IQVU to 0.581 considered Regular. The same occurs with the Socialista (IQVU 0.674) and Igarapé (IQVU 0.646) neighborhoods, which decrease to (IQVU 0.296) and (IQVU 0.370), respectively, considered Bad indexes. Six years later, of the 23 neighborhoods that make up the East Zone, 43% have IQVU Regular and 57% Bad, that is, 10 neighborhoods have IQVU Regular (IQVU less than 0.600) by the scale adopted and 13 neighborhoods with IQVU Bad (less than 0.400). Only the neighborhoods of the São Francisco, Police School, Juscelino Kubitshek, Tancredo Neves, Marcos Freire, Tiradentes, Mariana, Cidade Jardim, Cascalheira and Planalto remain with the IQVU Regular. All other neighborhoods are in the IQVU Bad rating range. There was a significant drop in the quality of life in these neighborhoods (table 4).

Table 4: Health and Environment Parameters by East Zone Neighborhoods (IQVU).

Neighborhood	Before	1 year later	6 years later
Escola de Polícia	0.700	0.581	0.572
Socialista	0.674	0.295	0.299
Igarapé	0.646	0.370	0.380
Lagoinha	0.594	0.321	0.333
Jardim Santana	0.584	0.388	0.387
Pantanal	0.584	0.404	0.399
Planalto	0.584	0.404	0.410

Mariana	0.577	0.421	0.435
Juscelino Kubitschek	0.564	0.519	0.522
Cascalheira	0.559	0.416	0.437
Tiradentes	0.555	0.422	0.440
Tancredo Neves	0.550	0.498	0.488
Cidade Jardim	0.546	0.448	0.451
Marcos Freire	0.540	0.477	0.483
Ronaldo Aragão	0.529	0.339	0.337
Três Marias	0.523	0.405	0.399
Aponiã	0.520	0.339	0.339
Cunhã	0.517	0.348	0.340
Ulisses Guimarães	0.516	0.339	0.325
Maringá	0.513	0.397	0.367
Teixeirão	0.513	0.397	0.380
São Francisco	0.487	0.526	0.521
Esp. Comunidade	0.342	0.318	0.311
IQVU	**0.529**	**0.407**	**0.406**

Source: search result.

In the North Zone, in general, there was a worsening in the scenario of this Zone, where it was possible to verify that the reduction from 85.71% to 57.14% of the neighborhoods in the situation considered Regular IQVU, in the corresponding period before and after 1 year of construction of UHE's. There was an increase from 14.29% to 42.86%, in the same period, for the situation that indicated IQVU Bad after the construction of UHE's. The neighborhoods Rio Madeira, São Sebastião and Costa e Silva remain in the IQVU Regular before and 1 year after the construction of UHE's. The National, Military and New Hope neighborhoods descend to the IQVU Bad, results found by Silva [2] and confirmed by the sample presented by Paraguassú-Chaves [15]. (table 5).

Six years later, of the 7 neighborhoods that make up the North Zone of the city of Porto Velho, 4 (57%) neighborhoods remain classified with Regular IQVU (Rio Madeira, Industrial, São Sebastião and Costa e Silva) and 3 (43%) remain with IQVU Bad (National, Military and New Hope).

Table 5: Health and Environment Parameters by Neighborhoods in the North Zone (IQVU).

Neighborhood	Before	1 year later	6 years later
Rio Madeira	0.528	0.568	0.579
Nacional	0.476	0.368	0.353
São Sebastião	0.466	0.439	0.427
Nova Esperança	0.461	0.341	0.342

Costa e Silva	0.431	0.432	0.440
Área Militar	0.426	0.341	0.386
Industrial	0.380	0.446	0.469
IQVU	**0.452**	**0.419**	**0.428**

Source: search result.

In the South Zone, there was a negative increase in quality of life. In the period prior to the UHE's, it was observed that 30.76% of the neighborhoods had IQVU Good, 53.4 IQVU Regular and just over 15% IQVU Bad. Thus, the neighborhoods Cidade Nova, Novo Horizonte, Castanheiras and Aeroporto presented themselves with the IQVU Bom before the construction of the UHE's. In a year after the construction of the dams, none of the neighborhoods has a good performance index. There has been a significant decrease in the quality of urban life in this Zone.

In this area, neighborhoods with low IQVU (between 0201 and 0.400 considered a low performance index) increased from 15% to 61.53%, after the UHE's [2]. (table 6). These findings by Silva [2] are proportional to those found 6 years later, according to Paraguassú-Chaves [15]. Six years later, of the 13 neighborhoods in the South Zone, 7 (53%) have IQVU Regular (Aeroclube, Novo Horizonte, Cidade Nova, Caladinho, Castanheira, Cidade do Lobo and Eletronorte) and 6 with IQVU Bad.

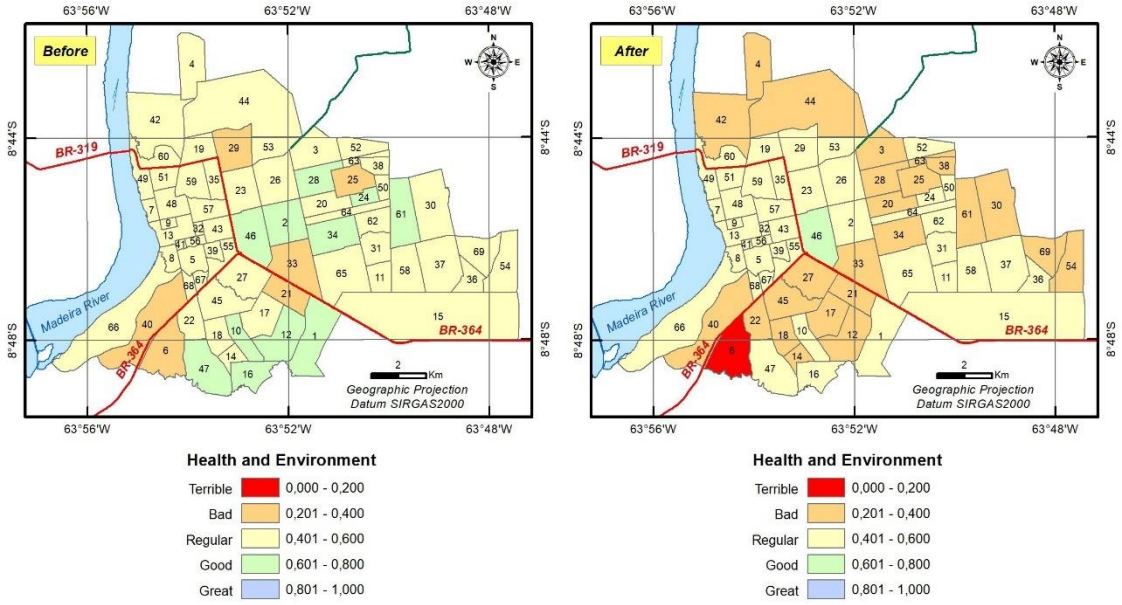
Table 6: Health and Environment Parameter by Neighborhoods in the South Zone (IQVU).

Neighborhood	Before	1 year later	6 years later
Cidade Nova	0.661	0.484	0.496
Novo Horizonte	0.649	0.512	0.500
Castanheira	0.644	0.362	0.444
Aeroclube	0.602	0.564	0.580
Caladinho	0.586	0.418	0.473
Cidade do Lobo	0.557	0.288	0.412
Eletronorte	0.534	0.275	0.404
Cohab	0.530	0.270	0.338
Floresta	0.478	0.339	0.341
Conceição	0.446	0.273	0.297
Nova Floresta	0.418	0.244	0.309
Eldorado	0.377	0.294	0.298
Areia Branca	0.373	0.108	0.222
IQVU	**0.527**	**0.340**	**0.393**

Source: search result.

Cartogram 1, below, shows the result of the Health and Environment index for all Zones of Porto Velho corresponding to the scenario that indicates the before and after the arrival of UHE's on the Madeira River presented by Silva [2] similar to cartogram 6 yeas later.

Cartogram 1: IQVU by neighborhoods in the city of Porto Velho.



3.2 Analysis of Health and Environment Parameters by Urban Areas in the City of Porto Velho.

For the Health and Environment parameter, table 7 and cartogram 2 demonstrate the performance of this parameter for the four Zones of the urban perimeter of the city of Porto Velho. Before the UHE's, the 4 Zones presented a performance consideret regular.

According to Silva [2], after UHE's there was a worsening of IQVU. The South Zone decreases from Regular to Bad performance. All zones also undergo changes in the IQVU. The index rating scale values decreased from the first phase to phase 1 years after the UHE's: East from 0.529 to 0.407; Center from 0.491 to 0.481; South from 0.527 to 0.340 and North from 0.452 to 0.419. The 4 Zones, in general are in the same class of paramenter analyzed (IQVU Regular), wint the exception of the South Zone [2]. (table 7 and cartogram 2).

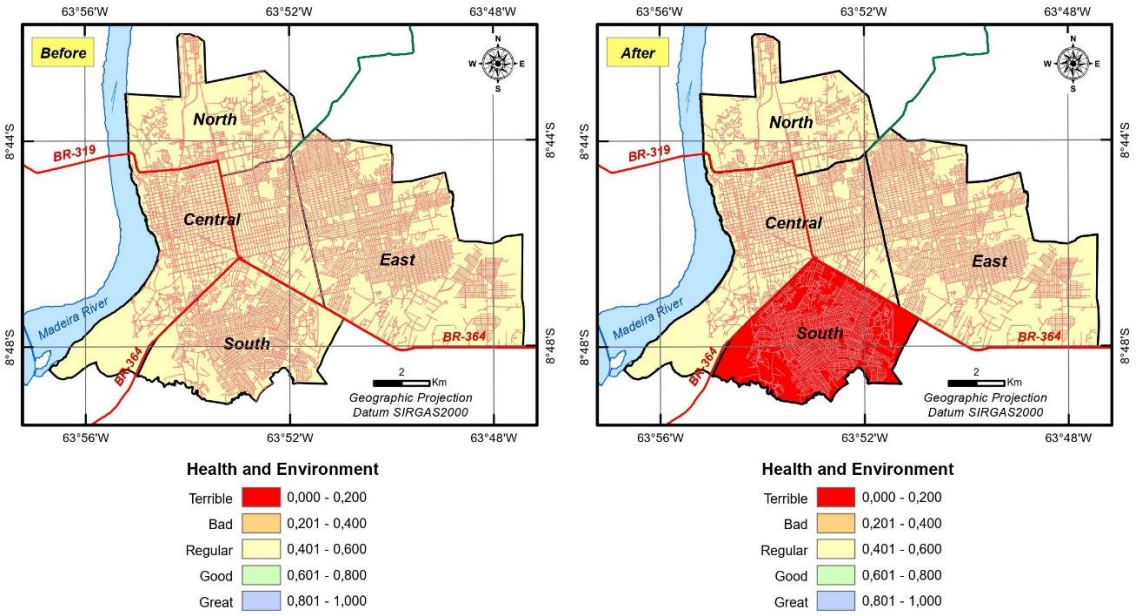
After 6 years, the quality of life indexes found in this research are similar to those found previously. Central Zone IQVU (0.456) Regular, East Zone IQVU (0.406), North Zone IQVU (0.428) and South Zone IQVU (0.393), with the average IQVU (0.420) of the city of Porto Velho.

Table 7: Health and Environment Parameter by Zone (IQVU).

ZONE	Before	After	6 years later
EAST	0.529	0.407	0.406
SOUTH	0.527	0.340	0.393
CENTRAL	0.491	0.481	0.456
NORTH	0.452	0.419	0.428
IQVU	**0.499**	**0.411**	**0.420**

Source: search result.

Cartogram 2: Health and Environment Parameter by Zone.



The discussion on the environmental issue is historical and endowed with a lot of rhetoric, especially when it comes to the urban environment [16]. Several aspects such as pollution, contamination of soil and water, the irregular occupation of urban soil, are stages of discussions. Other manifestations, such as natural disasters as a result of human action in cities, have been much discussed. In the city of Porto Velho, the precarious public services of basic sanitation, sewage, the inefficient collection and disposal of garbage, poor public lighting, streets without adequate infrastructure, violence, traffic problems, precarious health services and other problems are a reality in a city of the Amazon.

One of the environmental and public health problems is the collection and final destination of domestic solid waste. In the city of Porto Velho, urban waste is still deposited in a landfill consisting of cells from waste deposits owned by the Porto Velho municipal government.

The lack of a landfill in itself is already a sanitary, environmental and public health problem. According to Silveira [17] in a work under the guidance of Dr. Paraguassú-Chaves, one of the major environmental and health problems and which requires an immediate solution plan and the issue of the collection and final disposal of solid waste in the city of Porto Velho. Silvera [17] makes another warning when it draws attention that the collection of waste is done in only part of the city's neighborhoods.

Paraguassu-Chaves (15), in Amazonian Studies of Medical Geography and Health, refers to the gaza strip in a given situation related to the environment of the urban periphery of the city of Porto Velho. This phrase would have already been used by Silveira (16), his graduate student in environmental analysis. Said Silveira (17) "Porto Velho looks more like a strip of gaza".

In Porto Velho the only area that has sewage services is the city center. The entire structure of the sanitary sewage service does not exceed 3%. Incipient to meet the demand of the population of Porto Velho. This record was made by Paraguassu-Chaves in the Amazonian Studies of Medical Geography and Health [15].

In the city of Porto Velho, the North Zone is the one that suffers the most from floods and overflow from the Amazon rainwater. Silva [2] confirms this by observing that streams and springs are transformed into open sewage This situation is observed in the neighborhoods that make up this Zone. Rodrigues [18], when

spatially assessing the quality of groundwater in the urban area of Porto Velho, has already warned about the contamination of water consumed by the human population.

Several studies endorse the scenarios found in the research. According to a study by Paraguassú-Chaves *et al* [19], urban groundwater used by the population for human consumption and other uses is impacted by high levels of N nitrate (NO3-). Seventy-three percent (73%) of the samples had contents> 10 mg / L of nitrate. These sites are urban areas of high environmental risk to human health, a public health issue. Only 7.5% of the samples are less than 3 mg / L nitrate. The high concentration of nitrate in urban groundwater in cities in the Brazilian Amazon puts at risk the health of a large part of the population that obtains this type of water resources for human consumption [20; 21]. The study "Nitrate Contamination of Ground Water: sources and potential health effects" by Bouchard, Willians, Surampalli [22], confirms this real situation and its effects on human health.

In a paper published in the "International Journal of Research and Science in Advanced Engineering", Paraguassú-Chaves *et al* [19] and another research result published in the journal "Debate in Action: scientific debate", Paraguassú-Chaves *et al* [23] demonstrate that urban groundwater in the city of Porto Velho, used for human consumption has a high concentration of nitrate. The precarious situation of sanitary sewage, distribution of drinking water of quality and quantity to serve the population, the collection and destination of solid waste found in this research is contrary to what is recommended by Brazilian legislation [24; 25; 26].

Among the conditions that aggravate the situation of water contamination by N nitrate (NO3-) in the urban area, is the inefficiency of basic sanitation (water supply and collection of sanitary sewage, construction of a rudimentary and septic tank in a precarious state). Queiroz, Heller, Silva [27], states that abundant and quality water is essential for public health, preventing diseases such as diarrhea and intestinal infections. These researchers analyzed the correlation between the occurrence of acute diarrheal disease and the quality of water for human consumption similar to those already found in Porto Velho.

Paraguassu-Chaves *et al* [28] highlights several health problems associated with non-standard nitrate and nitrite levels, which can promote diseases such as childhood cyanosis and, possibly, different types of cancer. The ineffectiveness of sewage services forces the local population to build black and septic tanks for the deposition of effluents in the vicinity of their homes that, in practice, contaminate groundwater. The proximity between water collection wells and human feces deposits has drastic consequences and a negative influence on people's quality of life [29].

According to IBGE [30], more than 40% of the Brazilian population use rudimentary cesspools or do not have any sanitation system and only 32%, that is, 61 million are correctly connected to the sewerage network. This procedure is manifested in the inadequate deposition of effluents, which are often discharged directly into the aquifer, as an alternative, in view of the low supply of sewage collection network in all municipalities of the State of Rondônia, whose percentage has 2% of service.

The water supply, whether public or private, may have its quality compromised by the lack of sanitary sewage in urban areas, where different substances are present, whether they are of natural or anthropogenic origin [31].

Other important studies corroborate the precarious situation of environmental conditions in the city of Porto Velho. Like Melo Junior *et al* [32] when he carried out an assessment of the quality of groundwater

in an urban area of the Brazilian Amazon: a case study of the Eletronorte neighborhood, Porto Velho - Rondônia.

Similar studies, such as Machado's [33], "Environmental quality: quantitative and perceptual indicators"; Wies, Silva [34] and Moret, Guerra [35] found results similar to those presented in this research. The environmental impact report of the Santo Antônio and Jirau plants already signaled the indicators of the environmental conditions in Porto Velho and the entire surroundings of the projects [36].

CAERD - Water and Sewage Company of Rondônia in its technical operational diagnosis of water supply and sewage systems - Basic Sanitation Program of the State of Rondônia, recognizes the lack of this essential service to the population of Porto Velho before and even after construction hydroelectric dams on the Madeira River.

This diagnosis corroborates the EBITA report from January to December of the years before and after the Jirau and Santo Antônio UHE's on the Madeira River in Porto Velho [37; 38].

It can be seen that Law No. 11.445 / 2007 and all legal amendments that establishes the national guidelines for basic sanitation in the case of Porto Velho is far from being complied with [39].

According to Barata [21], the number of households with access to the treated water network in most cities in the Amazon is still very low: only 16.88% of the households. While 83.91% are supplied by wells or springs on the property, only 4.84 wells or springs are located on properties. In the vast majority of Amazonian municipalities, there is no sewage collection network. Deficiency in basic sanitation can cause public health problems, because water pollution can cause diseases such as: basilar dysentery, dengue fever, yellow fever, leptospirosis, hepatitis A and others. The lack of basic sanitation in the city is compounded by the fact that most families are supplied by water wells with environmental risk. Therefore, a local culture of basically using open wells on its properties for human consumption is something extremely dangerous that requires further studies, such as the assessment of the socio-environmental impacts that affect this practice on human health [3].

According to Paraguassú-Chaves *et al* (3) another implication resulting from the lack of sanitation refers to environmental damage, such as floods, silting up of water courses (due to deforestation and monitoring of margins), disappearance of green areas, slopes of landslides, compromising water courses. water that turns into garbage dumps and sewage channels.

The concentration of public health units is found in neighborhoods called Embratel, Liberdade, Industrial, Nova Porto Velho, Conceição, Caladinho and Eletronorte. For Silva [2] in the distribution of health units there are large empty areas. As is the case with the situation in the East Zone according to Silva [2].

According to Silva [2] the concentration of medical services is high in the area that corresponds to Conceição, Caladinho and nearby neighborhoods, for example. When comparing the population density with that of the average number of low complexity patients, it is possible to verify that, although these neighborhoods have a high concentration, they do not present significant convergence of the population density. It is concluded, therefore, that the attendance to these health units includes the residents of this region and also the residents of the neighboring regions. In Porto Velho there are areas of the city that lack the concentration of medical care and health units.

According to Paraguassu-Chaves [40], the distribution of health units is at odds with the recommendations of the Ministry of Health of Brazil. For Paraguassu-Chaves [40], the spatial distribution of health units has

primarily obeyed political criteria and interests. For Paraguassu-Chaves [40], the decisions for the construction and operation of health units in the city of Porto Velho obey political criteria and interests and by determination of dominant groups in the local society.

Several studies are references to justify the research findings. Among them are the "Urban expansion of Porto Velho: analysis of the socio-spatial context of a city in transformation" by Almeida [41], "Conditions and quality of life in a reorganized space" by Azevedo [42], "The quality of life in the micro-region of Porto Velho, Rondônia: a quantitative study "by Cavalcante [43]," Systems of quality of life indicators "by Guillén-Salas [44], Porto Velho, the construction of the Madeira plants and the socio-environmental impacts of Gutierres, Marques [45], "The quality of life and its indicators" by Herculano [46], "Urbanization and quality of life in the municipalities of the Legal Amazon created after 1988" by Maniçoba [47], Pereira [48] "Geoprocessing of occupational diseases in Rondônia in the last decade", Pinheiros [49] "Social and institutional problems in the implementation of Hydroelectric Plants: selection of recent cases in Brazil and relevant cases in other countries", RIMA [36] "Report on the environmental impact of the Santo Antônio and Jirau plants", Seild, Zannon [50] "Quality of life and health: conceptual and methodological aspects", Paraguassú-Chaves *et al* [51] "Local Powe as the Basis of the Understanding of the Federative Pact", Uchôa, Uchôa [52] "Social inclusion in the region frontier ", Vieira Neto [53] "Culture, Leisure and Health. The generalized (dis) organization. A case study from Rondônia ".

Medical or health care services were the subject of research in Paraguassu-Chaves [54]. This author seeks to identify, from the perspective of health geography, a distribution and planning of infrastructure components and human resources of the health system.

In the analysis of Paraguassu-Chaves [54], public health services partially fulfilled their objectives throughout the historical process. This author analyzes the elements that make up the health system, based on some indicators. Among them, the author presents: human resources in health, training, professional experience, territorial and spatial distribution of professionals, attributions and legal competence; technological equipment and materials for dressings - real applications and needs; territorial and spatial distribution of health units; hospital beds in public and private institutions, among others.

According to Paraguassú-Chaves *et al* [3] the quality of medical care is provided for in the Brazilian Constitution: "everyone has the right to public health care, in a universal and equal way. This parameter is indicated as a negative aspect of quality of life. In addition, it is the duty of the State to provide access to health promotion, protection and recovery services".

However, although guaranteed in the Brazilian Constitution, there are some barriers in accessing outpatient and hospital services. Among these barriers, there is the unavailability of basic and specialized services for the majority of the population, in addition to the irregular geographic distribution of health units. Also according to the Ministry of Health, the limited distance between demand and supply, established an additional difficulty in the use of these services [3].

The Whoqol Group's quality of life assessment instrument [55] and the quality of life assessment model developed by Paraguassú-Chaves [56] can also be considered as the basis for supporting the research and its findings. The one that best represents the findings can be found in the book Epidemiological Profile of Rondônia by Paraguassú-Chaves *et al* [57].

As for the concept of quality of life, it suffers different interpretations, due to its area of interest. Frequently, concepts related to health concerns, personal satisfaction and happiness or conditions of service are adopted [58]. However, there are others who have a tendency towards lifestyle, conduct and behavior, health and human behavior, health and the environment, among others.

IV. CONCLUSIONS

The construction of hydroelectric dams in the Amazon draws more attention to the social and environmental problems involved than to the relative advantages that these projects bring to local society. At least that is what has been observed so far with the Health and Environment parameter.

All Zones in the phase that precedes UHE's Santo Antônio and Jirau on the Madeira River in Porto Velho, presented a performance of IQVU Regular. The values of the index classification scale decreased from the previous construction of the dams to the phase 1 year later and remains for 6 years afterwards.

The results pointed out by Silva (2) show that there was a decrease in IQVU from the phase prior to the UHEs to 1 year later. The South Zone was the most negatively impacted, moving from IQVU Regular to IQVU Bad.

The negative difference from the reference period before the hydroelectric plants to the reference period after the construction of the UHE's was IQVU of 0.088 and which corroborates with all findings over the last 6 years.

After 6 years, the quality of life indices IQVU in the Central Zone (0.456) Regular, IQVU in the East Zone (0.406), IQVU in the North Zone (0.428) and IQVU in the South Zone (0.393), with the average IQVU (0.420) of the city of Porto Velho. The difference between the average IQVU 6 years later in relation to the living conditions of the population in the period prior to the construction of the hydroelectric dams is -0.079.

What is observed is a worsening of the scenario of quality of life in the city of Porto Velho when evaluated by the parameters of Health and Environment. What was already the negative indicator after the hydroelectric plants became more negatively aggravated.

Porto Velho throughout its history has presented serious problems of infrastructure and inefficient public services. The installations of the UHE's that brought benefits to the population of Porto Velho ?. The results point much more to the negative aspects with the aggravation of the problems that already existed and the uncertainty of their solutions.

It can be said that there was a significant drop in IQVU in the city of Porto Velho. The IQVU, which already had a negative performance, worsened with the arrival of the Jirau and Santo Antonio UHE's on the Madeira River, in Porto Velho - Rondônia, Western Amazon.

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The Effect of Learning Method Schoology Applications and Learning Style on Student Learning Outcomes

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Abstract

This type of research is a quasi-experimental research. The purpose of this study is to determine whether student learning outcomes with the LMS method (using Schoology) are higher than conventional and whether there is an interaction between learning methods with student learning styles. The population of this study were all students of the mechanical engineering study program at the PTKI campus Medan. The sampling technique used was cluster random sampling. The control class and experimental class selected each consisted of 20 people. The instrument used to measure students' mathematical achievement is the essay-test. The instrument used to measure student learning styles is a questionnaire. The normality test used is the Lilliefor test and homogeneity test using the Fisher test. Then the ANOVA test was performed with a significance level of 0.05. The results showed that students who were taught using Schoology had high learning outcomes compared to conventional learning and visual learning styles were highest in learning outcomes than other learning styles. But learning styles and learning methods don't have interactions. For further research, it can be done with different learning models and adding other variables to see the readiness of our human resources in facing the industrial world.

Keywords: Learning Styles, Schoology, Teaching Factory;

1. Introduction

Education is a way of changing mindsets about life. By education, a person can make decisions about the direction of his journey in life. In the course of his life not only thoughts, but also actions or skills in realizing or solving life problems. A government regulation can run well if there are qualified makers and implementers and supervisors (community). Quality can be interpreted not only smart in terms of theory but also skill. The learning process leads students to have a desire to learn, not to make them smart because every human being has his own intelligence based on intellectual abilities that are born from birth (there are 8 intellectual abilities). Then this learning process helps students develop their skills.

The development of knowledge and skills related to industry can use teaching factory learning. Teaching factory is education that connects factories with training where the campus is made a "pseudo industry" before dealing directly with the real world of industry (Chryssoouris, Mavrikios & Rentzos, 2016). In Indonesia, teaching factory is one of the learning models in vocational education. Graduates of vocational higher education are expected to be able to develop their knowledge in the industrial field. Through teaching factory, it is expected that graduates can meet the needs of industry in terms of workers.

Developing an industry is not easy, because of the many problems faced both from employment, government and customer interest for a long time. Because of that, innovation is needed through creativity and critical mindset of industry, where students are accustomed to creating something that is needed by customers with a variety of creativity / innovation and solving various difficulties through critical thinking. Because teaching factory is based on education, research and innovation, all of which form a triangular relationship. Based on that relationship, it is hoped that there will be innovations which are the results of research that can be applied to education so that graduates are needed by industry.

Whereas one of the 2015-2030 Sustainable Development Goals (SDGs) programs is to increase equity in the quality of education and increase learning opportunities for anyone, which means that anyone including those with low economic life can learn, so that in 2030 there will be no more illiterates (Anna & Esther , 2017), but if the cost of education is expensive then there is a possibility that in 2030 there are still those who have not experienced the world of education.

Not to mention at this time, education began to be directed to the industrial revolution 4.0 related to the use of digital technology or known cyber systems. To start education 4.0, it requires a large cost, which consequently students are also required to provide large costs as well if there is a lack of government attention, because there are still many uses of learning systems in industrial space 3.0 and even are taught with industrial systems 2.0. One way that can be used to reduce the cost burden in terms of education 4.0 is a learning system based on LMS (Learning Management System). LMS is software that contains features needed in the learning process (Almrashdeh, Sahari & Alsmadi, 2011) such as management of user access rights, management of courses, management of teaching materials, activity management, value management, and management of e-learning visualization so that they can be accessed with a web browser. Learning Management System is an infrastructure that provides and manages learning content, identifies and assesses learning objectives, tracks all progress in achieving learning objectives and presents data to oversee the overall learning process (Watson, William R., & Watson, Sunnie Lee, 2007) .

The use of LMS allows teachers to manage classes and exchange information with students, as well as access to learning material that takes place within a predetermined timeframe. One LMS is a schoology which combines subject matter with social networks so that it is easy to access. The industrial learning system indirectly directs students to look at cases visually but this does not always make student learning styles toward visual learning styles. Because it will be seen also whether the industry-based learning system makes student learning styles toward the visual.

The benefits of this industry 4.0 revolution are interoperability, transparency of information by creating virtual copies of the physical world by enriching digital factory models and sensor data, technical assistance such as collecting data and making visualizations so that humans can make wise decisions, and independent decisions through the ability of the cyber-physical system so that they can make decisions and tasks as independently as possible. Therefore, education needs to be adjusted towards the industrial revolution 4.0. Education 4.0 is a phenomenon that responds to the needs of the fourth industrial revolution where humans and machines are aligned to get solutions, solve problems and of course discover new possibilities for innovation. Basic education to higher education, adjusting the education curriculum with the challenges and needs of the current era. A curriculum that opens access for millennials to gain knowledge and training to become competitive and productive workers.

High Order Thinking Skills (creativity and critical thinking) are needed in the industry, but not all children can reach this stage, but a good idea can be generated from the collaboration of various student abilities. The way students learn is often referred to as a learning style or student learning modality. Learning styles are a combination of how they absorb, and then organize and process information (DePorter & Hernacki, 2011: 111). Whereas Dunn & Dunn (in Sugihartono, 2007) explained that learning styles are a set of personal characteristics that make learning effective for some people and ineffective for others.

In general, children will find it difficult to process information in ways that are uncomfortable for them. Children have their own learning needs, learn in different ways, and process information in different ways. Some people may have certain dominant learning styles used in various situations, so less use of different learning styles for different situations.

From the explanation above, this journal aims to find out how the influence of the Schoology application learning method and learning style on vocational-based higher learning outcomes and whether there is an interaction between schoology and learning styles. After knowing the results of this study, it is expected that further research can examine various types of student learning styles and other variables such as family conditions and how to unify these types of HOTS leads to industrial-based learning systems.

2. Method

This research is a quasi-experimental research type because in order to obtain information that is an estimate that can be obtained with actual experiments in circumstances that do not allow to control and / or manipulate all relevant variables (Suryabrata, Sumadi, 2006). If a population is very large then samples can be taken that can represent a picture of the state of the population. Because the number of student population is more than 400 students and the determination of class of students in the tertiary institution where the study is random, the sample taken using cluster random sampling type. After that, two research classes were obtained, namely a control class consisting of 20 students and an experimental class consisting of 20 students, assuming the characteristics of the two classes were the same as conducting normality and homogeneity tests first, and the two group samples were normal and homogeneous. Variables in a study are circumstances that are manipulated for observation (Best and Kahn, 2007). The variables used in this study are independent variables (Schoology), dependent variables (learning outcomes) and moderator variables (learning styles). This research is to see whether using the schoology application for student learning outcomes is higher than without using schoology. Then it will be seen how the value of students who have a visual, auditory, kinesthetic style and whether the learning style and schoology have interaction. The test used is an essay test because students are given the freedom to elaborate on what they think will, then be given a learning style questionnaire.

To analyze data we need a method or method of analyzing research data so that the resulting report is easy to understand. Data obtained from field descriptions are presented in the form of data descriptions of each variable, both independent and dependent variables. This data analysis includes the presentation of the smallest and largest data, averages, medians, modes, and standard deviations. Furthermore, analysis of variance is performed to see whether there is a relationship between learning methods and learning styles, but before using variance analysis begins by testing the requirements for normality and homogeneity tests.

Normality test data in this study will use the Lilliofers test. Homogeneity test data in this study is to use the Fisher test.

3. Result and Discussion

The learning method used in this study is to use a learning application namely Schoology in the experimental class and conventional methods in the control class such as teaching by writing without using any application. The following is a summary of descriptive statistics:

Table 1. Summary of Descrptive statistic

Statistics	A_1	A_2	B_1	B_2	B_3
Mean	76,92	71,65	75,29	74,72	73,68
Standard deviation	4,66	6,82	3,95	7,86	6,44
Minimum	70	57	66	57	63
Maximum	90	82	78	90	85,9
Range	20	25	12	33	22,9
Median	76,95	73,5	75,95	75	75
Mode	78	78	78	78	78

A_1 = Experimental Class

A_2 = Control Class

B_1 = Visual

B_2 = Auditory

B_3 = Kinesthetics

After obtaining the results of descriptive data, normality and homogeneity were tested from both group samples. In both the experimental and control group samples using the Lilifors test to see whether the samples were normally distributed, and obtained Lhitung in the control group samples 0.089 <0.19 (Ltable) and Lhitung on the experimental group samples 0.14 <0.19 (Ltable), which meaning that both group samples are normally distributed. Then the variance homogeneity test is performed with the Fisher test, with the results in the following table:

Table 2. Table of Homogenity

Learning Method	N	Df	S^2	$F_{calculation}$	F_{table}	Hasil
Schoology	20	19	46,56	2,150577	3,03	Homogen
Conventional	20	19	21,65			

From the table it is obtained that the sample variance is homogeneous. When viewed from the learning

method, students from groups taught using Schoology are higher than groups taught in the conventional way. Schology can be called like a "pocket book", because schoology can now be used on mobile phones, so it can be carried anywhere and used anywhere. Educators motivate students to be diligent in opening the application and storing various data related to the course. As for the conventional method. students tend to have difficulty reading data related to their courses, because vocational education students spend more time in campus, due to the number of hours of practicum more than theory so that if carrying books the bag will be heavy, consequently the time to relearn eye material Certain lectures have little time outside campus hours. This is in line with the results of Murni and Harimurti's (2016) research, that Schoology has a positive influence on learning outcomes. After knowing the learning outcomes of the two sample groups which are higher, it is seen that there are other variables that affect learning outcomes, namely learning style.

Indirectly, the way someone to capture or process information varies, there are those who listen to music, read seriously or have to practice, this is what is called a learning style. One type of learning style is visual, where someone is more dominant using eyes, more sensitive to sound (Hamzah, 2008). Someone who prefers voices such as music, discussion or anything else related to sound is another type of learning style, auditory. Someone who uses the hand as the main recipient of information by applying it through touch is included in the kinesthetic learning style. In this study, indicators of each type of learning style are:

1. Visual
a. Study in a visual way
b. Understand well the position, shape, numbers and colors
c. Neat and orderly
d. Difficulty in receiving verbal instructions

2. Auditory
a. Learn by auditory
b. Good in oral activities
c. Having sensitivity to music
d. Weakness in visual activities

3. Kinesthetic
a. Study with physical activity
b. Be sensitive to expressions and body language
c. Like trial and error and less tidy
d. Weak in verbal activity

From the results of the study, it was obtained that the dominant of 40 students used visuals were 8 students, auditory 11 students and kinesthetic 21 students, with the highest average being visual learning styles (75.29). To see whether there is an interaction between learning styles and learning methods of the Schoology application, an Analysis of Variance Test is conducted with the following results:

Source of Variance	Df	SS	MS	F-calculation	F-table	Conclusion
Learning Approach (A)	2	21,93	10,96	0,37	3,28	Not Signficant
Learning Style (B)	1	248,88	248,86	8,39	4,13	Signficant
Interaction (AB)	2	56,32	28,16	0,95	3,28	Not Significant
Galat	34					
Total	40					

From the table above it is known that there is no interaction between learning styles and learning methods, but learning styles can affect student learning outcomes. This is because the learning style has been brought from birth, so the learning method only helps educators in making variations of teaching.

From the results of this study indicate that learning methods that use the Schoology application are higher than those not using the application and from 40 sample data it is found that the highest average is students who have a visual learning style. From this research it can be seen that each child is talented. Whatever the child has from birth is good, only the role of parents and educators is needed to direct the children so that they achieve the success of the learning objectives.

4. Conclusion

Every child has unique talents, learning styles and abilities and sometimes differ from one child to another. At the beginning of the study, learning methods were carried out on two different groups where the experimental class using the Schoology application and the control class did not use any application and both sample classes had normal and homogeneous distributed characteristics. Student groups with schoology learning methods have higher learning outcomes. Then the researcher realized that there was a learning style inherent in the students, therefore a learning style questionnaire test was carried out on 40 children. From this study it was found that learning outcomes with a visual learning style were higher than those of auditory and kinesthetic. So an ANOVA test is performed to see if there is an interaction between learning styles and learning methods and the results are not. For the next research students who have visual learning styles can be grouped into two classes, namely the experimental class taught with Schoology and the control class taught without application. Subsequent research can also add other variables so that the

factors that affect student learning outcomes in industry-based tertiary institutions increasingly become apparent.

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Perspectives on The Teaching Career Beginning in Basic Education: A Case Study

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Abstract

This article presents an analysis of the teaching career beginning in Basic Education using the beginning teacher as a reference. The study is based on the theoretical discussions of Gonçalves (2000), Huberman (2000), Guarnieri (2005), Tardif (2008), Darling-Hammond (2014), among others. For methodological development, we used qualitative research (BRASILEIRO, 2013), type case study (MEKSENAS, 2011) with input in ethnomethodology (COULON, 1995). The research was carried out in a public school and had as participants a teacher whose teaching time is less than two years, a principal and a pedagogical coordinator. The data collection techniques were observation, questionnaire, interview and field diary. Data analysis was performed based on Bardin (1977), and interpretation in accordance with Hermeneutics-Dialectics also discussed through Minayo's reflections (1998). The results indicate elements that facilitate the beginning of the teaching profession, such as commitment, respect, profile, self-confidence, among other principles. They also point out difficult elements, such as shyness and practical fragility. They also show the different challenges encountered by the teacher, especially the process of overcoming the dichotomy between training (theory) and professional practice. In general, the research findings show that the entry of the beginner teacher into the school results from a university education based on teaching and research. And, that the beginning of the teaching career explains a context of learning knowledge, characterized by the availability and proactivity inherent in pedagogical work, by the experiences of social relations between students and school professionals that converge to the construction of the teaching professional identity. Therefore, the study expands the reflection on the teaching profession from the perspective of the beginning teacher collaborating to expand this field of knowledge.

Keywords: Teaching profession. Beginning teacher. Basic Education.

1 INITIAL CONSIDERATIONS

The teaching profession has been discussed by some authors, with the intention of describing it in an attempt to understand it. This idea is justified based on the considerations of scholars such as Huberman (2000), who reports in his work ideas about the succession of facts that occur according to a weather forecast, and presents the work of the teacher of the 1st (first) to 40th (fortieth) year of service. Another study related to this theme is the discussion by Gonçalves (2000), who also systematizes the teacher's activity from a section that comprises from 01 (one) to 40 (forty) years of professional practice.

After this initial orientation, it is understood that "the teaching profession is born and developed in parallel with the growth of teaching activity and in line with the cultural characteristics of specific countries" (PENIN, 2009, p. 16). Through the placement of the author, it is possible to understand how the pedagogical actions of that professional are related to different contextualizations, and their practice is analyzed during the process. Also according to Penin (2009, p. 25) "the person / profession relationship occurs throughout the productive life, in a continuous process, involving, as it is common, experiences that are both stimulating, tense and conflicting".

In view of this situation, Huberman (2000) and Gonçalves (2000) consider several periods with some characteristics that may be present during the dynamics of the teacher. In this sense, and specifically about the teaching profession beginning, Huberman (2000) presents this moment from 01 (one) to 03 (three) years of activities, and Gonçalves (2000), from 01 (one) to 04 (four) years. We understand that both authors agree that during that time, there is a discovery by the teacher about the practice, among other situations.

Through the described context, and with the proposal to contribute to the development of the teaching profession, this research presents as an objective to analyze the beginning of the teaching career in Basic Education. The aforementioned production about the beginning teacher, comes from a category of the Master's Dissertation in Education. In this context, we reflect on the theme, from Gonçalves (2000), Huberman (2000), Guarnieri (2005), Tardif (2008), and several authors, who through their scientific productions, collaborated with reflections for the systematization of the study.

In order to develop the objective defined in the research and obtain reflective and critical responses, a methodology based on qualitative research was essential because it conceived as situations without considering various considerations in the statistical area (BRASILEIRO, 2013), with advanced ideas of ethnomethodology that "is a research perspective, a new intellectual posture" (COULON, 1995, p. 7), and through considerations about the case study "it is defined as an empirical research method that conducts a comprehensive analysis of a significant social unit" (MEKSENAS, 2011, p. 118-119).

In this perspective, we highlight the research data produced from systematic and participant observation (GIL, 2010), semi-structured questionnaire (BRASILEIRO, 2013), directed interviews (MEKSENAS, 2011), and field diary (MEKSENAS, 2011), developed in the public school space through the participation of a physics teacher who had less than two years of teaching experience, a principal and a pedagogical coordinator. Therefore, the study and explanation of the research findings were based on the contributions of several authors.

It is interesting to note that the beginning teacher is a professional who presents relevant work in order to streamline the teaching and learning process. In addition to this work, some of the school managers,

commonly called the director and pedagogical coordinator, are some of the professionals able to be together with the teacher who starts his career, helping him in carrying out his activities in the classroom and at school - institutional space that presents a culture. In this locus, the physical components - human and material are important, so that a quality education occurs, even if it is not possible in its entirety, but it is a project to be followed to obtain continuous and relevant results.

The reading of the information came from ideas of the content analysis proposed by Bardin (1977, p. 95), which uses "pre-analysis; exploration of the material; the treatment of the results, the inference and the interpretation", and also the interpretation according to notions from the Hermeneutics-Dialectic also discussed through the reflections of Minayo (1998), being all these important steps for the investigation, and with the intention to better understand the object of the research.

The article is structured based on the empirical methodology described by Bardin (1977), that is, in category, followed by its subcategory. For a better systematization of the work, in the subcategory its interpretation is carried out, accompanied by a self-explanatory figure, then the product of the research is described and soon after the discussion is developed in the light of the theoretical foundation. In this sense, for a demonstration of all the elements contained in the work, *Table 1* presents the general idea of the study in focus, that is, with the category, subcategory and inferences.

Chart 1 – Research category, subcategory and inferences

CATEGORY	*SUBCATEGORY*	*INFERENCES*
TEACHING PROFESSION	TEACHING CAREER BEGINNING IN BASIC EDUCATION	Facilitating elements
		Difficult elements
		Challenges

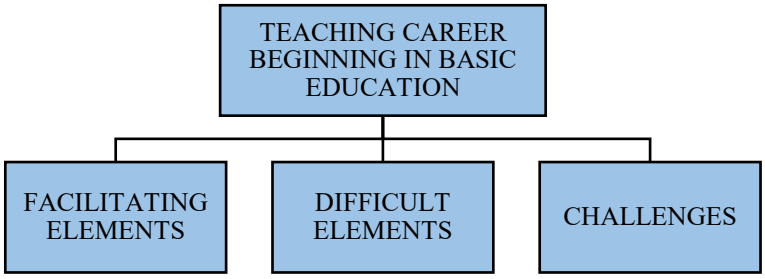
Source: Research data, 2017.

Considering which category is used with instruments to understand regularities in the participants' speech, we identified the category analyzed as being the teaching profession, which emerged from the content analysis and presents in its context the arrival at school.

2 TEACHING CAREER BEGINNING IN BASIC EDUCATION

When starting the teaching career, the professional is invited to learn about the dynamics of the school through the initial guidelines of the managers, but over the years and social relationships, the teacher realizes the problems during the exercise of the educational action. "Teaching is a human activity, an interactive job, that is, a job based on interactions between people" (TARDIF, 2008, p. 118). In this process of interactivity, we sought to unveil the exercise of the beginning teacher through the subcategory – Beginning of the teaching career in Basic Education, and specifically dealing with the facilitating elements at the beginning of the teaching career, the hindering elements at the beginning of the teaching career and the challenges in the beginning of the teaching career, as shown in *Figure 1*, below:

Figure 1 – Teaching career beginning in Basic Education



Source: Research data, 2017.

2.1 Facilitating elements at the beginning of the teaching career

The teaching career is also constituted by pleasant moments that encourage the teacher to seek specialized knowledge, to live with other professionals and students, and he is willing to help in whatever is necessary and within his possibilities. Guarnieri (2005, p. 9) understands that "a part of the teaching profession's learning only occurs and only starts in exercise. In other words, the exercise of the profession is a condition for consolidating the process of becoming a teacher." In this sense, daily life and their experiences are important for the professional's development at school, as the beginning teacher says about the elements that favor his development at the beginning of his career:

> In the sense of conviviality and in the sense of entry. Here is a contest, they think me good or bad, the tendency for me to stay was very big, only if I did a big mistake for them to be able to give me back. In general terms, I try not to miss it, I never missed it, I came to need to leave after you started to accompany me, then I told you, I did an activity, I got around the whole situation, [...]. This question of attendance, of punctuality, you are witnesses of times when I was the last one at school, [...]. Okay, this is a point, this question of attendance and punctuality. With regard to socializing, I don't know what the people think of me, I consider myself a very easy person to deal with, I am very much in my own, although he is very friendly, and he is easy to make friends with. I respect everyone, I treat everyone the same way. I go to school, I talk about the doorman to the coordinating staff, the students, the school cook, everyone, just as normal. "Ah! Because it's the director, I'll treat you better, no, I treat everyone the same." I don't like to criticize anyone (BEGINNING TEACHER).

Continuing on his arrival at school, he explains that:

> I arrived at school, the first person I met was the math teacher and she was responsible for adjusting the schedule. Regarding my workload, I asked that I distribute my classes in only two days. I was very well received by the principal, by the teacher who was working the schedule, by all the other teachers and the staff are very good people (BEGINNING TEACHER).

The teacher continues to report other principles that enabled the exercise at the beginning of the teaching career without many problems, that is:

> I think that this relationship, we have a very good friendship relationship, I with the other teachers, the coordination, the direction, everyone, with the students I am partly very strict, but on the other hand, I try to understand the their situation, their reality, some work, sometimes they miss classes, we try to take them, [...], I think I have a good relationship, a good relationship with the students, I believe they like me. So I think that all this facilitated my stay because the entry was made through a contest, but the permanence I believe that these factors are crucial for it to exist, [...]. I always give the whole subject, my normal class, I don't mess around, if they have questions I answer, in a thousand and different ways that I can imagine, I try to answer, so I think that all this has facilitated my stay, if someone there is something against me I didn't know and if someone criticized it was behind my back I also didn't know, so there's no way I can change without knowing what they're criticizing (BEGINNING TEACHER).

Specifically, the elements that facilitated your career in the classroom space have the following context:

> I usually say that I am not frustrated, I am not a frustrated teacher, [...]. There are even professors who prioritize research over teaching, and I don't, I like the teaching part more. I already like teaching more. There was a guy who gave a lecture I seriously thought about doing my PhD in Physics Teaching, seriously, so I like to teach, and I like it even more when the student is interested in learning, that we don't keep talking and everyone dispersed, [...]. So, what makes me really stay is the will, I like it, I like what I do, I think it's cool (BEGINNING TEACHER).

It is perceived that some contexts contributed to the beginning of the career with less ease, as well as allowing greater tranquility during the performance of their teaching activities, being thus presentable: the admission that was through selective, he is present at school, being punctual, assiduous and using the time that actually belongs to the class, he shows that he has a good relationship with the managers, teachers, employees and students, and above all the love for the chosen, desired and accomplished profession. In this sense, the relationships developed in the educational action space are important for the constitution of the teacher (FURLAN, 2014).

It is noticeable in the daily work of the beginning teacher, a relevant pleasure in exercising the teaching profession, highlighting the moments of the activities carried out together with the students, thus providing an opportunity for an exchange of learning between both. These actions corroborate for a dynamic practice in the classroom, as it uses the sharing of ideas, highlighting an ascending professionalism.

The managers of the institution also point out elements that facilitate the work of the teacher, even when he is at the beginning of teaching, that is, "because he already comes with luggage, he is open to dialogue, he conquers students, he conquers other teachers, he conquers everyone that he is an excellent professional, if it depends on me he remains in school. I take my hat off to him and put on a red carpet" (DIRECTOR). The pedagogical coordinator adds that:

> In terms of classroom management, in terms of how to deal with the student, you know, he does not show insecurity with the student, he knows how to deal with the student, because I think the

> difference of a teacher ..., I see that it could be that the teacher still didn't know how to deal with the student, because that's something that comes from experience, it isn't, but the [name suppressed] doesn't show this insecurity.

It is understood that the teacher has a good education, also valuing a healthy interaction with the school professionals and students, which collaborates to develop their teaching strategies in the classroom with quality, attracting everyone's attention in the moments of explanation of the contents.

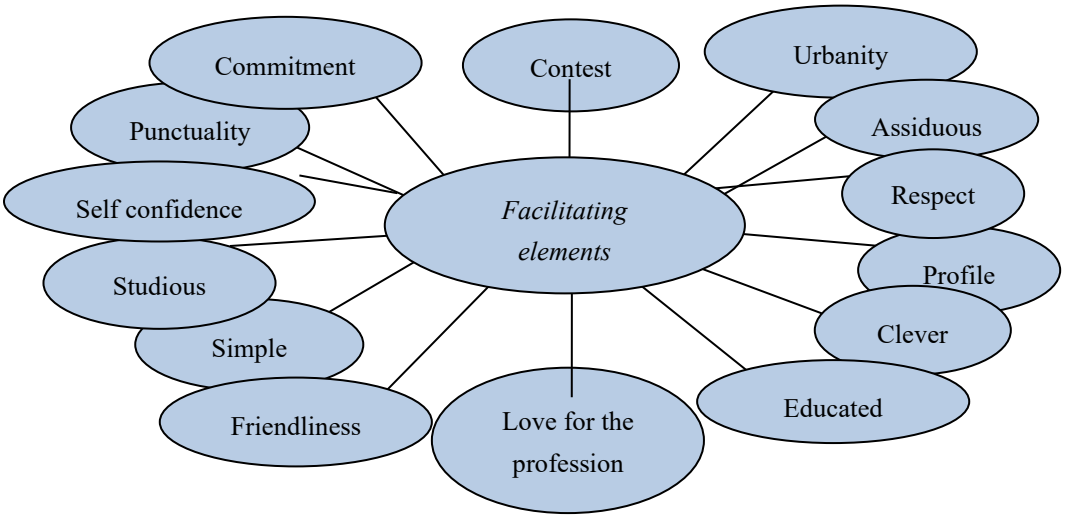
However, the safety demonstrated in the classroom by the teacher, also comes from the knowledge about the subject worked. The way in which he teaches Physics – by means of example and contextualized, facilitates his own learning in working with students, in a friendly and professional relationship.

It is noticeable that if the entry into the career stems from technical competence, since the competition was the means of entry, the permanence in the profession requires, among other knowledge, human competence, and this permanence is ratified by the love for the profession, by I like to teach and among others, as can be seen in the comment below:

> For me the possibilities I see, I don't specify anything, but for me I see it as a way of life, I see it as something I like, something I enjoy. It's part of me. I feel like I was born for this. I could do anything, I could do any job. But I like to teach and I like it even more when students pay attention. Without needing to call attention all the time, I don't think it's very cool, but anyway, it's part of it (BEGINNING TEACHER).

According to the beginning teacher, it is clear how satisfied he is with his activity, even in the face of some unpleasant situations. Still, from this subcategory, it is conceivable to specify the following facilitating elements at the beginning of the teaching career, as shown in *Figure 2*. However, there are also elements that hinder the beginning of the teaching career.

Figure 2 – Enabling elements



Source: Research data, 2017.

2.2 Difficult elements at the teaching career beginning

The difficulties are inherent to all professions, and related to the teaching professional at the beginning of his career is no different. For this, the school is considered as a great novelty and as a different experience to be known, understood and overcome. In this sense, the obstacles are daily, since school activities are continuous and involve several people with their particularities, needing a harmonious dialogue to exist together. However, the beginning teacher participating in our investigation assumes that he has not encountered any difficulties in entering and arriving at school:

> There is no difficulty in my mind. The contest, the test was simple, I was well classified, I was called, I was one of the first to be called, and this school is a little bit on my way home, so I chose this school. I managed to fill my entire workload here, it was another benefit. [...]. So, as I remember, I had no difficulty. I was very well received from the beginning. The classes had already started, I had a few days left, it was also a strike period, the night shift did not strike and then when I entered I was very well received and everything went well (BEGINNING TEACHER).

It is noticed that there was no difficulty for the beginning teacher to enter the educational institution, because due to his theoretical training provided by the university, he managed to succeed in the selective for substitute teacher. Since his curricular internship was smooth, providing practical learning. It is also noteworthy that there was no difficulty in accessing the school because it is close to home and because it is possible to cover its entire workload. Even when he was called to work in the afternoon when there was a strike and in the evening shift he had already started classes, he did not characterize it as an obstacle in the development of his work.

When we asked about the difficulties related to the management team, he highlights that he never had any problems. In this sense, there is a good relationship with all who make up the management team. This information is in line with Martínez's (2009) idea when suggesting that contentment and honesty need to guide educational action. However, through dialogue, or rather, communication, that professionals involved in education can develop work strategies and also build lasting and ethical relationships.

It was also observed that the beginning teacher did not present any difficulty when starting his pedagogical action in the classroom:

> [...] so I never had speaking difficulty, sometimes we get a little shy, the voice becomes a little breathless, but after those initial minutes pass, it's normal, from the beginning I never had much difficulty, it's mine I really had no difficulty in restraining students, I am very friendly, very friendly, sometimes they confuse, go beyond the limit of tolerance, but I call attention to a good one. We try to be more rigid, but I never lost control. It never turned into chaos. Since the first time that I entered the classroom and gave the first class, it was all very quiet, I had nothing like that. It was a unique experience, nothing compares to the classroom itself, although we have a whole training, as I already mentioned in other questions, we do not leave the University prepared to teach, and my training was very good, because I invested in myself, I studied a lot. In theory we know the subject we know. Passing on this subject is a bit complicated, so many times when I prepare the class, I think about

> what the student may have of doubt then I try to speak in the simplest way I can, so I never had a difficulty saying: "oh! I was like that between the cross and the sword!" I didn't have that kind of experience. [...] (BEGINNING TEACHER).

The difficulties that the teacher presents refer only to the first minutes of the class and are related to his resourcefulness. However, it is clear that it is difficult for him to present the content with an explanation. He attributes his training to this, excellent for being theoretical, but fragile in practical aspects. "Teachers themselves have difficulty articulating what they know and how they know it" (SHULMAN, 2014, p. 203). For Farias et al (2014) the principles related to the period, place and accessible objects, are pointed out in intentionality so that the methodology is executable, being relevant during a class the presence of questions, experiences, figures and other supports that favor active action of the students. These strategies allow the teacher to work with broad objective results, despite requiring more work during practice.

Under the analysis of the school managers, the teacher has no difficulty because he comes with the experience, so he had no problem with the student and the management. For the principal and the pedagogical coordinator, the identity of the beginning teacher is linked to a professional who already emerges from an "experience", not related to his career, but due to his systematized and committed actions. This professional uses a variety of knowledge.

Such knowledge comes, among other reasons, from daily learning and the responsibilities worked by the professional, as a result of what is proposed by the profession and what the classroom requires, providing that both: beginning teacher, managers and students, could be satisfied with the work offered.

However, one of the difficulties perceived by the participant affects his training. Hence the need to reflect on initial teacher training in Basic Education, which is also developed through studies in undergraduate degrees, the locus being Higher Education, in which it aims to train an ethical and critical professional.

For Imbernón (2016, p. 128) "[...] the university intervenes directly and indirectly in the formation of teachers in all educational stages." It is in this sense, that the Ministry of Education – MEC has sought to improve the training dynamics of the future educator, seeking to offer a physical structure consistent with reality, subsidized by laboratories, library, training of teacher educators, increase of workload and disciplines in the graduation curriculum and others. It is understood that society's demand is growing every day, requiring Higher Education to accompany its resourcefulness, needs and current contexts. However, the initial training offered by the university does not yet train the teacher:

> The university teaches us a lot, but it does not train us. That is their intention, but in practice it does not happen to train the student so that the student arrives in the classroom. So, what I see with greater difficulty, is that sometimes, we are there and we don't have my own discipline, there's a lot that I watched in the room, but I wasn't curious to ask or the question for that mathematics is very advanced and then when we arrive here in the classroom, mainly in high school and elementary school too, they have access to a lot of information, so they ask questions about many things that I often apply to people who never even thought about it. This becomes a problem, we cannot reveal

> many doubts because otherwise we will fall into disrepute. [...]. Even when I did the internship, the teacher said that the internship was in theory, it is totally practical, not theoretical. His workload is even practical, but thus, the internship is a first contact only that he falls far short of the teacher's real activity, [...] (BEGINNING TEACHER).

The conflict between the training and the action of the beginning teacher is noticed when he points out that the classroom practice is being different from what is theorized in the university. That the students have knowledge beyond that imagined by the beginning teacher, and that the teacher has a fear of not knowing how to answer the questions according to the wishes of the students. However, the internship is still far from the teacher's reality, as found in Pádua and França-Carvalho (2016) in a recent research on the intern's practice at school.

In this sense, Coutinho (2002), highlights that the beginning teachers when entering the exercise of teaching, perceive the discrepancy between the theory that was learned during graduation and the existing reality of some educational institutions with limited structure for the development of the activity. However, the university has some of its objectives, the training of people to exercise a profession with responsibility, respect for others and ethics in carrying out the action, and it is unable to promote the training of the future teacher, because this training requires that knowledge about the profession and its specific knowledge is brought about in:

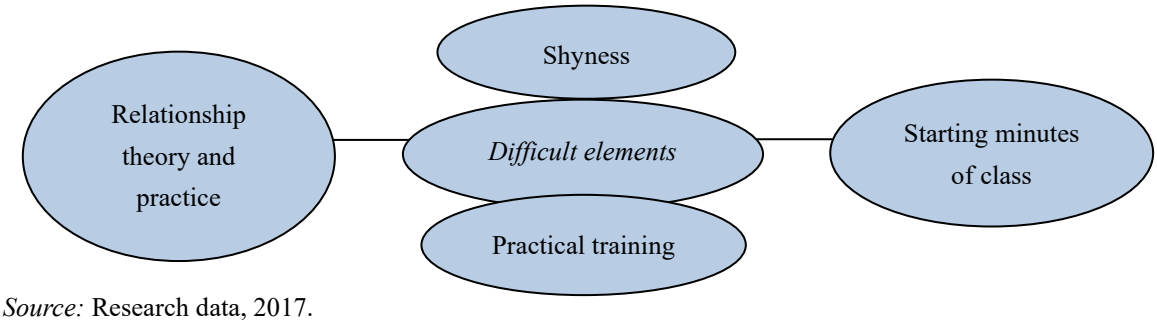
> [...] social interactions, collective activities, the linking of competences and responsibilities in which successes and failures are the responsibility of all those involved in the educational act, with a view to enabling the integral development of the trainee and, consequently, their autonomy (COUTINHO, 2002, p. 61).

It is important that the supervised internship is part of the training process during a relevant period of development of the course, not being characterized only in the last blocks / periods, and these contacts with reality express an experience with the future locus of the teacher's work – the school. It is observed that this professional had little experience in the classroom (only in the supervised internship) and that even with an excellent theoretical training, he was unable to immediately relate his academic activities to practice. It is from this intentionality that the university needs to constantly evaluate its courses.

However, Higher Education has sought to develop its educational policies for the training of licensed professionals, despite many curricular, structural and other adversities. This same educational and transformative space has contributed to the construction of the ethical and innovative teacher, who is concerned with the current reality in search of practical and usual changes in the daily life of society, this being the beginning teacher, the desired one.

Although at this stage it has been shown that the element that hinders the beginning of the profession is the teacher training that the university still offers and that unties theory and practice and even in the mandatory internship, the future teacher learns in soliloquy, through trial and error, as he can be seen in *Figure 3*. However, at the beginning, there are also those elements that challenge staying in the profession.

Figure 3 – Difficult elements



Source: Research data, 2017.

2.3 Challenges at the teaching career beginning

The arrival of the beginning teacher at the school was marked by a challenge on the day of his presentation to the school managers.

> The day I arrived, due to the absence of the teacher, there were holes in the timetable and there were also many teachers missing, there was no chemistry teacher, no Spanish teacher had arrived, some other teachers had not arrived. When I arrived to introduce myself and everything, I did it all in the afternoon, at night I went to adjust the schedule, all this on the same day, I went in the afternoon I took the documentation to take to the stocking center the next day and I went at night to adjust the schedule. That same day that I went the night, I was only going to deliver the documentation the next day and the director already wanted me to come into the room, you know. She took me from room to room, introduced me, said that she had a Physics teacher and such, that they were supposed to keep going, that another teacher had arrived, that motivation that the principal gives to the students. But there was going to be a vacant schedule and she wanted me to go to class and do something and then I avoided it, because first of all I had no experience, it is the first point, two of my classes escaped from regular school, the 6th (sixth) stage A and B the subject that is given in them is differentiated, so I didn't even have the direction to start, but in the other classes I could even risk it, [...], but if it was a regular school class it would be simpler, it would still be complicated, [...] then I avoided it, I told her that I was not able, that I had not gone to teach, I needed the material to see what their material was like. I know that I managed to avoid it (BEGINNING TEACHER).

When starting his work, the teacher is faced with many situations that need a solution, but due to the little time of experience it can become something exhausting until an answer is found, being important the help of all those who build the school.

> [...] The big challenge is the difference in training there for acting here. Of course, I agree that after I become a teacher here I need a much higher education there. I defend that. Even for the purpose of those who want to continue in the master's and doctorate. So we see something much more advanced than we would use to teach here. [...]. It is also a challenge to transmit this content. The students have a lot of aversion to my discipline. They have my discipline as difficult, but I always

> try to show that it is not difficult. That we always have the advantage of this has many applications. I even joked who doesn't like Physics, Chemistry, Mathematics, it wasn't to use a smartphone, it wasn't to use any technology. Because all these technologies. You take a cell phone and use the cell phone you are using purely physical, mathematical, chemical knowledge ... So all this evolution is present in our daily lives. Not that the other disciplines are not, but this is present in our daily lives, so we should be aware of that. [...] (BEGINNING TEACHER).

For the beginner teacher, there is still a distance between what is studied at graduation and the practice at the educational institution. He considers continuing education relevant and necessary. And he realizes that the students show a rejection for the discipline worked in the classroom. This action of relating the theoretical to the activity, the pronouncement with doing, is a barrier to the performance of teaching practice according to Coutinho (2002). In fact, it is challenging for the teacher in the beginning of his career to enter a classroom after knowing several theories at the university, but in reality it is being underused. The school space for the beginner professional is becoming an environment of experiences, because according to the context, he uses solutions that are being developed during his actions or through the experiences of other teachers. It would be interesting that he initially resorted to his knowledge learned at the HEI, thus not being restricted to content only.

Another challenge is to keep constantly updated, in continuous training, as the beginning teacher thinks, being one of the exceptions that are outside the statement of Coutinho (2002, p. 44), in which "the initial training (graduation) for some beginning teachers have a terminal character, as they consider themselves competent to face the challenges of the classroom of specific schools."

If it is during the teaching career that the teacher continues his training, constituting himself through readings, extension courses, specialization, master's, doctorate, exchange of experiences and others. The training process goes beyond graduation in order to cause essential disruptions during the teacher's pedagogical practice, in this sense, Imbernón (2016, p. 145) highlights that:

> Traditionally, permanent training was a moment of "culturalization" of the teacher (pedagogical, didactic, disciplinary...). It was assumed that, updating his knowledge, scientific and didactic, the teacher would transform his practice and, as if by magic and miraculously, he would become an innovator who would promote new projects. [...]. Now we are beginning to see that ongoing formation increases its innovative impact if the relationship takes place the other way around: not training to develop a change project, but creating an innovative project. And to carry it out you must receive or share the necessary training.

It is also observed that this teacher at the beginning of his career has characteristics similar to the one detailed by Huberman (2000) and Gonçalves (2000), who during the initial phase of his career, are faced with an amazing and challenging reality. The novice teacher was considering it strange, the small number of students participating in the class, sometimes just one, which made the teaching and learning process challenging, and a questioning was important.

The challenges made explicit by the beginning teacher seem not to have been perceived by the

director and pedagogical coordinator who were always satisfied with the work performed by the beginning teacher, not observing any problem in his practice, as it is possible to identify in the following quotes: for the director, "the his diversity is very interesting, he conquers the students, he has that attraction with the students so I like him very much, [...]", and for the pedagogical coordinator, "he is a great teacher, he does not demonstrate he is at the beginning of his career no, so much so that I didn't even know he was in the beginning of his career, because when I arrived here he was here acting as a teacher without any difference from the other teachers who are already veterans." This identity is validated by school management, teachers and students, due to the dynamism of the teacher in solving situations, being communicative, doing a good job in the classroom. And in this regard, Alonso (1999, p. 15) recalls that "the teacher needs much more than intuition to reflect on his practice: he needs to be concerned with the student more than with the knowledge to be transmitted, [...]." The teacher, however, recognizes himself as an excellent professional due to the fact that he performs his actions with quality, for comparing his dynamics with the other professionals of the school, and even though he is a beginner professional, he sought answers to his doubts and improvement in his practice.

Although the beginning teacher encountered several challenges during the pedagogical action, he highlighted some attitudes towards them, which can be presented through the following context:

> [...] being from the stages or regular education, they are more or less at the same level, this audience is a public that has a certain scientific knowledge, even at a very low school level, so most of the knowledge they have is everyday, it is more that knowledge, roughly empirical, it is something that they experience, it is something that is present in their daily lives and then the book of the stage does not, it is already well contextualized although here comes some I work preparing a class, explaining certain content, but it's easier, I need to go to the things they have on a daily basis in order to explain the subject, that was a problem. I got around this problem by bringing it to their reality, to their experience, I always set an example with things at home, I always set an example with things even if it happens on a daily basis. I live in the north, I know what happens here and I use things that happened here as an example too (BEGINNING TEACHER).

Therefore, he informs that he sought to overcome the challenges encountered through the following reasoning / strategy:

> As challenges arise I do not try to react in the heat of the moment, I always think very well before making a decision, because sometimes something happens and we even get upset and if we react at that moment, we will certainly be reacting for emotion, so I always think well, relax, to act. So, I didn't find any problems like this, very difficult to get around, I think maybe my way will help, make it easier for me not to have this kind of problem, as I see there are many teachers there that everything said is against them, I'm always in favor, I'm always with the school, whatever they decide I'm here to support, I've always taken that position, I've always taken that position, [...] I also won't work against my principal, [...] (BEGINNING TEACHER).

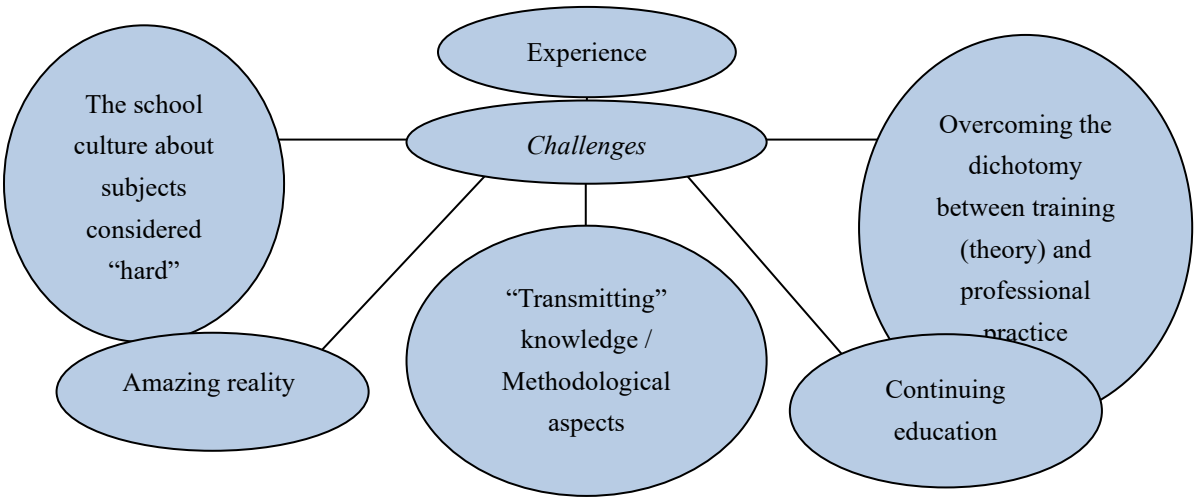
It is analyzed that the challenges have synonyms of problems and that for him it is challenging to combine the student's daily life with the content of the book, due to the difficulty of transforming the

material in class, or the contents, didactically. "The way in which the teacher manipulates the contents and directs the teaching activities is determined by his intentions about the practice and his understanding about the purposes of education, in general" (FRANCE-CARVALHO, 2007, p. 81). It is observed that he used examples from the students' reality to resolve the situation, bringing the student closer to the content and mediating the content. As stated by Lüdke and Boing (2012, p. 443), "the better the initial training, the more capacity for reflexive response and adaptability."

It appears that given the challenges encountered, he seeks to reflect on a possible situation to be put into practice. Stahlschmidt (2009, p. 111) highlights: "we believe that practice enables teachers to appropriate their knowledge and actions as they seek to go beyond the immediate demands of everyday life to achieve praxis, that is, a thoughtful and reflected practice." Through reflection, the teacher will be able to systematize the content to be approached, develop a certain subject and relate / evaluate his work according to the proposed objectives and consequently be those achieved by the students. Thus, it is appropriate to present the thinking of Darling-Hammond (2014), when informing that teaching aimed at elucidating some adverse situation, as well as producing and putting into practice an idea, proposes to the teacher the need to make use of a set of knowledge in advance.

In summary, we can see that the greatest challenges for the beginning teacher are related to his experience, ongoing training and methodological aspects, as shown in *Figure 4*. Since these challenges are perceived by the teacher, but not completely overcome, examples of this are the their dissatisfaction with the small number of students present in the classroom, as well as the "transmission" of the content for a better pedagogical practice and consequently a desirable learning by the students. However, these moments of questioning evaluated by the beginning teacher are important.

Figure 4 – Challenges



Source: Research data, 2017.

3 FINAL CONSIDERATIONS

A teaching career comprises a field of action, participation and feelings, which directly interacts

with several factors, such as: the quality of the teaching and learning process, initial training, interactive relationships in the educational space, the instruments and items available for practice, and among other aspects. Reflecting on this reality and the teacher's daily activities, we understand that dynamic actions during the process until the completion of the class, go through planning stages with discussion of the object of knowledge, the approach, the resources to be used and the different pedagogies inherent in a reality . Such conditions corroborate for a predictable teaching systematization and that possibly become easier when working together with clear and agreed ideas, between teams of teachers and managers.

In this sense, the teacher, when starting his career, needs to obtain knowledge about his rights and duties, his dynamics of daily work, and the guiding principles that subsidize the institution in its various contexts. The school, on the other hand, as a social and learning space, needs to present daily dynamization of objectives to contribute to the students' development, as well as reflect, together with the teachers, necessary teaching strategies, which provide satisfaction among those involved. Through this perspective, we infer that such purposes are also valid for the professional in question.

We also understand that the beginning teacher is inserted in the school to offer his / her work based on years of studies related to undergraduate training, and that new learning is essential for obtaining relevant theoretical and practical concepts about daily pedagogical practice. According to these and other clarifications, we analyzed the beginning of the teaching career in Basic Education, and according to the work of this professional, we identified some elements that hinder, elements that facilitate and challenges.

In view of the research findings, it was evidenced that the entry of the begining teacher in the school results from a university formation based on teaching and research, but that dichotomizes the theory and practice of being a teacher, that is, the teaching profession. Notably, the beginning of the teaching career spells out a context for learning knowledge, characterized by the availability and proactivity inherent in pedagogical work, by the intensity of social relations between students and school professionals who contribute to the construction of the teaching identity.

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Differences between strawberry cultivars based on principal component analysis

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Abstract

Strawberry culture is of extreme economic importance, especially for small producers, as it has the capacity to add value to small family farms, in addition to absorbing family labor. Principal component analysis (PCA) is a multivariate technique for modeling covariance structure, where a basic idea is to find latent variables that represent linear combinations of a group of variables under study, which in turn are related between itself. In this way, the objective of the work was estimated, through the analysis of main components (PCA), as relationships between development variables, products and fruit quality in different strawberry cultivars. The design used was a randomized block with 11 treatments, consisting of strawberry cultivars of Italian and American origins, with four replications. During the culture cycle, the following variables were evaluated: phyllochron, number of commercial (FC) and non-commercial (FNC) fruits, mass of commercial (MFC) and non-commercial (MFNC) fruits, total titratable acidity (AT), total soluble quantities (SST) and total soluble ratio, titratable acidity (SST / AT). The relationships between the variables were evaluated by the PCA analysis and the results were plotted on the Biplot graph. From the analysis, it was possible to identify the relationships between the variables that show how to cultivate the same photoperiod and the same characteristic origin. Growing short photoperiods are more productive, for example, as the neutral photoperiod has less phyllochron and less acidity. The increase in soluble solids can cause a reduction in acidity, which is one of the characteristics that add flavor to the fruit.

Keywords: *Fragaria x ananassa* Dusch.; Variability; Multivariate Analysis, Principal Components.

Introduction

Strawberry (*Fragaria x ananassa Dusch.*) it is an economically important crop (FAOSTAT, 2020) and with great acceptance by the consumer. Its fruits can be consumed both in its fresh form and in processed form, such as sweets, yogurts, jellies and ice cream (Richter et al., 2018). In recent years the consumption of strawberries has also increased, due to the nutraceutical properties found in fruits, having important compounds to prevent heart disease and some types of cancer (Zhang et al., 2008; Šamec et al., 2016). Due to its characteristics such as red color, striking aroma, mild fruit flavor, nutraceutical properties and multifunctionality in cooking, these are some of the reasons that lead to consumer acceptance (Šamec et al., 2016; Trevisan et al., 2017).

Due to this acceptance by the consumer, coupled with the increase in population, world strawberry production has grown steadily over the years (FAOSTAT, 2020). According to data from FAOSTAT (2020), determined in 2017, the main strawberry producing countries are China, the United States, and Mexico, with yields of 3724647, 1449280 and 658436 tons respectively. Brazil, on the other hand, is not among the largest strawberry producers, it is occupying the 55th position in the world ranking, according to FAO (FAOSTAT, 2020). Brazilian strawberry production reaches 120000 tons, harvested from an area of 5278 hectares, of 6,030 producers, totaling an average area of 0.9 hectares per producer (Anuário Brasileiro de Horti & Fruti, 2019). Brazil has the potential to increase the area and production of strawberry fruits, aiming at the export of fruits, which is still incipient because, according to the Anuário Brasileiro de Horti & Fruti (2019), Brazil exported 0.03 thousand in 2018 tons of prepared or preserved strawberries and 0.07 thousand tons of fresh strawberries.

Thus, to supply the growing demand for food sustainably and increase the production and export of strawberries in Brazil, research must be carried out with cultivars that are more productive and tasty, with high nutritional value, so that it meets the wishes of the final customer.

Based on the increase in the demand for high-quality fruits and with an increase in population, high yield and high flavor cultivars must be defined. For this, the work of genetic improvement must seek to understand the existing relationships between characters of production, quality, and development of the plant so that the cultivars that satisfy these characteristics are selected.

One of the ways to choose new cultivars, with certain characteristics is through the analysis of main components (PCA), which is one of the statistical tools that can be used to define the relationships between variables, such as the relationships between productivity with the origin of the cultivar, photoperiod, among other factors that may interfere with productivity and fruit quality. PCA is a multivariate technique for modeling covariance structure, where the basic idea is to identify latent variables that represent linear combinations of a group of variables under study that, in turn, are related to each other (Islabão et al., 2013; Souza et al., 2019). Principal component analysis (PCA) is a method that has the basic purpose of reducing the database, eliminating overlaps and choosing more representative forms of data from linear combinations of the original variables. This procedure extracts the dominant patterns in the data matrix in terms of a complementary set of scores and loading charts (Kassambara and Mundt, 2017). The PCA allows obtaining a reduction in dimensionality, exploration of data to find relationships between objects, an estimate of the correlation structure of the variables and an investigation of how many components are needed to explain most of the variation with a minimal loss of information. (Mingoti, 2005; Šamec et al., 2016).

Principal component analyses (PCA) were used by Šamec et al., (2016) to evaluate the physical and phytochemical parameters of four strawberry cultivars grown in soilless and off-season systems, to evaluate specific quality parameters for each cultivar studied. PCA was also used by Nowicka et al. (2019) in the comparison of the polyphenols content and antioxidant capacity of strawberries from 90 cultivars of *Fragaria x ananassa* Duch, to evaluate both widely cultivated and new varieties, to detect those with higher polyphenolic content and antioxidant capacity in fruits. Given the above, the objective of the work was to estimate, through principal component analysis (PCA), the relationships between development, productive and fruit quality variables in different strawberry cultivars.

Material and methods

The work was conducted under low tunnels in the experimental field of the Federal University of Santa Maria, Frederico Westphalen / RS Campus, geographically located at 27º 23' 728" S and 53º 25'749" O and 493 m altitude. The soil of the experimental area is classified as a typical red dystrophic Oxisol, with a clayey texture, deep and well-drained (Embrapa, 2006). The climate of the region is of the Cfa type by the Köppen climate classification (Alvares et al. 2013).

The soil was prepared with plowing, harrowing and enchanting. Proceeding with fertilization according to the previous analysis of the soil and calculated according to the requirements of the crop (Santos and Medeiros, 2003). Tanned bovine manure (5.5 kg m^{-2}) was incorporated and, before planting, a dose of 55 g m^{-2} of chemical fertilizer (10-20-10) was used.

Seedlings of Italian cultivars were planted on May 6, 2015. American cultivars were transplanted on June 3 to Camino Real, June 2 to Camarosa, June 8 to Albion, and cultivars San Andreas and Aromas were transplanted on June 22 of that year. The planting dates followed the delivery schedule of seedlings by nurseries and importing agencies, since most of the seedlings used in Brazil, for planting crops, come from nurseries located in Chile and Argentina. The Italian cultivars came from an agreement between Brazil and Italy, from the Convention for the experimentation and diffusion of the genetic material of Italian strawberry in Brazil. The agreement was signed in 2012 between the Center for Agricultural Sciences of the State University of Santa Catarina - UDESC and the 'Consiglio per la Ricerca in Agricoltura and L'analisi dell'Economia Agraria' - Unità di Ricerca per la Fruticultura (CREA-FRF) from Italy. Irrigation and fertigation were carried out via drip tape, following the cultural treatments according to the requirements of the culture.

The design used was a randomized block with 11 treatments, these being composed of Italian strawberry cultivars (CREA-FRF PIR 29, CREA-FRF PA3, CREA-FRF CE 51, CREA-FRF CE 56, CREA-FRF Jônica and CREA -FRF Pircinque) and American (Albion, Camarosa, San Andreas, Camino Real, and Aromas), with four replicates per treatment and 8 plants per plot, totaling thirty-two plants to be cultivated. The evaluation was carried out in each plot, counting the results of the 8 plants in the plot. During the crop cycle, the following variables were evaluated: phyllochron, number of commercial (FC, g $plant^{-1}$) and non-commercial (FNC, g $plant^{-1}$), mass of commercial (MFC, g $plant^{-1}$) and non-commercial fruits commercial (MFNC, g $plant^{-1}$), total titratable acidity (AT, % citric acid), total soluble solids (SST, º Brix) and total soluble solids and titratable acidity (SST / AT).

For the phyllochron variable, the number of leaves in the crown was counted every three days, from the beginning of the leaves emission until full bloom, a period in which the plant emits the second floral cluster (Mendonça et al., 2012). For counting, a leaf was considered when it was visible and the edges of the leaflets were no longer touching. In order to estimate the phyllochron, linear regression was performed between the number of crown leaves and the accumulated thermal sum, with the phyllochron being the inverse of the angular coefficient of the linear regression (Mendonça et al., 2012).

The fruits were harvested twice a week (from August to December), in the stage of complete maturation, separating commercial and non-commercial fruits, thus generating two variables: number and production of commercial and non-commercial fruits. For that, non-commercial fruit was considered to be deformed

or weighing less than six grams.

Qualitative analyzes of fruits were carried out throughout the cycle, to eliminate specific characteristics of the harvest season. The variables of total titratable acidity and total soluble solids were analyzed in the laboratory. To determine the total acidity, titrimetry was performed with a standardized solution of NaOH 0.1 mol L^{-1} and the determination of total soluble solids using a manual refractometer.

From the Pearson correlation matrix of the original variables, the principal component analysis (PCA) was performed and the interpretation was performed based on the linear relationships between the variables and the responses of the cultivars and the origin of the seedlings and photoperiod. The importance of each variable was determined to explain the variability between the treatments evaluated. PCs are obtained using the PCA () function and the biplot is built using the fviz_pca_biplot () function, both implemented by the FactoMineR package (Le et al., 2008) in software R version 3.5.3 (R Development Core Team, 2019).

Results

The contribution of the first two main components PC1 and PC2 were 58.81 and 21.25%, respectively, and the accumulated contribution rate totaled more than 80%, this being a significant percentage of the variability extracted using the first two axes of the PCA, following the recommendation of Rencher (2002). PC3 was not added because it has a low contribution, not providing relevant information, with 9.6% (Figure 1A).

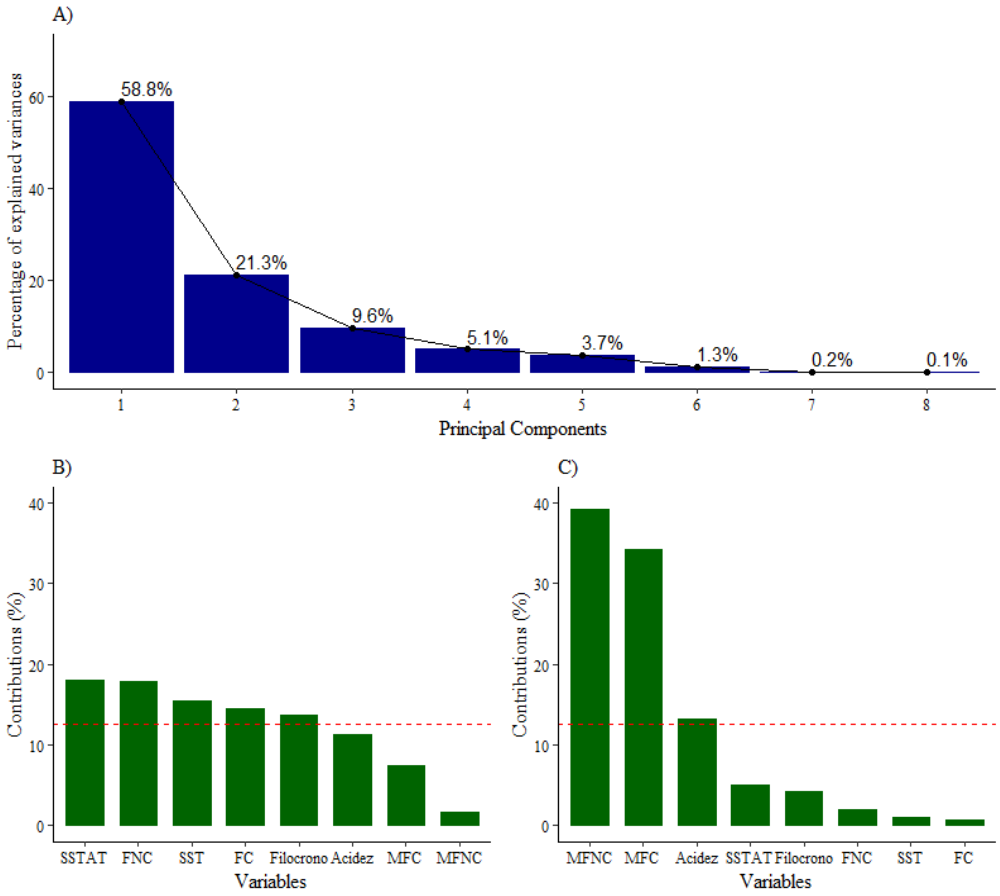

Figure 1: Percentage of variance explained in each main component for different strawberry cultivars and contribution of variables in accounting for variability for the first two main components.

The variables with the greatest contribution were the SST / AT, FNC, SST, FC, and Filochron ratio in PC1 while for PC2 they were MFNC and MFC (Figure 1B and 1C). Those with the lowest contribution were FC and phyllochron. The red dashed line indicates the expected average contribution and for the variable to be considered important in the component's contribution, the value must be above this cutoff point. In this case, due to having relatively few variables, it was decided to keep all variables in the analysis.

The interpretation of the relationships between the variables can be viewed from a biplot (Figure 2). It is observed that the variable HR has a positive relationship with the variable FNC. This relationship was already expected, as the increase in production occurs, the production of non-commercial fruits also increases, in the same way as for the MFC and MFNC variables that showed a positive relationship (Figure 2).

For the quality variables, it was possible to observe the negative relationship between the variables AT and SST / AT, at the same time that the relationship between SST and SST / AT is positive. Thus, by increasing the acidity content in the fruits, there is a reduction in the AT / SST ratio, the latter being responsible for the flavor of the fruits. Another important relationship was observed between the Filochron variables with the SST and AT / SST variables, both negative, inferring that the higher the plants' Filochron, the lower the SST and AT / SST content (Figure 2). Plants with a greater Filochron need a greater accumulated thermal sum for leaf emission, that is, they may have slower growth, causing a smaller leaf area for absorption of photosynthetically active solar radiation and conversion of this into photoassimilates, which will be converted into sugar, for example.

The results show that the cultivar grouping was separated by the evaluated factors, separating the cultivars into two groups. In the first quadrant, the grouped genotypes are of short days and feature high productivity and fruit quality, with a high AT / SST ratio. In the second group of variables, it is noticed that, except for the cultivar Camarosa, the others are of neutral days and presented low phyllochron and Acidity.

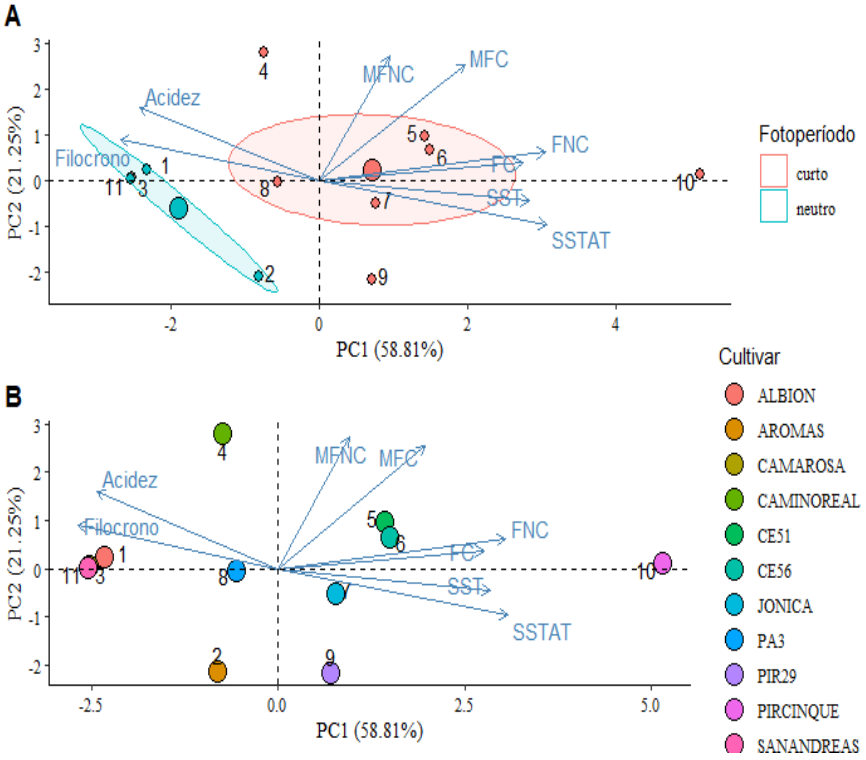

Figure 2: Analysis of main components of strawberry cultivars from different origins and photoperiod.

Discussion

The first two main components obtained managed to explain more than 80% of the total variation of the data set for all investigated characteristics, this is a high and sufficient value to explain the variables because, according to Rencher (2002), at least 70% of the total variance must be explained by the first two main components. Similar results to this were also observed by other researchers working with *Fragaria x ananassa* Dusch. Šamec et al., (2016) found in the first two CP, values of 53.81% and 21.31%. Already Li et al. (2019) found 50.40% and 23.57% representation of the data variability for PC1 and PC2, respectively. The inverse and negative relationship observed between SST and AT is mainly due to the maturation of the fruits, where there is an increase in the amount of total soluble solids and a decrease in the titratable acidity (Mazaro et al., 2008). In the culture of passion fruit Silva et al., (2005) showed that as fruit maturation increases, there is an increase in the SST / AT ratio. A high SST / AT ratio gives fruits a better balance between sweet and acidic, giving the most pleasant flavor and making them more attractive and having greater acceptance by consumers (Brackmann et al., 2011). There is also a positive relationship between FC and FNC with MFC, this relationship was already expected, because with the increase in the number of fruits, consequently there is an increase in fruit mass.

Second Henz (2010), some of the great difficulties for the production and quality of strawberries are inherent, mainly, the susceptibility of the crop due to the incidence of pests and diseases. Several of these are difficult to observe and control, which can cause numerous losses, both in productivity, as well as in the final quality of the fruits.

The PCA analysis separated the cultivars into 2 groups, which were formed by cultivars of the same photoperiod and the same origin, as they have greater similarity between their variables, which are

separated by the ellipses of the analysis. Photoperiods shorter than 14 hours of light, favor short-day cultivars, as floral differentiation occurs, and delay the emission of stolons, which will be emitted when the length of the day stretches and the temperature increases (Villagrán et al., 2013). The cultivars of neutral days do not have stimuli of the photoperiod and respond well to temperature, with flowering occurring continuously during their cycle, as long as the air temperature occurs in the range of 10 to 28ºC (Heide, 1977; Santos, 1999; Strassburger et al., 2010).

It was also possible to observe a higher value of phyllochron in the cultivars of neutral days, which means that the emission of leaves was more slowly about the cultivars of short days (Streck et al., 2007). When the plants have a shorter photoperiod, in the case of short-day cultivars, they have a larger leaf area and a higher production of photoassimilates which can be used for fruits, as these are considered the main drains in the plant, thus favoring the higher content of total soluble solids and decreased acidity (Taiz et al., 2017). Cultivars with higher phyllochron values are less efficient in transforming photosynthetic energy, which reflects in lower yield (Tazzo et al., 2015). Contrary results were obtained by Diel et al., (2017) where the cultivar Camarosa, which is of short days, obtained lower phyllochron values than the Albion cultivar of neutral days, indicating greater leaf area of the cultivar of short days. Phylochron-mediated plant development responses may vary by location and cultivation system. In the present study, culture was conducted in the field in a traditional system, while in the study of Diel et al., (2017) the plants were grown in a protected substrate culture, which may have influenced the response presented in the cultivar Camarosa and Albion.

Conclusion

From the principal component analysis (PCA) it was possible to identify that cultivars of the same photoperiod and the same origin have similar characteristics.

Cultivars of short photoperiods are more productive, but those of neutral photoperiod has less phyllochron and less acidity. The increase in total soluble solids causes a reduction in acidity, which is one of the characteristics that give flavor to the fruit.

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Rooting Enhancers in The Production of Bougainvillea Seedlings (*Bougainvillea Sp.)*

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ABSTRACT

This work aimed to evaluate the effect of different rooting enhancers on the development of Bougainvillea cuttings (Bougainvillea spetabilis Willd), aiming to accelerate rhizogenesis for seedling production. Semi-hardwood cuttings standardized in fifteen centimeters in length and diameter of approximately one centimeter were used. After collected, one third of the basal part of cuttings was immersed according to the following treatments: water (control); commercial product (RADIMAXi 20® at concentrations: Ca 25.6%, S 1.8%, Zn 2.5%, Co 1.5%); coconut water (Cocos nucifera L.); Tiririca extract (Cyperus rotundus L.) and Lentil extract (Lensculinaris Medik), for about two seconds. After immersion, cuttings were planted in polyethylene bags filled with 50% of Carolina Soil® commercial substrate and 50% of washed sand, packed under screen (50%) with a micro sprinkler irrigation system. The experimental design used was completely randomized, with five treatments and ten replicates. Results were submitted to analysis of variance and the means of treatments to Student's t test at 5% probability. Evaluations were carried out at 45 days after installation and variables analyzed were: number of sprouts per cutting, length of the largest sprout, percentage of rooted cuttings and non-rooted live cuttings, length of the largest root, fresh and dry matter of roots, fresh and dry matter of shoots. Treatments that showed statistical difference were lentil extract, with the highest number of sprouts and the highest percentage of rooted cuttings and non-rooted live cuttings, and treatment with coconut water obtained the highest result in relation to variable length of the largest sprout, standing out as a promising sustainable alternative in the vegetative production of Bougainvillea seedlings.

Keywords: Plant extracts; floriculture, propagation of ornamental plants; rhizogenic process.

1. INTRODUCTION

Floriculture is an important economic activity in agribusiness due to social, cultural and ecological function [1]. In the last five years, the ornamental plants segment has grown significantly, as this segment of horticulture is no longer seen only as an aesthetic issue, but also as a synonym for well-being and quality of life [2].

In Brazil, among the species of ornamental plants, Bougainvillea (*Bougainvillea spectabilis* Willd), belonging to the Nyctaginaceae family, also known as três-marias, ceboleiro, santa-rita, espinho-de-santa rita, is a popular ornamental plant grown in many parts of the world in tropical and subtropical gardens for

its colorful bracts of red, pink, yellow and white flowers [3] [4]. In addition, its leaf extract has shown medicinal properties of anti-inflammatory [5] and hypoglycemic activity in diabetic rats [6].

Bougainvillea is considered a rustic plant with low demand for cultural treatments; it is a climbing plant with trunk protected by strong thorns that branch every year, growing in a disorderly manner, reaching up to 9 m in height [7].

The production of seedlings of this species can be made using propagating methods [8], and cutting is the most used technique for commercial production [9] [10]. However, the species has low rooting rates [11] [12] [13].

The difficult rooting of some species can be explained by the fact that cuttings do not have sufficient reserves of rooting cofactors required for this process [14]. For this reason, developing propagation techniques and improving them aiming at the production of better quality seedlings and greater uniformity are of great importance to make commercial cultivation feasible [10]. In this sense, non-conventional and natural rooting-inducing plant regulators are promising options for the production of seedlings in a sustainable and economic way.

Thus, the aim of this study was to evaluate the effect of synthetic and natural rooting enhancers on Bougainvillea cuttings (*Bougainvillea spectabilis* Willd.), searching for alternatives for the production of healthy and quality seedlings.

2. MATERIAL AND METHODS

The experiment was carried out in an agricultural greenhouse of Pad & Fan type, belonging to the Faculty of Agricultural and Technological Sciences - FCAT / UNESP, located in the municipality of Dracena / SP, whose geographical coordinates are 21° 28'57 ”S and 51 ° 31'58 ”W and 421 m a.s.l.

The climate is classified as Subtropical cwa (mild, dry winters followed by very hot summers) [15] with average annual temperature of 23.6 ° C.

Semi-hardwood *Bougainvillea spectabilis* Willd cuttings were collected in the winter period from mother plant with purple colored flowers, located at Rodovia Comandante João Ribeiro Barros, km 653 in the municipality of Dracena - SP, standardized with 15.0 centimeters in length and 1.0 cm in diameter.

The experimental design used was completely randomized, with 10 replicates per treatment and 5 treatments: T0 - water; T1 - Radimaxi 20® commercial product (concentrations: Ca 25.6%, S 1.8%, Zn 2.5%, Co 1.5%), diluting 3 tablets per liter of water, as indicated by the manufacturer; T2 - fresh liquid endosperm (*Cocos nucifera* water); T3 – *Cyperus rotundus* L. extract (Tiririca); and T4 - lentil extract (*Lensculinaris* Medik).

For treatment 2, coconut water extracted from fresh green coconut was used on the day the experiment was implemented. For treatment 3, 100 g of *Cyperus rotundus* L. and leaves, roots and bulbs were collected, which were washed and crushed in blender containing one liter of water. In treatment 4, 500 g of lentil seeds were previously weighed, placed to germinate in 2 liters of water and after germination, seedlings were ground in blender with water.

The basal third of cuttings was immersed in rooting enhancers for two seconds and placed in polyethylene bags measuring 15 x 30 cm (diameter x length) filled with 50% Carolina Soil® commercial

substrate and 50% washed sand, packed in greenhouse with screen (50%) with micro sprinkler irrigation system, ten times a day at flow rate of 118 liters per hour.

Forty-five days after cutting, the following morphological analyses were performed: percentage of non-rooted live cuttings (EVNE) and rooted cuttings (EE); number of sprouts (NB): healthy sprouts were those larger than one centimeter; length of the largest sprout (CMB) and the largest root (CMR) (mm); fresh (MFR) and dry matter of roots (MSR) (g); as well as fresh (MFPA) and dry matter of shoots (MSPA) (g). For fresh matter, samples were weighed on precision scale (0.01g) and subsequently packed in paper bags and taken to oven with forced air circulation for drying at 65 ° C for 48 hours until reaching constant weight to obtain dry matter.

Data were analyzed using the SISVAR 5.6 software [16]. The normality hypothesis was tested by the Shapiro-Wilk test and analysis of variance was performed by the F test (5% probability) to detect differences among treatments. When significant difference was found for each variable, the Tukey test (5% probability) was performed to compare means.

3. RESULTS AND DISCUSSION

TABLE 1: Number of sprouts (NB), percentage of non-rooted live cuttings (PENE), percentage of rooted cuttings (PEE), length, in centimeters, of the largest sprout (CMB) and the largest root (CMR) and bougainvillea cuttings with different rooting enhancers. UNESP, Dracena - SP, 2019.

SOURCES OF VARIATION	NB	PENE (%)	PEE	CMB	CMR
	Mean Square				
Rooting enhancers	0.9343*	1500.00*	1000.00*	1564.2554*	719.0144NS
CV (%)	39.00	23.57	35.36	42.93	52.74
Rooting enhancers	Means				
Water	2.10 B	60.00±18.71 B[1]	60.00±18.71B[1]	58.92±11.04 AB	55.85±15.57
RADIMAXi 20	3.50 AB	100.00±0.00 A	90.00±10.00A	57.96±6.52 AB	60.28±10.11
Coconut water	3.50 AB	90.00 ±10.00 A	70.00±12.25AB	74.22±11.35 A	79.57±11.25
Tiririca extract	2.90 AB	100.00±0.00 A	90.00±10.00A	54.52±7.71 AB	60.99±11.98
Lentil extract	4.00 A	100.00±0.00 A	90.00±10.00A	38.22±4.32 B	75.78±17.01
General average	3.2	90.00	80.00	56.23	67.32

* Significant and NS not significant by F test at 5% probability. [1] Means with the same capital letter in the column do not differ by the Tukey test at 5% probability.

Table 1 shows that the vast majority of variables analyzed differed statistically from each other, and for variable number of sprouts, it appears that it was higher for bougainvillea cuttings treated with lentil

extract, with average of 4 sprouts per cuttings, almost double in relation to control, which had average of 2.1 shoots per cuttings, thus obtaining the lowest average in relation to the other variables analyzed.

The presence of leaves in semi-hardwood cuttings is essential for the formation of new roots, since the production of carbohydrates by photosynthesis occurs in leaves, in addition to auxins and other substances necessary for rooting [17].

In addition, sprouts are very important since natural auxin is produced in leaves and buds, and naturally moves to the bottom of the plant, increasing its concentration at the base of the cut, along with sugars and other nutritious substances. In many ornamental plants, rooting is maximized by the application of auxins [18].

In variable percentage of non-rooted live cuttings (PENE) and percentage of rooted cuttings (EE), cuttings treated with regulators did not show statistical difference from each other, but presented better results in relation to control, being statistically different from it. Table 1 shows that control presented 60% PENE and the same percentage for PEE, and treatments obtained average percentage between 90% to 100% PENE and 70% to 90% PEE, and treatments consisting of commercial product and lentil and tiririca extracts stood out.

The process of root formation in cuttings may be related to the growth regulator. Indole-acetic substances (IAA), a specific plant regulator for root formation, act on apical stem growth, cell membrane division, cell elongation and formation of adventitious roots in cuttings and other explants [19]. Works with alternative rooting enhancers in the rooting of *Spondias* cuttings observed high leafing levels in cuttings treated with lentil extract [20], presenting superior result in relation to the number of shoots when compared to indul-butyric acid used, concluding that lentil extract resembles synthetic auxin, corroborating data found in the present study.

Table 1 also shows statistical difference among treatments for variable length of the largest sprout (CMB), where cuttings treated with coconut water were those that showed the highest results, with averages of 74.22 cm.

The sprouting of vegetative propagules may be correlated with factors intrinsic to the plant material, such as the concentration of phytohormones and carbohydrates in branches [9]. The capacity to provide carbohydrates necessary for the growth of roots and sprouts is greater in woody or basal cuttings [21]. Therefore, these cuttings present optimal conditions in relation to the energy source used for the maintenance of metabolic activities in the plant.

In addition, coconut water contains mineral salts, myo-inositol and cytokinin (s), as well as nucleotides [22]. It also has micronutrients such as inorganic ions and vitamins, which play a vital role in helping the antioxidant system of cells [23], thus being able to provide nutrients for the development of sprouts.

As for the length of the largest root, the highest values may be related to the higher endogenous concentration of sugars and hormones [24], which may have occurred with the use of coconut water and lentil extract, which despite not statistically differing from the other treatments, presented the highest values.

The development of the root system is due to the accumulation of carbohydrate reserves, correlating rooting and the survival of cuttings, because auxin requires a carbon source for the biosynthesis of nucleic acids and proteins [25].

TABLE 2: Fresh matter (MFPA) and dry matter (MSPA) of shoots and fresh matter (MFR) and dry matter (MSR) of roots, in grams, of bougainvillea cuttings with different rooting enhancers. UNESP, Dracena - SP, 2019.

SOURCES OF VARIATION	MFPA	MSPA	MFR	MSSR
	Mean Square			
Rooting enhancers	0.9739^{NS}	0.0339^{NS}	2.4958^{NS}	0.0222^{NS}
CV (%)	54.92	46.35	104.22	84.35
Rooting enhancers	Means			
Water	1.42±0.37	0.29±0.05	0.19±0.03	0.22±0.13
RADIMAXi 20	1.23±0.17	0.26±0.02	0.99±0.37	0.15±0.03
Coconut water	1.75±0.37	0.34±0.06	1.79±0.60	0.17±0.05
Tiririca extract	1.13±0.16	0.23±0.07	0.33±0.09	0.06±0.01
Lentil extract	0.89±0.09	0.18±0.02	1.01±0.22	0.19±0.05
General Average	1.26	0.26	0.93	0.15

* Significant and ^{NS} not significant by F test at 5% probability. [1]Means with the same capital letter in the column do not differ by the Tukeya test 5% probability.

Regarding the average fresh matter of shoots (MFPA), fresh matter of roots (MFR), dry matter of shoots (MSPA) and dry matter of roots (MSR) of Bougainvillea (*Bougainvillea spectabilis* Willd), no statistical differences among treatments were observed, as shown in Table 2, but it was observed that treatment with coconut water obtained the highest averages, with the exception of fresh matter of roots (MFR), which obtained the second highest average, only behind commercial product.

The stimulatory effect of coconut water can be explained by the high levels of sugars, sugar alcohols, lipids, amino acids, nitrogen compounds, organic acids and enzymes, which perform different functions in plant systems due to their distinctive chemical characteristics [26]. Coconut water, as it is a natural substance with high zeatin levels, may become a component that successfully replaces synthetic zeatin [27]. Zeatin is the main cytokinin found in vegetables, which function is related to cell division [28].

Regarding the *Cyperus rotundus* L extract, even having phytohormone action, it did not present statistical difference in any of varieties analyzed under the conditions of this experiment. *Cyperus rotundus* L has high level of IBA hormone, specific for root formation, being an important hormone for rooting [29].

C. rotundus has high level of indolbutyric acid hormone (IBA), which are plant regulators responsible for root formation [30]. In tubers, they have large amount of IAA, apparently much more than in other herbaceous species.

However, it was found that *C. rotundus* tuber extract did not improve the rooting of *Duranta repens* L. stem cuttings [31]. It was also found that the use of *C. rotundus* leaf and tuber extract does not have significant effects on *C. citriodora* rhizogenesis, corroborating the results in the present study [32].

Thus, under the conditions in which this study was carried out, an improvement in the rooting of Bougainvillea cuttings (*Bougainvillea spectabilis* Willd) was observed, highlighting lentil extract and coconut water treatments as a promising sustainable alternative in the vegetative production of Bougainvillea seedlings.

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Study of the Applicability of the Restriction Theory and the Value Stream Mapping in the Management of Processes of the Legal Practice Nucleus of a Law Faculty in Rondônia, Brazil

Acsa Liliane Carvalho Brito Souza, Prof. Dr. Ricardo Jorge da Cunha Costa Nogueira

Abstract

This article aims to discuss, based on the researcher's observation during the years 2017 to 2019, about the flow of lawsuits from a Legal Practice Nucleus of a law faculty, in the city of Porto Velho, Rondônia, Brazil, highlighting the lawsuits of the family court, because these processes need urgency and usually take time in the elaboration of their pieces. This research will present a study on how the Value Stream Mapping and the Restriction Theory help to decrease or eliminate time losses in the process of this NPJ. For the development, used an analytical literature review methodology on the Restriction Theory and Value Stream Mapping. The research subjects were the agents involved in the activities of the NPJ and the data collected by the participant's observation method.

Keywords: *Value Stream Mapping; Restriction Theory; Legal Practice Nucleus.*

1. Introduction

The development of society and human relations required a system of laws to resolve judicial demands and pacify conflicts in society. Therefore, there is an increase in demands from law firms and law faculty to train new professionals in the area and serve as access to the legal world. For this study, we investigated the NPJ (Legal Practice Nucleus) of a Faculty of Law based in the city of Porto Velho, Rondônia, Brazil, defined here as a law firm that administers free legal consulting services from now on 2 reduced installments, at the beginning of the process of each of those served, based on the guidance of the lawyers who make up the NPJ team.

The institution that is analyzed here has a great flow of services, being precise, for the fulfillment of the purpose of legal education, the service to society and the search for the solution of conflicts in a strategic way and with quality. For this, efficient management must be directly linked to the quality of the services performed and to the awareness of employees in the search for a culture of organization with agility and commitment in the realization of legal services. Thus, this study investigated a law firm, based on the combination between the application of techniques from *Lean Manufacturing* and *Lean Office*.

On the other hand, the *Value Stream Mapping* tool was used to compose this research, considering that this instrument aims to identify improvements in processes and enablesmore agility, eliminating steps that do not add value and generating gain for the entire organization.

Many companies seek strategies to be adopted and this research proposes a model that integrates the Lean

Office and the philosophies of quality management in the management of lawsuits in a Legal Practice Nucleus. In this understanding [1] suggests that the Theory of Restrictions be combined with other approaches, enabling results above the results of traditional models. Based on the application of Restriction Theory and Value Flow Mapping, it is sought to verify the difficulties that generate delays in the development of processes, a fact that can cause financial losses to customers and the loss of rights due to prescription.

In this case, this article was born from observations of the researcher, in the years 2017, 2018 e 2019, on the NPJ process flow of an institution of law, highlighting the processes of the family court, considering that these processes need more urgency and usually take longer in progress. In this research, a study will be elaborated on how the Value Flow Mapping and the Theory of Constraints work to decrease or eliminate the losses of time in the course of family processes filed by the NPJ of a law faculty in Porto Velho, Rondônia, Brazil.

1.1 General objective

Proposed improvement of critical processes, from Lean Offfice and VSM, in the judicialization of family court cases at the NPJ of a law school in Porto Velho, Rondônia, Brazil.

1.2 Specific objectives

- Mapping the Current Value Flow of Family Court Cases at the NPJ of a law school in Porto Velho, Rondônia, Brazil;
- Identify factors that affect the performance of the lawsuit;
- Propose improvements in the processing of judicial lawsuits.

2. Theoretical Reference

2.1 From Lean Manufacturing to Lean Office

The term "Lean Thinking", defined by John Krafcik, originates from the revolutionary oriental system [2] and is based on the continuous effort starting from the change in mentality, structure and behavior [3], coming from the strategic level and expanded and spread to the operational level [4].

Lean Thinking is a process that aims to eliminate waste, as a means of optimizing results through simple procedures, having five principles [5]: (i) value; (ii) value flow; (iii) continuous flow; (iv) pulled production; (v) perfection.The Lean Production model was born from the Toyota Production System, in Japan, in a post-war period when there was a great need to rebuild the industry and resources were extremely scarce [6].

The creators of lean thinking were Taiichi Ohno and Eiji Toyota and they wanted to solve problems associated with the reduced availability of resources, putting ideas into practice and creating a new vision based on three factors: people, processes and solutions [7]. TPS is a concept that has been adapted from the practices adopted by Toyota's production system with the objective of producing quality goods that meet customer expectations at the lowest possible cost [8].

These methodologies were closely followed for years by James P.Womack and Daniel T. and reported in

the 90's in two works "The Machine that Changed the World" and "Lean Thinking". The objective is to reduce waste, have higher quality products and reduce delivery time to the customer, from this concept of producing more with less and less, the system is now called Lean Manufacturing [9].

The tools and philosophy of Lean Manufacturing can be applied in several branches, not being limited to manufacturing environments [3]; [10] being expanded to several areas and productive environments, being one of them the administrative [11]; [12]. With the intensification of lean practices in the industrial environment, applications of lean thinking were later developed in other areas of knowledge, such as lean healthy and lean office.

Lean Office has as main objective the use of lean tools to eliminate work or processes from administrative areas that do not add value, that is, waste [13]. Thus, the creation of the idea of "Lean Office", within Production Engineering, returning to the administrative sector of the process, is focused on reducing or eliminating waste related to information and process flows, generating and adding value to it [14].

2.2 Theory of Constraints - TOC

The Restriction Theory created by Israeli physicist Eliyahu M. Goldratt, and defined as a continuous improvement process, began to be incubated in the 1970s, when he developed software for plant production planning [15].

Already in the 80's, with the experiences accumulated by the implementation of the software since its creation, Goldratt develops the Theory of Restrictions that then happens to be a new philosophy of global management, as Just-in-Time and the Total Quality Management [16].

The basis of the reasoning of the Theory of Constraints (TOC) is in the concepts of cause and effect and the relation of interdependence of the elements of a system, where each element of the system depends on each other in some way, and that, the overall performance is intrinsically related to the performance of the set as a whole and not to the individual and isolated performance of each part of the system, thus discarding the optimal site [16]

This theory presents solutions to the problems faced by organizations, regarding the achievement of their objectives. It deals with the identification of constraints (bottlenecks) of systems with the aim of optimizing processes at these points and thus maximizing their performance [17]. Bottlenecks are considered to be restrictive resources, that is, those that limit production capacity and those that do not have a capacity greater than demand, so there should be a flow balance, the resources must not be tied to the bottlenecks so that there is no accumulation of stocks [18].

In the TOC provides a coherent management theory for the execution of an organization's objectives. Restriction Theory has two main components: the philosophy that supports the principle of continuous functioning and improvement, and a generic approach to research, analysis, and the creation of solutions to problems [19].

Every tangible system, such as a service-providing organisation, must have at least one restriction. Such an idea, [20] "is explained by the fact that if there was something that limited the performance of the system, it would be infinite, since nothing would prevent the system from constantly evolving its performance in relation to the goal". Following this reasoning, the process of continuous optimization of the theory of constraints was created, whose orientation is the global goal of the organization and is composed of five

steps, as shown in Figure 1.

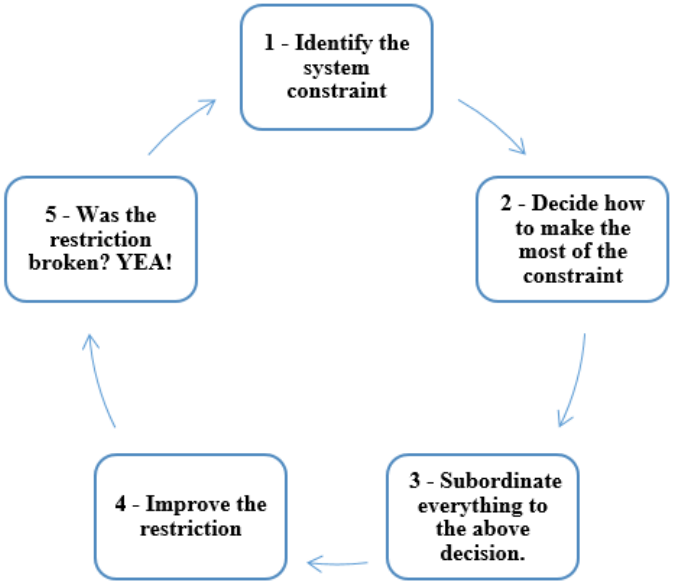

Figure 1. Identification of difficulties [20].

Within the Theory of Constraints for a company to achieve a satisfactory form, its goal is necessary for the development of three performance measures, explored by Goldratt. Performance measures are [21]:

- Gain (G) - In the theory of restrictions, the moment of recognition corresponds to the moment of delivery of the final product to the customer;
- Investment or inventory (I) - This concept covers the classic concept of inventory and other fixed assets. The value assigned to the inventory corresponds only to the amounts that were paid to suppliers for the items characterized as inventory. In this model, the finished product inventory is valued only by the raw material cost paid by the supplier.
- Operating expenses (DO) - Make a practical point of view, or consider the model of all expenses with something that cannot be saved for future use that is part of the operating expenses. In addition to these values, incorporate a depreciated operating value of assets that is part of the inventory and is used or used in the period (such as a depreciation of machinery).

2.2 Value Stream Mapping - MFV

Lean manufacturing has several tools used to eliminate the waste found in the production process. Among the several existing tools to assist the development of the theory will be highlighted the Value Flow Map since it is the most relevant for the present research.

The value flow mapping (MFV) is defined as follows: The Value Flow Map (MFV) is a tool that consists in identifying all actions/information; that can add value or not in the chain, necessary for the product flow or product line; the flow of production, from raw material to consumer and/or product design flow, from design to launch [22].

Thinking like this "considering the perspective of the flow of value means taking into account the broader picture, not only the individual processes, improving the whole and not only optimizing the parts" [23]. According [4], the value flow is any action that, adding value or not, is necessary to pass a product or

information from the state of concept to the state of product or activity completed. It is a simple tool and requires only to follow the production path from start to finish, drawing, in detail, the map of each process in the flow of material and information.

Also according to [13] Value Flow Management is a process for planning and associating initiatives through systematic data capture and analysis. This process comes from study, research and experience. In this sense, the authors say that in managing the flow of value, it is desired that the work units flow to consumers as smoothly as possible. But this ideal situation rarely exists. Usually there are pronounced curves or constraints in the process that prevent a smooth flow. Lean uses the appropriate tools necessary to make the work flow as smoothly as possible.

Therefore, MFV consists of a tool that designs all the processes through which the products pass "capturing the relevant information for their understanding. Thus, a systemic view of the process is obtained, admitting the improvements that affect the flow" [24].

There are a more comprehensive view of MFV claiming to be "a business modeling process" [25], which serves as a master plan of changes and allows the identification of improvement points, assisting in the process of consensus among the participants of a work team, to define the priority waste that will be aligned with the company's strategy [26].

According to [23], value flow mapping (MFV) is an essential tool for visualizing the entire system, which evidences value flow. In this sense, the value flow maps are drawn at different times, aiming to signal the opportunities for improvement of the current state, projecting the future state and the ideal state. It is important to begin the analysis by the final shipment and then by the previous processes, because the final processes are the ones that are closest to consumers [27].

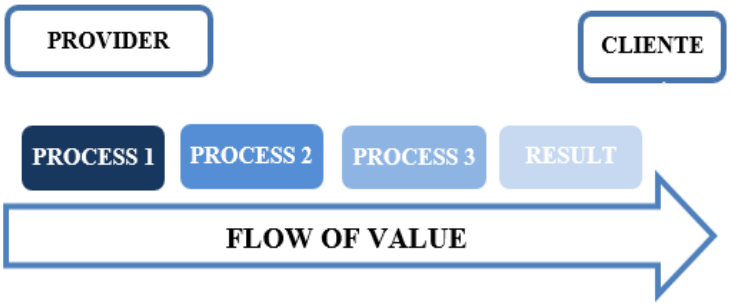

Figure 2. Understanding the Flow [13].

[13] point out the main advantages, among others, of mapping the value flow: - helps to visualize more than individual processes, helps to identify waste and its sources, provides a common language for handling, manufacturing processes, facilitates decision making about the flow, bring lean concepts and techniques closer together, helping to avoid the implementation of isolated tools, form a basis for the Lean Mentality implementation plan, it presents the relationship between the flow of information and the flow of material, it is a qualitative tool that describes, in detail, the way for the production unit to operate in flow.

The MFV tool is essential to visualize the system and for its result to be satisfactory, it is necessary to follow some steps "select the product family; determine the flow manager; draw current and future states;

and plan and implement the action plan" [28].

As the MFV is also a tool for communication, planning and management of change processes, in the understanding of [13], mapping is a language, and like any new language, the best way to learn is to practice it, the which will allow organizations to visualize their waste by seeing how variables related to stocks, demand, cycle times, takt time (time available for production divided by market demand) are among those variables at that very moment. Taking into account the entire value chain, the value flow must be analyzed following the total path, from the raw material to the finished product [26].

The MFV also allows for the mapping of the administrative area in the organization and the entire supply chain. According to [24] "the mapping process includes steps such as the identification of the product family; the design of the current state, the future state, the work plan and the implementation."

3. Methodology

When carrying out a survey, the methodological trajectory and the classification of appropriate techniques for solving the investigated problem should be taken into consideration [29]. It is then necessary to demonstrate the methods that guided the development of the study in focus, taking into account the nature, objective, approach and procedures used in the construction of the research.

At this stage, the method used in the research had as main proposal to associate the Study of the Applicability of the OCD and the Mapping of Value Flow in the Process Management of the NPJ Family Court of a Faculty of Law of Porto Velho, Rondônia State.

The research sought to identify the most critical processes, i.e., the types of processes that take the longest, from entry into the NPJ to protocol in legal systems, as can be seen, the object of the research is quite broad. In view of this, we have proposed that only cases in the "family stick" category be addressed in this article, as they present greater urgency and demand.

For this study, the analytical review of the literature was used as methodological support, based on the identification, filtering, selection, reading, analysis and organization by topics related to the Theory of Constraints and Value Flow Mapping.

The research subjects were the agents involved in the activity, which are secretary, coordinator and lawyers of the entity and, additionally, the research data were collected through the participant's abstervation method. Thus, the procedures of this survey were carried out according to the steps described in Table 1.

Table 1. Research Steps

STEPS	OBJECTIVE	APPROACH	PROCEDURE	COLLECT
1st Exploratory	Develop a flowchart for processing family court cases.	Qualitative	Bibliographic and Documentary	Observation of Participant
2nd Description	Map the process through the MFV tool and propose improvements.	Quantitative	VSM e TOC	Quantify the times of the process of judicialization of demands based on data from documentary research.

Synthesis of the methodology. Prepared by the author (2020).

4. Results

With regard to the initial purpose of the research, the need to carry out a preliminary diagnosis of the activity to be studied was highlighted, given the purpose of proposing improvements to the processing of family area proceedings with the NPJ of a Faculty of Law, aiming, thus, greater speed in serving the jurisdiction. The first step was to choose the critical processes to be researched, as shown in Figure 4.

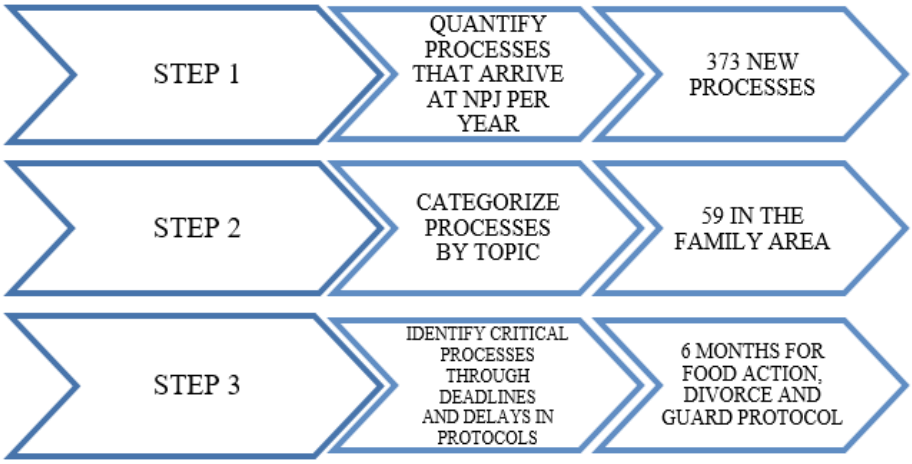

Figure 4. Critical Process Definition Steps. Elaborated by the authors (2020)

As illustrated in figure 4, step 1 included quantifying all new cases, received at the Legal Practice Centre, in the years 2017, 2018 and 2019. In step 2, these 373 (three hundred and fifty-two) cases were categorized by subject. These categories were defined by the researcher in consensus with the employees who work directly with the processing of these processes. Therefore, when analyzing the received demands, five categories were created, defined based on the content of the documents received: Consumer, Family, Civil, Labor and Social Security.

After the definition of the categories, each process was distributed among them, according to the subject approached, reaching the conclusion that the category "Family" was the one that presented the greatest urgency in the solution, when the three years were counted, with 59 (fifty nine) processes. Based on these data, this category was chosen to be worked on in this article, as it represents the most delicate subject that needs special attention, since it deals with minors in search of assistance, including their own subsistence.

The next step was to identify the critical processes, illustrated by step 3. To this end, the responses of the 59 (fifty-nine) cases in the chosen category were analyzed per year, identifying the period that most repeats each year was 6 (six) months / 180 (days), from the entry of the case in the NPJ to the Protocol of Action.

Following the analysis of the data, in order to begin the mapping of the current state, of the 59 (fifty-nine) cases that presented the critical period of 180 (one hundred and eighty) days for protocol, in step 4 the researcher gathered all the cases that dealt with the "family" issue, to analyze and develop the flow of the NPJ, the receipt of the documents, preparation of the petition and the Protocol of the Action, with the respective information, prepared the flowchart of this process. According to [14] this flowchart elaboration consists of a momentary image of how information travels through the functions of the mapped

environment.

They emphasize the importance of the flowchart being elaborated in a way that can be modified, since the organization tends to be in constant change, being necessary the updating of the referred flowchart.

The authors also call attention to the practice of analyzing and improving information flows, since this is strictly linked to lean principles, since it facilitates the identification of bottlenecks through its representation.

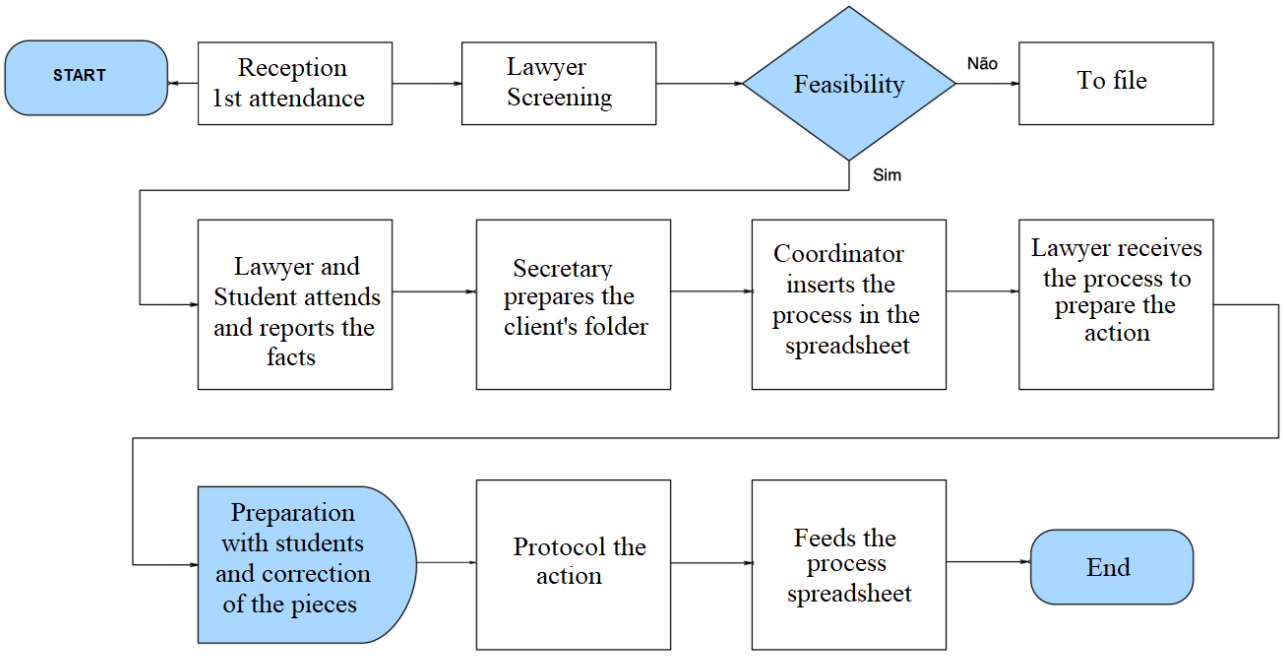

Figure 5. Flowchart of the Current State. Elaborated by the authors (2020).

With the elaboration of the flowchart, one has an idea of the process, since the practice of analyzing and improving information flows is purely linked to lean principles, since it encourages the identification of problems in the sequence of activities, their improvement and the elimination of the difficulties of relationship between sectors. Based on the flowchart of Figure 6 and the information collected in the spreadsheets and documents, it was possible to draw the Current State Value Stream Mapping (VSM).

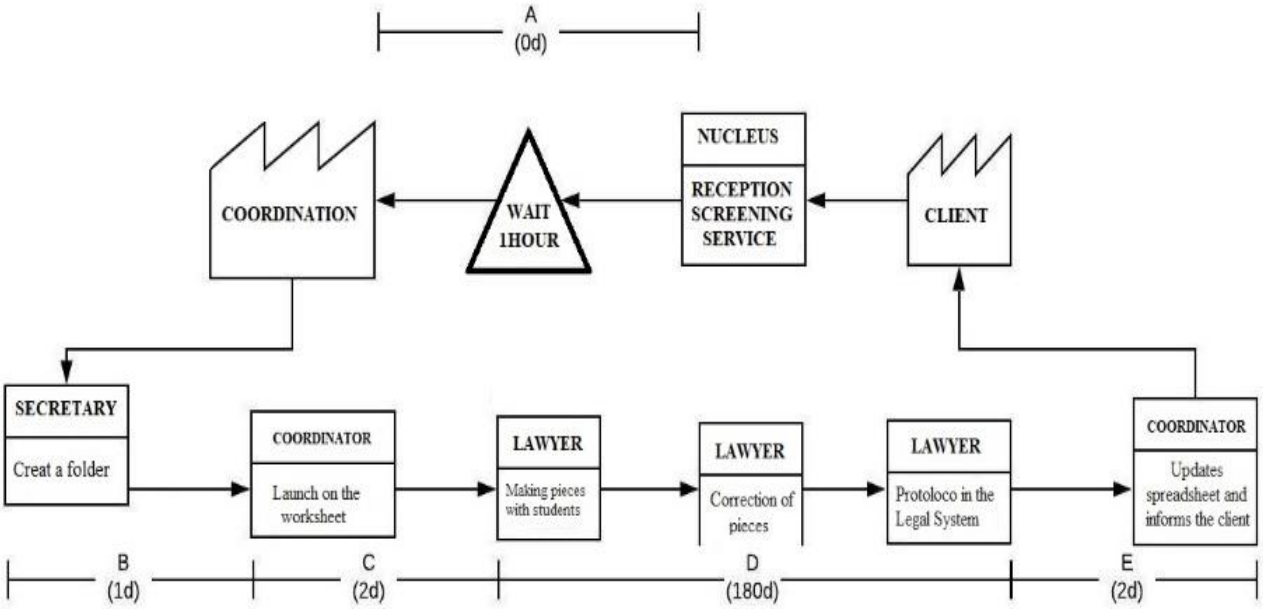

Figure 6. Mapping the Current State Value stream. Elaborated by the authors (2020)

Figure 6 presented the Value Flow Mapping of the Current State of the Process. Due to the impossibility of quantifying in minutes/hours each activity, it was necessary for the researcher to name them by letters to later compare each step of the process in the collected through the observation and physical analysis of demand. The mapping was initiated when the client, the jurisdiction, which are the people of the community, go in search of free legal assistance and seek the NPJ daily.

At the first moment, the reception and analysis of the feasibility of the action and the service is carried out, which lasts on average one (1) hour. If the action has viability, after the initial service, the documentation is forwarded to the NPJ coordination, where the secretary receives the documents and formalizes the client's folder, this stage lasts one (1) day.

After the folder is created, the process/action is forwarded to the coordinator, who includes the information in a control sheet, being the following data: name of client, date of entry and lawyer responsible and subject. It is an internal control spreadsheet, in excel format, since in NPJ, it does not have a specialized management system for internal monitoring of processes. The coordinator takes on average 2 (two) days to include it in the spreadsheet and deliver it to the lawyer.

After that, the case is handed over to the responsible lawyer, who receives the documentation and, together with the students, starts to prepare the initial petition. It is important to emphasize that the unit of analysis, is an extension of the law course, therefore, the purpose of the NPJ and bring knowledge to academics, therefore, all documents relating to the lawsuit to be filed, which are processed on site, must be submitted to analysis, in order to provide qualification in the legal field and a familiarization with the various types of lawsuits.

After the students work and analyze the documents of the lawsuit, they are returned to the lawyers, who now have the function of making the respective corrections. Once the corrections are made by the lawyer, they are filed in the judicial systems. The cycle time of this "D" process, according to the mapping of figure

6, was 180 (one hundred and eighty) days.

The major bottleneck is in the processing of case "D," which, according to the documents and to the spreadsheets analyzed, there is no internal system to control the entry and exit of legal claims, and division by priorities, so that the order of arrival and urgencies are not observed, and the same are recorded at random.

During the research some critical situations were found, especially with regard to the use of the proper management system, where those involved in the process do not have control of priorities and seniority of the demands, most of the manual processing, causing this processing not to be registered, by the absence of a system and still running the risk of the action documents being lost, making it difficult to locate them, or be forgotten.

Another problem identified was the inexistence of an internal regulation about the procedural proceeding with the NPJ, which could establish a reasonable period for the proceeding, thus avoiding the loss of deadlines and even the loss of the right.

In this sense, based on the analysis of the data gathered at the NPJ and with the application of Lean Office tools associated with VSM and TOC, it is suggested: - Updating of the organizational structure and internal rules that provide for internal procedural procedures, with stipulation of deadlines; - Implementation of a process control and management system, to categorize the processes, and signal that it is a demand with urgency, including the pre-determined deadline, automatically generating the deadline for action protocol. - Creation of reports where it is possible to visualize the demands with due date, in chronological order.

5. Conclusion

Through the analysis carried out, it was possible to identify some models of Lean Office practices, in which it was noticed the existence of significant changes in the applied environments, also identifying that the application of dry practices, are strongly allied in reducing the delays in the processing of cases, including in legal offices and similar. This gain is not exclusive to manufacturing, as [13] well explain in the work "Lean Office: management of the flow of value to administrative areas".

The Lean Office philosophy is a great ally of the manager, independent of the area of application, in particular regarding the elimination of various types of waste through the Value Flow Mapping tool, since it allows the visualization of bottlenecks throughout the process, be they of services or manufacturing, which according to [14] has the objective of organizing the work environment, seeking the elimination of unnecessary costs, taking into account that a well-managed information flow therefore serves as a support for proper decision-making.

In the progress of the research, some limitations were found, the need for a change of organizational culture and behaviors, which with the help of the Lean Office philosophy, through the tool Mapping of the Flow of Value and the Theory of Restrictions, it is possible to implement the lean mindset in the institution and make use of all the benefits and gains it will bring.

The study suggests for future research that the Nucleus of Legal Practice can use it in the effective implementation of the leaning mentality by mapping the flow of value, which can be implemented gradually, without time pressure, according to the response of those involved in the process.

As a suggestion, the improvements indicated should be implemented, such as the updating of the organizational structure and internal rules that provide for internal procedural procedures, with stipulation of deadlines, implementation of a system of process control and management, to categorize the processes, and to signal that it is a demand with urgency, including the predetermined deadline, automatically generating the deadline for the protocol of the action and the creation of reports where it is possible to visualize the demand with term to overcome, in chronological order, ensuring agile, loss-free processing, transparent and with online management.

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Starch-Based Biofilm Associated with Refrigeration in The Post-Harvest Conservation Of 'Prata' Banana

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ABSTRACT

Since it is a climacteric fruit, banana can be harvested still green, but in a state of complete physiological development, and due to the high release of ethylene, it needs appropriate post-harvest conservation to increase its conservation, and for that, coating with starch-based biofilm becomes an alternative. Thus, the aim of this study was to verify the effects of corn starch biofilm and refrigeration on 'Prata' banana fruits in order to develop an accessible and more sustainable technology in the conservation and protection of fruits. Bananas from the 'Prata' subgroup were used, submitted to refrigeration and / or coating with corn starch biofilm and evaluated in three post-harvest periods. The design was completely randomized in a 4x3 factorial scheme, with nine replicates. It could be concluded that low temperature provided by refrigeration is able to delay the ripening process of 'Prata' banana, preserving its measurable characteristics. Biofilm is capable of providing protection, less water loss, consequently preserving measurable characteristics, such as refrigeration; however, with the advantage of allowing fruits to ripen, resulting in better consumption properties.

Keywords: *Musa* spp, edible coatings, post-harvest conservation

1. INTRODUCTION

Banana, *Musa* sp. L, is a fruit species belonging to the Musaceae family, widely cultivated in all regions of the world with tropical climate, being one of the most popular fruits in the world [1].

Brazilian production reached values of 449,284 ha of total harvested area, with production of 6,752,171 t and average yield of 15.03 t ha^{-1}, being produced mainly in the States of São Paulo, Bahia and Minas Gerais, remaining in second place in terms of volume of fruit marketed in the national market and placing the country in fourth place in terms of world production [2].

The evolution of the culture led to the emergence of a wide range of varieties. In the beginning, the Brazilian banana activity had only two varieties, 'Branca' and 'Pacovan' [3]. From these varieties, new varieties originated by natural mutation. 'Branca' variety originated all varieties of the 'Prata' subgroup, directly, as in the case of 'Prata', 'Prata-Anã' and 'SCS451 Catarina', or indirectly, as in the case of 'Pacovan' and 'Prata-Gorutuba' [4], with 'Prata' subgroup representing 24% of world banana production [5].

However, banana is a climacteric fruit and its ripening process is greatly influenced by the presence of ethylene, and this physiological characteristic leads to rapid ripening and short post-harvest life [6].

Thus, in view of the high perishability of climacteric fruits and post-harvest losses, it is necessary to develop appropriate techniques that maintain quality and extend the shelf life of fruits [7]. The refrigeration technique (10ºC) is among them, which is directly related to the physiological and metabolic processes of fruits, where low temperature allows the delay of the ripening and senescence process, preserving the product with characteristics desirable by consumers [8].

Another method to increase the post-harvest life of vegetables is the use of edible coatings, defined as a thin layer of edible material deposited on foods as a coating [9], among them biological films, which can be used for the same purpose as wax, since they protect fruits and can still be consumed or washed off [10].

In this sense, storage technologies have profound effects, with marked consequences on composition and general flavor of foods and, therefore, on commercial life and consumer acceptance [11].

Thus, the present study aimed to verify the effects of corn starch biofilm and refrigeration on 'Prata' banana fruits in order to develop an accessible and more sustainable technology in the conservation and protection of fruits.

2. MATERIAL AND METHODS

The experiment was conducted at the Faculty of Agricultural and Technological Sciences, FCAT / UNESP, Campus of Dracena, using ‘Prata’ banana fruits acquired from a commercial production area located in the municipality of Dracena - SP, whose geographical coordinates are 21 ° 28 '57 ”S and 51 ° 31'58” W and average 421 m a.s.l., with regional climate of Subtropical Cwa type (mild and dry winters, followed by very hot summers), and average annual temperature of 23.6 ° C [12].

Fruits were harvested considering the point of harvest when they were still green, but in the stage of physiological development, characterized by the disappearance of corners [13], being submitted to superficial disinfestation with 70% alcohol and 2% sodium hypochlorite solution.

Biofilm was produced from the solubilization of corn starch in deionized water at proportion of 3% (weight / volume) by heating to 70°C under constant agitation until gelatinous consistency was obtained.

After natural cooling, fruits were submerged in the biofilm until complete coverage for uniform coating, followed by vertical conditioning of fruits for draining and drying.

The experiment design was completely randomized, totaling four treatments: control (fruits without coating or refrigeration), biofilm (fruits coated and kept at room temperature 25°C), refrigeration (fruits without

coating kept in BOD chamber at 10ºC) and, finally, biofilm with refrigeration (fruits coated and kept in BOD chamber at 10ºC). Each treatment consisted of nine fruits, each fruit being considered a replicate, which were divided into three subplots for periodic evaluations in three periods (0, 7 and 14 days after harvest), totaling 36 fruits.

The evaluated characteristics of fruits were: mass, in grams (using scale with accuracy of 1 g), length, in centimeters (measured with the aid of graduated ruler), diameter, in millimeters (measured with the aid of digital caliper), soluble solids (using portable refractometer, with values obtained in ºBrix) and sensory evaluation carried out in the last two evaluation periods (evaluation given by scores from 1 to 5, where 1 was considered very poor and 5 was excellent according to taste). Results obtained were submitted to analysis of variance using the SISVAR software [14], in order to verify the statistical significance among the different values. Post-hoc analyses were performed with the Tukey test at 5% probability.

3. RESULTS AND DISCUSSION

The superficial appearance of fruits treated with biofilm was visually similar to untreated fruits, that is, they did not appear to present covering of the vegetable tissue, thus not interfering in the product presentation.

From analyses performed, it could be observed that there was no variation in the content of soluble solids among fruits on day 0, indicating that fruits were in maturation stage similar to the beginning of the experimental period, which was expected due to the selection of fruits with similar physical characteristics in order not to influence the results over time.

The content of soluble solids is a great indicator of fruit ripeness, which indicates the greatest sweetness for consumption. Table 1 shows the results for control (without biofilm and without refrigeration) and for fruits with biofilm stored at 25°C at 7 and 14 days after the beginning of the experiment, and the superiority of values, not differing from each other, comparing each study period. The same was observed for fruits without biofilm stored at 10 ° C and with biofilm plus refrigeration, that is, they also did not differ from each other in the different study periods.

Regarding the content of soluble solids, it is worth mentioning that fruits kept in refrigerator at 10 ° C and with biofilm plus refrigerator, °Brix did not differ statistically over time, starting from 6.3 to 7.6 ° Brix and 6.3 to 8.3 °Brix, respectively, differing from control, which started with 6.3; 19.6 and 19 ° Brix, respectively at periods of 0, 7 and 14 days after the beginning of the experiment.

In climacteric fruits such as banana, the increase in °Brix over time is normal, especially if there are no ripening inhibitors or delayers in this process. When still green, it has high starch content, which undergoes hydrolysis in the post-harvest period, being the precursors of sugars [15], promoting fruit ripening. These authors found 24.38 °Brix for 'Prata' banana on the 10th day after harvest, which remained constant until

the 14th day after harvest. Although this value is higher than that found in the present study, these authors reported that minimum values from 19.72 to 22.36 °Brix have already been reported by other authors.

TABLE 1: Content of soluble solids (° Brix) of 'Prata' banana according to treatments and evaluation periods after treatments. Dracena, 2019.

TREATMENTS	EVALUATION PERIODS (DAYS)		
	0	7	14
Control	6.3 Ba[1]	19.6 Aa	19 Aa
Biofilm	6.3 Ca	21.6 Aa	16 Ba
Refrigerator (10°C)	6.3 Aa	5.6Ab	7.6Ab
Biofilm + Refrigerator (10°C)	6.3 Aa	5Ab	8.3 Ab
CV (%)[2]	18.1		

[1] Values followed by the same uppercase letter in the row and lowercase in the column do not differ statistically from each other by the Tukey Test at 5% probability. [2]CV (%): coefficient of variation.

Temperate fruit crops are commonly stored at temperatures close to freezing (0–1 ° C), while those of tropical or subtropical origin should be kept at higher storage temperatures (7–15°C) to avoid losses due to the development of cold injuries [11].

Changes induced by low temperatures in a biological system are positive in terms of shelf life, as it slows down the general metabolism and reduces changes in composition and, consequently, the respiration rate [16], which is directly related to ethylene synthesis.

Ethylene is a gaseous hormone involved in plant growth and development, including abscission, leaf senescence, seed germination, organogenesis and ripening [17] [18].

As a general effect, low-temperature storage positively regulates stress-responsive genes, affects primary and secondary metabolism and blocks signal transduction of ethylene-related processes [19] [20]. Thus, differences presented in the content of soluble solids of fruits stored at room temperature and under refrigeration can be explained by the lower ethylene production rate and consequent lower rate of conversion of starch into soluble sugars.

Treatment with biofilm presented the highest values at 7 days of evaluation (21.6), followed by a significant decrease, reaching mean value of 16 °Brix on the 14th day of storage (Table 1), which can be attributed to fruit senescence [21].

In addition, reductions in total soluble solids may be due to the increase in the water content during storage, changing the proportion of solids in the total mass, or be related to the consumption of part of the substrate by microorganisms [22].

Significant reduction in the content of reducing sugars for all treatments was found when the storage of powdered prickly pear packaged in laminated packages under different temperatures and relative humidity [23]. And significant increase in the content of reducing sugars was also found when storing osmotically dried jackfruit slices in sucrose syrup with different contents of soluble solids (35, 40, 45 and 50 ° Brix) packed in high-density polyethylene plastic packages in ambient conditions for 240 days [24].

Regarding length, diameter and mass data, influence of evaluation periods was observed, thus, it could be observed that all parameters decreased their values with advancing fruit storage period (Table 2).

For variable length, regardless of treatment, value observed at 7 days (17.45 cm) did not differ from that of day 0 (17.85 cm), but there was a reduction at 14 days (16.51 cm), showing a subtle and gradual reduction (Table 2).

Regarding diameter, no significant difference was observed between fruits evaluated at 7 (39.87 mm) and 14 days (38.21 mm), both being statistically different from the value observed at the beginning of the experiment (42.32 mm) (Table 2).

For mass, all values observed were significantly different from each other, with the highest value obtained at the beginning of the experiment (167.00g) and the lowest at 14 days (134.25g), probably indicating water loss due to transpiration and dry mass consumption.

TABLE 2: Influence of the evaluation period on length, diameter and mass of "Prata" banana fruits submitted to different treatments. Dracena, 2019.

PERIOD	LENGTH (cm)	DIAMETER (mm)	MASS (G)
0	17.85 a[1]	42.32 a	167.00 a
7	17.45 ab	39.87 b	147.83 b
14	16.51 b	38.21 b	134.25 c
CV (%)[2]	5.82	4.65	8.37

[1] Values followed by the same lower case letter in the column do not differ statistically by the Tukey Test at 5% probability.

[2]CV (%): coefficient of variation.

Among treatments, the only variable that showed statistical difference was mass, and control differed from the other treatments, showing the lowest value (132.6g), indicating greater mass loss, as shown in Table 3.

Fruits coated with biofilm and kept at room temperature did not differ statistically from fruits kept under refrigeration, showing higher mass value (159.4 g), indicating that despite temperature, biofilm was able to create a protection in relation to water loss due to transpiration.

TABLE 3: Influence of treatments on the mass of "Prata" banana. Dracena, 2019.

TREATAMENT	MASS (G)
Control	132.6 b[1]
Biofilm	159.4 a
Refrigerator (10°C)	151.5 a
Biofilm + Refrigerator (10°C)	155.1 a
CV (%)[2]	8.37

[1] Values followed by the same lower case letter in the column do not differ statistically by the Tukey Test at 5% probability.

[2]CV (%): coefficient of variation.

In experiment with tomato fruits using 2 and 3% cassava starch coating, was observed that treatments did not significantly influence mass loss [25]. However, in experiment with guava fruits treated with 2% cassava starch films stored at room temperature (19.5-27ºC), and it was obtained mass loss of 18.93% compared to 27.60% of control on the 11th day of storage [26].

Water from plant tissue is the source of oxygen and hydrogen in organic biomatter [27]. As in other plant organs, fruit epidermis plays an important role in the gas exchange between product and environment, allowing fruits to maintain high water content, despite the low relative air humidity around the product. This protection against dehydration is particularly important after harvest, when fruits will no longer receive water from the plant [28].

Thus, the higher moisture content of treatment with coating may indicate that the film would be preventing marked moisture loss, acting as an "extra" epidermis in fruits. Another hypothesis would be the fact that films can retain part of the existing moisture in the environment, since they are hydrophilic [9].

Table 4 presents the results regarding taste sensory analysis. It is observed that the fruits treated with biofilm and evaluated at 7 days were considered the best, obtaining the highest score (5) and differing from all treatments and evaluation periods, indicating that biofilm at 7 days of storage at room temperature, in addition to replacing refrigeration in the mass preservation, also presented the best flavor, mainly due to the higher °Brix observed (Table 1), enabling the physiological changes caused by ethylene, without fruit degradation.

TABLE 4: Scores of the taste sensory analysis of "Prata" banana according to treatments and evaluation periods.

TREATAMENT	EVALUATION PERIODS (DAYS)	
	7	14
Control	2.5 Bb[1]	3.2 Aa
Biofilm	5.0 Aa	2Bb
Refrigerator (10°C)	1.2 Bc	2Ab
Biofilm + Refrigerator (10°C)	1.0Bc	3 Aa
CV (%)[2]	12.25	

[1] Values followed by the same uppercase letter in the row and lowercase in the column do not differ statistically by the Tukey Test at 5% probability. [2]CV (%): coefficient of variation.

Thus, it could be concluded that the low temperature provided by refrigeration is able to delay the ripening process of 'Prata' banana, preserving its measurable characteristics. Biofilm is capable of providing protection, reducing water loss and, consequently, conserving its measurable characteristics, such as refrigeration; however, with the advantage of allowing fruits to ripen, resulting in better consumption properties.

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Marijuana Purchase Intentions on A Scenario of Possible Legalization in Brazil

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ABSTRACT

This article aims to evaluate the effects of the potential legalization of marijuana in the intention to purchase, in case of approval of Bill 7.270/2014, which authorizes the production and commercialization of marijuana derivatives in Brazil. The data from this exploratory research were collected from the application of two questionnaires, built in Google Docs. A total of 217 responses from non-marijuana users and 118 marijuana users. The data analysis method used was the content analysis with application of categorial analysis. The results indicated two categories of discourse and seven subcategories. One of the categories was denominated of Favor of the consumption, having the subcategories: public security; consumption already exists; government control; medicinal use; market, labor and tax. The other category was denominated against legalization with two subcategories: drug is always drug and government structure.

Keywords: Legalization. Marijuana. Intention to purchase. Users. Decriminalization.

1 INTRODUCTION

The legalization of recreational use of marijuana and its derivatives, as well as the decriminalization of its users, have been topics that have been widely discussed in recent years around the world, whether in the academic or political segments. Thus, countries such as the Netherlands, Czech Republic, Switzerland, Spain, Canada, Iran, the United States and Uruguay are cited as examples to guide debates in various sectors of the economy, government and society, when associated with commercialization and use of Cannabis.

Recently in Brazil, following the discussions in other countries, the debate on the use of marijuana has taken a different course due to the protocolization of Bill 7.270/2014, held on March 19, 2014, by Federal Deputy Jean Wyllys, which has as one of its objectives to regulate the production and commercialization of marijuana and its derivatives, making Cannabis a licit drug with a regulation and restrictions similar to those of alcohol and tobacco.

The regulatory nature of Bill 7.270/2014 makes room for further discussions of how marijuana marketing would be, as new legal prospects for acquisition would be possible and could influence the intention of users and non-users. Thus, when considering the possibility of a lawful marketing, this article seeks to evaluate the effects of a possible legalization of marijuana in the intention to purchase users and non-users.

The stated objective is justified by the low incidence of scientific studies in Brazil that discuss the commercialization of cannabis and its derivatives when related to the market aspects, mainly regarding the

behavior of the existing consumers and the potential ones. Commonly, the points most treated in Brazilian scientific studies refer to health and public safety, which shows the presence of a gap to be explored in the field of marketing.

2 LITERATURE REVISION

This section presents two topics. The first, of an empirical nature, explores the Brazilian commercial aspects of marijuana associated of Bill 7.270/2014, as well as some consumer-related research. The second section, of a theoretical nature, deals with the concept of purchase intention.

2.1 Marketing marijuana in Brazil

Brazil, although permeated by a culture of criminalization of marijuana users, also follows discussions about the release of its use. In 2014, federal deputy Jean Wyllys signed the Bill7.270/2014 defending the use, production and marketing for recreational and therapeutic purposes of the plant in Brazil.

The Bill considers that simply prohibiting the sale of marijuana increases crime and violence. The intention of the project is to regulate as a legal drug to marijuana, as well as to establish rules of planting, cultivation and consumption, to encourage studies that aim to reap benefits in medicine through Cannabis and to adopt campaigns of social reintegration to chemical dependents (Bill 7270/2014. 20, p. 13).

The Bill is very broad and detailed. It restricts and controls the producers, distributors and users, beginning with the cultivation of Medicinal Cannabis, which may be in all Brazilian territory, provided they obey the rules stipulated by the PL, such as the non-genetic modification of the plant. The distribution and consumption will also be ordered according to the law and other illicit drugs will continue to be treated in the same way, however, users will have a more relaxed sentence, with more incentive to social reinsertion.

Article 38 of the draft Law 7,270/2014 in its second paragraph still explains the amount of plants that a person can maintain without being considered a producer:

> § 2º Unless proven otherwise in the sense that the agent is dedicated to the market, it is assumed that the seeding, cultivation and harvesting of up to twelve forage plants for the preparation of delictive drugs should be used personally.

The justification of the bill describes that marijuana use and trade in Brazil are without control. Trafficking matters, manipulates with other components and sells this and other drugs, while the government can do nothing to stop this illegal trade and thus increases crime and the involvement of young people of disadvantaged classes in the underworld.

Carvalho (2014) indicates several important data regarding the purchase intent of Brazilians. With a survey that collected information from 3,007 adult people throughout the national territory that were willing to answer questions about the decriminalization of marijuana in the country, it was observed that 74% of respondents do not consider that the theme is well Discussed. In another topic, 45% stated that they would not like to receive information on the topic.

The interesting research of Carvalho (2014) is the last part of the interview: When you question people if Cannabis were legalized in Brazil they would buy, 91% claim they would not buy. Then, it is

asked whether the use would increase if marijuana was decriminalized, and the answer was 54.8% that it totally agrees that consumption would increase against 14.9% that disagrees, believing that there is no interference in drug use when legalized.

With these data, we have an incongruence, because the interviewees believe in the increased consumption of legalized marijuana, but they would not make use of the substance. However, the fact is that, according to the research, consumption would increase, and consequently, there would be an increase in the market value of marijuana in the country.

A fact that would increase consumption is the situation of the buyer or user not being marginalized (Bill 7270/2014), seeking to buy the product by illicit means, as it happens today. Drug trafficking is one of the main problems of Brazil, responsible for barbaric crimes and violence that increase every day in statistics. According to data from the report of the National Penitentiary Department of 2014, 27% of the Brazilian prison population is related to trafficking. More recent data, according to the National Council of Justice, Brazil has a total prison population of 654,000 prisoners in 2017 and 29% of them for narcotics trafficking, followed by prisoners for robberies, marking 26% (NCJ, 2017).

Alves (2014) ponders in his article that the controversy of the release or not of marijuana should be discussed broadly among the population. For this, it demonstrates examples of three situations: who is in favor of therapeutic purposes and reduction of violence, who is not in favor of decriminalization and who has not yet defined opinion. For those in favor, the historian Henrique Carneiro was invited to manifest himself and he believes that he should not advertise to stimulate consumption among young people. "The issue is the regime of ownership. State control does not instigate the use, unlike private capital that aims to supply and increase demand, "he says. Against the decriminalization of Cannabis, psychiatrist Ana Cecília Marques states that marijuana has no positive therapeutic effects. "In 2012, UNIFESP Research showed that 75% of Brazilians are opposed to the legalization of marijuana (...) Psychiatric dependency situations make the depressive and psychotic disorders worse in patients suffering from schizophrenia, "he says. In turn, Elisaldo Carlini, a specialist in Psychopharmacology, believes that the substance should be differentiated for recreational or therapeutic use.

> Medical use takes into account three aspects – the human being, the disease and the drug – and the recreational use takes into account two, the man and the drug. Marijuana has a proven therapeutic effect, through various medicines recognized and approved in Canada, United States, England, and which are sold in health units. I think we must first discuss the legalization of the use of marijuana components to treat diseases and then legalize their recreational use. (Alves, 2014).

In fact, the population should be instigated to discuss on the subject, but in the academic universe, theories are based on the therapeutic, psychological and social effects, but practically no discussions are found regarding intent to purchase, Marketing positioning by users or non-users. On the web, we find many journalistic materials on the subject also involving the aforementioned issues, without any conclusion, awaiting the outcome of the vote of the Bill.

2.2 Purchase intent

Getting a person to buy a product is no simple task. The whole purchase process goes a long way until its realization. Firstly, the consumer must feel the need to own or consume the particular product and this need is designated according to the individual behavior (Kotler, 2012). This process has basically five stages, when the person recognizes that he has a need or problem coming from personal or external stimuli, like wanting something that another person already has. It then departs to search for information regarding the item with known people, websites, mass communications and experiments. After this search, the consumer evaluates alternatives and competitors through their personal judgments. In this, he begins to evaluate the value position that the product fits for him, and, finally, to decide for the purchase (Kotler, 2012).

Ajzen and Fishbein (2000) argue that the buying attitude is influenced by a psychological object that has two sides, such as good and bad, harmful or beneficial. This judgment is made by the consumer very fast, according to his positive or negative stimuli and also by the routine and his behavior.

According to Merlo and Ceribeli (2018), the concept of attitudes starts from a behavioral perspective and is defined as individual predispositions in relation to a given object (Petty, Wegener & Fabriger, 1997). Consumers can maintain positive attitudes towards an object (product, service or brand) and react in a constantly favorable way towards it, whether it is acquiring, consuming more or doing word of mouth. Otherwise, they may maintain negative attitudes toward an object and react negatively frequently to it, whether complaining or not buying.

When a new product is launched on the market, companies must take care to make this product necessary, because the needs are not created, they are shaped based on those that already exist and before were not supplied, to arouse the desire in the people and thus, sell (Merlo & Ceribeli, 2018). The authors further argue that customers buy products that are available at a lower price and that companies must meet customers' desires profitably by investing in value creation. In fact, important factors that determine the intention to buy a particular product are the cultural factors, groups and social classes. In Brazil, for example, which has a large territorial belt, there are many different cultures and values rooted and making a comprehensive and generic campaign can be seen in a negative way in a certain region. Groups and social classes are strong allies to arouse buying interest, because the influence arises from the desire to belong to a group that has the product to be accepted in an environment and to be part of it (Merlo & Ceribeli, 2018)

Merlo and Ceribeli (2018) still tell us that Brazilian consumer behavior has strong features. Of greater female influence, searcher of many information about the product to be acquired, if the product raises its social status, values marketing with celebrities, gives importance to the sense of belonging of groups and still does not value products with socio-environmental culture.

3 METHODOLOGICAL PROCEDURES

Qualitative procedures and an exploratory approach were adopted to meet the objective of this research. It is noteworthy that in the literature review, the construction of the introductory section and that which deals with marijuana marketing and use in Brazil and in the world were elaborated, in large part, with the use of current Brazilian legislation, news and other sources, since there is still little scientific

literature available on marijuana market aspects in Brazil. On the other hand, the section dealing with the intention to buy was elaborated from a contribution of scientific works, considering that there is enough literature and theorization on this theme.

The data used for the analysis were collected through the application of two questionnaire models, built on the Google Docs platform and disseminated to groups of users and non-users of marijuana, making it possible to evaluate characteristics in two groups of individuals. The disclosure of the instrument was made through Facebook and Whatsapp.

A total of 217 valid responses were reported from people who presented themselves as non-users of marijuana and 118 people who declared themselves to be marijuana users. All of them answered voluntarily and anonymously to the research that happened between July 24 and 27, 2018.

In both questionnaire models, the respondents had a free amount of characters and space to explain their perceptions regarding each question asked. Considering the exploratory nature of this research, it was not asked in a timely manner the demographic characteristics of the people who answered the instrument, since it was not the intention to have control variables, but to allow any elements to emerge from the content of the answers. The user-oriented research tool was composed of seven questions and six questions for non-users, according to Figure 1.

Questions Made for Users	Questions Made for Non-Users
1. 1. What do you think about the possible legalization of marijuana in Brazil? 2. 2. Would you change your frequency of use if the Bill legalizing marijuana were approved? Because? 3. 3. What is the average value of your monthly income for marijuana use? This amount would change if there were legalization? 4. 4. How do you feel about consuming a product prohibited by law? 5. 5. Would you travel to countries where marijuana is legalized for recreational use? Because? 6. If there is legalization, will non-users consume marijuana? Because? 7. If there is legalization, are people already users going to consume more? Because?	1. What do you think about the possible legalization of marijuana in Brazil?? 2. Would you become a user if the Bill legalizing marijuana were approved? Because? 3. Would you recommend RECREATIONAL use of marijuana if your medical use is allowed by law? 4. Would you allocate part of your income to buy legalized marijuana? If so, how much? 5. Do you think marijuana demand and consumption will increase if it is legalized? Because? 6. Even if you were not a user, would you go to environments that sold legalized marijuana? Because?

Figure 1. Collection instruments questions

Source: Search Data (2019).

The analysis of the data was done using the content analysis method with the application of categorial content analysis, using the procedures described by Bardin (1988) and Oliveira (2008), involving the pre-analysis, coding, categorization, treatment and interpretation of responses.

4 RESULTS AND DISCUSSION

The categories were divided into two large groups: in favor of legalization of marijuana and against legalization of marijuana, as can be seen in Figure 2. Both were divided into subcategories, and the category in favor of legalization consists of: public safety, consumption already exists, medicinal use, governmental control and market, labor and tax. While the category against legalization is formed by "structure" and "drug is always drug".

Categories	Subcategories
In favor of legalization	Public safety
	Consumption already exists
	Government control
	Medicinal use
	Market, Labor and tax
Against legalisation	Drug is always drug
	Governmental structure

Figure 2. Categories and subcategories

Source: Search Data (2019).

4.1 Category: in favor of legalizing marijuana

In this category, we selected responses from users and non-users that contained allegations regarding marijuana legalization for a variety of reasons. We have seen the respondents' interest in positive market action, such as job creation and violence reduction. The medicinal purposes were also cited as important for the development of the Brazilian pharmaceutical industry and even the prison system would also benefit from the legalization of the herb, according to the perception of the respondents.

> A great (not yet attempted) opportunity to reduce violence and much of crime in the country, which today is mostly linked to drug trafficking. Marijuana repression is useless, it wastes time and money and puts many innocent people in jail and crime, as well as favoring many people who profit from it; A breakthrough in several areas: 1) Science: Prohibition creates problems even for research with the plant to be carried out. 2) Economy: collection for the government. 3) Social: Decriminalization of the user, debates "clean" 4) Health: with control and decriminalization, it is possible to maintain healthy levels of consumption with medical monitoring. 5) Prison system. Without trafficking, the number of arrests per possession of small quantities falls deliberately. 6) Security: decreased traffic. 7) quality: what is trafficked in Brazil is mixed with several substances. Whoever plants or obtains in a legal market, will stop consuming these other substances. (Research data, 2018).

All of these responses show the influences on the purchase intention of the respondents who say in favor of legalization as of PL 7.270/2014. However, for a more in-depth understanding of these influences, the correlated subcategories are presented in the following subsections.

4.1.1 Subcategory: public safety

In this subcategory, responses were based on the fact that marijuana legalization would benefit society with the weakening of illegal trade and thereby reduce violence.

> It would look very cool, because in addition to ending part of the Drug Trafficking, it would also end the marijuana trade itself, as it would bring a new market to Brazil, the *Canábico* market, which could "stabilize" some of Brazil's crises and thus generate more jobs ; I think it would take away the power of drug trafficking as people from certain social strata (middle class, high class) would stop buying marijuana directly from the hill and traffickers to buy directly at authorized sites. This is essentially because currently you never know what you are actually buying and consuming what does not occur buying from regularized establishments. (Research data, 2018).

For the respondents who had their statements framed in this subcategory, legalization would be an unprecedented step forward in several areas. From a possible improvement in the social sphere, repairing some errors of the drug war, passing through the economic part, with the creation of a new market generating jobs and income, by the industrial scope, with revolutionary technological applications and the medical study of cannabis.

4.1.2 Subcategory: consumption already exists

In this category, we had answers that told us that it was important to legalize because marijuana already has its market, even if it is prohibited. Legalizing it would only make the habit of buying freer from users, who, according to other responses, feel oppressed by the ban, but do not stop consuming the amount they want.

“The ban seems to have no effect of decreasing consumption; The use does not depend on the prohibition or not; I agree. Since it is not a law that inhibits the use of it” (Research data, 2018).

Because it is an already consumed product, in which some respondents compared with alcohol and cigarette, legalizing will only positively influence users' behavior, regardless of their legal or illegal situation.

4.1.3 Subcategory: government control

The responses were said to be in favor of legalizing marijuana in the country "under conditions". The idea taken from the answers is that before the liberated practice, Brazil must stick to regulations, laws and control of the use and production of the drug, otherwise, there will be no benefit in such legalization.

> I think it's a great idea! In the sense of combating drug trafficking as well as in the sense of being a recreational drug such as alcohol, not making the slightest nexus in keeping it illegal. However, I think there must be measures to control the use so that the consumption of some, does not cause damages to others, as for example is done with the Dry Law to avoid deaths caused by the use of alcohol and direction. (Research data, 2018).

The central argument of this subcategory is that in some countries that have already released recreational use, such as Uruguay, Canada, and some US states, legalization has been extremely beneficial in weakening the violence caused by drug trafficking, exposing users to a very high risk and raising tax

revenues. However, it is worth noting that Brazil would need many regulatory adjustments related to consumption and planting so that everything is regulated normally, since the country acts poorly in its inspection activities.

4.1.4 Subcategory: medicinal use

In this subcategory, users and non-users believe that marijuana release should be for medical use only. With so many beneficial properties that have been discovered, it would be a breakthrough in medicine and the quality of life of people who need the substance. Stimulus to pharmaceuticals should be encouraged as there is dissemination of studies of beneficial properties of marijuana.

"Important if it was legalized only for medical use, indiscriminate use is not right; I disagree with the idea of openly marketing cannabis for recreational purposes, but I do not disagree with the release for medicinal purposes ..." (Research data, 2018).

It is important to emphasize that this type of discourse focuses on the manipulation of marijuana as a scientific and social advance for Brazilian society. Many people would need treatment with cannabis because it can be produced at lower costs than some other medicines that do not have the same effect. Examples of such diseases that could be treated were headache and insomnia.

4.1.5 Subcategory: market, labor and tax

In this subcategory we have important answers about the marketing aspects of marijuana. Considering that the positive impacts of job and income generation would increase, respondents believe in the power to leverage Brazil's economy with the presence of marijuana industries, as well as the collection of public power taxes, which would return the population.

> Necessary, it would bring more tax collection to the government, generate regular jobs and circulate more "clean" money in the economy; I find something valid to be discussed, since the marijuana "problem" has become a public health issue, and trade liberalization would ensure not only a greater source of national income but also a drop in consumption, as occurred with the cigarette and beer, this without mentioning the strengthening of scientific research to better benefit from the benefit of the herb. (Research data, 2018).

For the respondents, the legalization proposed by the bill would be an excellent alternative to combat violence. It would also help access to information by users, as well as service to reduce consumption. It would help the market for marijuana products such as seeds, fibers, oils and medicines. Still, it would be an alternative to treat the matter with more civility, bringing its aspects to the law, which could reduce risks to users and crime, as well as boost the production of the various derivatives of the plant.

4.2 Category: against marijuana legalization

In this category of respondents against legalization, some responses were grouped that reflect the negative thinking regarding marijuana, because it is a drug, because it does not know the real effects or because of a lack of management capacity of the country.

> The state will monopolize the sale, it will be expensive, it will have a tax burden of at least 70%, they will have to pay bribes to the Senator, Federal Deputy, Governor, Federal Deputy and to the aunt of the coffee or do you think that Zé Droguinha will be able to plant your weed in peace? They will go to miss the value of the toe but then it will be late because the trafficker will enjoy and will sell the cigarette for $ 50.00 or else will pay R$ in legalized marijuana; I'm not in favor. But I believe that it has not yet been legalized because they have not yet found a way to charge for cultivation, since it is possible to cultivate at home, therefore, it generates neither tax nor revenue for the market. But it's only a matter of time! (Research data, 2018).

Respondents in this category are not supportive of drug use in general and believe that such use should not be encouraged in any way, although they do not have enough information to have a definite opinion. In addition, they emphasize that there are more relevant issues to be prioritized by the State, such as education, infrastructure and political reforms.

4.2.1 Subcategory: drug is always drug

Separated in this subcategory, people's responses to legalization have been listed because they believe that marijuana is a drug like any other and it should remain banned within the control of punishable laws. It is noted that they believe to be evil for future generations due to the effects and lack of control in the consumption.

> Worse, the youth will be more injured than it already is; First, would it become a gateway to other drugs, which will ensure that people living in this environment are not encouraged to meet other heavier drugs, such as crack? According to which ensure that the person will consume only the amount "N" established. The alcoholic beverage already leaves crowded hospitals, people direct about the effect of alcohol, it was necessary to create law to punish such irresponsibility, in ballads the people go to tan and dance about the effect of alcohol, but they are not content themselves and consume together drugs to feel more free, with the release of marijuana such a factor would happen, we must pay the price to see such a situation occur? (Research data, 2018).

In addition to the negative health effects of the users themselves, some respondents emphasized the fact that passive smokers could also be harmed by being exposed to this type of "partnership" in consumption.

Another important aspect is the unproductive aspect that drug use would provide, so that even if it does not harm users' health, individuals using marijuana would become unproductive for short periods and would no longer benefit social groups and work they experience.

4.2.2 Subcategory: government structure

In this subcategory of denial of legalization, we have a group of answers that claim to be against precisely because of the lack of structure of the country. Respondents say that before thinking about releasing a drug, it is necessary to correct the various problems of health, education, policing, corruption, and then think about this question. Many respondents expressed their concern about control of permitted

consumption, planting and sale control, and whether there is an effective police and antidrug support system for users and their families.

> I believe that we currently have more relevant issues to prioritize by the State. I do not know this world of non-legal drugs, but when it comes to legalizing another drug that may be subject to dependence, I do not think it is possible, as it is also plausible. First, it would become a gateway to other drugs, ensure that people living in this environment are not encouraged to meet other heavier drugs, such as crack? According to which ensure that the person will consume only the amount "N" established. The alcoholic beverage already leaves crowded hospitals, people direct about the effect of alcohol, it was necessary to create law to punish such irresponsibility, in ballads the people go to tan and dance about the effect of alcohol, but they are not content themselves and consume together drugs to feel freer, with the release of marijuana such a factor would happen, should we pay the price to see such a situation occur? Public health is prepared to receive occurrences related to the use of marijuana? (Research data, 2018).

Respondents in this subcategory do not see legalization as a solution to the problems of violence or drug trafficking, because there is no governmental structure capable of supervising and acting on behalf of the population.

4.3 Other relevant aspects: frequency of use and consumption environments

Some respondents believe that after marijuana legalization consumption will not change. Current users already consume the amount they want and would have no interest in increasing just by being legalized. What would change would be the way to buy the product, which would cease to be illegal, taking risks by having to buy through the black market to some accredited place and marijuana of better quality and provenance. They cite examples of countries that have the legalization of the herb and for that reason there is no unbridled consumption of the substance.

> I think I would consume less. with state control over the plant we would have a higher price. For those who already smoke, planting at home without problems would not increase the use; I do not think it will increase because many come to buy and make use of for a matter of curiosity of the forbidden, the adrenaline discharge. They have certain situations that after becoming lawful have become monotonous and somewhat "bland". (Research data, 2018).

We list below the responses of users and non-users who believe that marijuana use will increase only at the beginning of the release because of people's curiosity, the euphoria of certain users about the "free" situation of buying and consuming.

> Maybe at the beginning, after they find out and know that it's okay. But I think the user fee will remain more or less stable. After all, prohibition never prevented anyone from consuming; Maybe at first, but I would not worry about it any more than I worry about overusing alcohol. Initially, due to the novelty, it could have an increase in sales motivated by curiosity, only. Things would then normalize and would only constantly use those who smoke while being legalized or not. (Research data, 2018).

Some answers that believe in the increase of consumption have been grouped, since they are based on the facility to acquire marijuana. There is an expectation of increasing the number of consumers who were not former users because it was an illicit product, but after being legalized they feel free to consume.

> I believe that no, because in countries where cannabis is legalized it has a decrease in new users, and if there is legalization here in Brazil I believe it will follow this trend, because the information about the use of the psychoactive substance THC will be like the use of other drugs, such as a cigarette containing the information and that the use of the substance nicotine causes, among other information, such as the prohibition for minors, which will be of great importance; I think there will be an increase because of the safety of purchasing the product, even better product. I believe there will be increased awareness campaigns and the level of information on cannabis. I'm just scared for the teenagers, because marijuana is not for those who do not have their brain and personality 100% formed. (Research data, 2018).

In the question we asked if we would go to marijuana-selling environments, we would subdivide: I would normally attend, would attend, as long as I separated the smoking area and would not attend to know if people would be interested in bars, restaurants, pubs that sold the product beyond other products. This question, we believe, is interesting because the market for green products linked to sales of traction products and alcoholic beverages grows, like California, in the United States, estimates that marijuana sales and production will reach 5.8 billion dollars by 2021 (Capital Letter, 2018).

For these answers, many non-users responded by not bothering to go to marijuana-selling environments because they already go to places that sell other products and do not feel compelled to consume. We also had answers that claim to go to places that sell marijuana to socialize with friends, without major problems or prejudices.

> Yes, there are other criteria that I would evaluate whether or not I go to the environment. The mere fact of selling legalized marijuana would not influence my decision so much; I am liberal in economic matters and somewhat conservative in customs, but would have no problem with "green" places; Yes. I already work in an environment that sells marijuana. I am a teacher in a community in Rio. What makes the climate tense is actually the heavy armament of the traffickers who are selling it. But I do not see any problem in this. (Research data, 2018).

We also asked non-users whether they would go to marijuana-selling environments and separate the negative responses below. The arguments were very similar, some afraid of the reaction of the effects on other customers, others complain of smoke and many were refusal to attend because they did not share the idea and did not feel well.

> DO NOT. I am not obliged to be a passive smoker of anything, and marijuana stinks beyond giving me air. And I hope that the use on the street for example is prohibited, as I expect the same for the "ordinary" cigarette; No, not to encourage other people to think that such use is common to human health. In addition, there is a study that proves that the person who is on the side of a person who is smoking, even without smoking, is as if she has smoked 10 cigarettes, who can

say that such a situation would not have the same effect with anyone who is in a place that are smoking marijuana? The effects of this herb on some people make them violent, so I'm out. (Research data, 2018).

We also identified answers That affirmed that the possibility of attending places that sold marijuana provided that there was separation of the smoking area, so as not to be disturbed by the smoke or the behavior of the users at the site.

5 CONCLUSIONS

We collected information from 335 people who volunteered to respond voluntarily and anonymously to the online questionnaire, between users and non-users of marijuana in Brazil. We analyze the answers carefully, filter the results and catalog to better understand each sentence constructed subjectively on the topic. Many have been careful to state their point by stating their concern about increasing substance use, others have categorically stated that legalization is necessary even if fiscal adjustments are needed because they understand that the money raised from the sale and production of legal marijuana brings dividends important to the economy, citing the example of Canada and the State of California in the United States, as informed in the introduction to this article. The result we believe to be legalize for medical and recreational use may be unnecessary or considered only on the condition of a structuring in the country prior to release, with strict laws and government organization in several tabs to give the support that the agenda needs, even a large part of the responses considering little increase in marijuana consumption.

Still, we received many positive responses to legalization, both medicinal and recreational, and many non-users stated that they would go to marijuana-selling environments, but few non-users said they would not. Users said they would not use it anymore for being legal. We catalog many answers that say that the search for marijuana would only increase for a moment and then, users would always return with normal consumption, given that marijuana would be of better quality and would use less quantity.

In the questions we do not catalog, but we consider as important factors for the final decision, we have seen that the concern to legalize Cannabis is to have the feeling of freedom to consume a natural product without being marginalized, even if it is taxed; this would be the price of "freedom".

The cold and deep analysis of the answers leads us to believe that legalized marijuana will not change the consumption in the country, considering that the answers lead us to define that who already makes use of the substance will continue with the same amount.

Considering, then, the same consumption that is made through the traffic and that if there are no consolidated policies and legislation for its combat, marijuana will always have its sale through the underworld, not altering and not increasing its legal commercial power and important for the Brazilian economy, such as the generation of jobs and income, taxes and other.

Therefore, we believe that the recreational legalization of marijuana, before a strong anti-drug campaign, moderate consumption, support to users and intensive action against trafficking, is unnecessary, since it is not in the population's interest to have stimulated consumption since use of marijuana in the amount desired, unlawfully. To authorize consumption only by authorizing, without the requisite

adaptations a priori, demands expenditures that are not urgent and will stimulate unregulated consumption. However, we believe that the medicinal use, through sales through registered pharmacies such as the Uruguayan example and the encouragement of Cannabis research, are very important and should be stimulated and, of course, authorized by law.

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Learning Analytics in a Virtual Learning Environment: the challenge of mapping socio-affective scenarios

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Abstract

Virtual courses are increasingly being offered in Brazil, making it imperative to develop technological resources and research to help in the teaching and learning processes in this modality. One approach is to analyze student's socio-affective profile in Virtual Learning Environments (VLE). The co-operative learning network (ROODA) VLE has two features called the Social Map (SM) and Affective Map (AM), which can both contribute to the visualization of data regarding social interaction indicators and students' moods in the environment. The SM presents the social relations formed through indicators, which are the absence; collaboration; the distance from the class; evasion; informal groups and popularity, enabling the identification of the participating subjects in the form of sociograms. The AM identifies students' moods graphically through indicators, which are excitement, discouragement, satisfaction, and dissatisfaction. Thus, this article aims to map the possible recurrent socio-affective scenarios in a VLE using Learning Analytics (LA). LA is defined as measurement, collection, analysis, and reporting of data about students and their contexts to understand as well as optimize learning and the environments in which it occurs. It can also contribute to the understanding of student's learning profile, based on social and affective aspects, thus allowing the teacher to develop pedagogical strategies consistent with the needs of each subject. The importance of integrating the possible social and affective scenarios was verified using LA, making it possible to deepen the comprehension of the subjective and qualitative questions regarding the students' interactions in the VLE. In this study, the scenarios are understood as the intersection between the Affective Map and Social Map indicators identified in a VLE. It has both a qualitative and quantitative approach. The choice is qualitatively justified because the research object involves social and affective phenomena that were subjectively expressed in texts and social interactions manifested in the ROODA VLE. It is quantitatively justified by the need to measure the mapping of socio-affective indicators through social parameters and moods applying LA. The subjects were undergraduate students who participated in distance learning courses at a Brazilian public university that used the ROODA VLE in the second semester of 2019. Data were collected from social and affective maps to identify if there was a relationship between them. As a result, based on the existing indicators of social interactions and moods, the socio-affective indicators were created using LA in order to analyze the students' behavior in relation to the forms of interaction and communication that occur in the ROODA VLE.

Keywords: Socio-affective; Virtual Learning Environment; Learning Analytics.

1. Introduction

There has been significant growth in Distance Learning (DL) over the last ten years in Brazil, particularly in the consolidation of practices aimed at bringing education to all areas of the country [1]. This modality is flexible both in terms of the time and place of study, but it hinders the physical and simultaneous interaction between the parties involved in the teaching and learning process. Considerable challenges exist in terms of accompanying each student's distance learning trajectory. Therefore, it is necessary to develop and employ different strategies to increase the success rates of DL students [2].

The lack of more autonomous and expressive performance, as well as competences such as planning and organization, make students feel unmotivated and lacking confidence to continue with their studies. The lack of interaction and close proximity to colleagues in the virtual space, often make it difficult to cope with these difficulties [3].

The field of education itself has been contemplating social and affective dimension in hopes of valuing a more integrative education. It is noteworthy that this research considers the construction of knowledge according to Piaget's work [4, 5] in which social interactions and affectivity play specific and vital roles. From the Piagetian perspective, it is understood that social interactions form a link between the subject-environment and thus foster discussions about the learning object, enabling new cognitive structures to be built. Affect, on the other hand, is linked to the motivation to discover, creating interest in investigation, which serves as the driving force of the individual's actions [5].

According to Dolle [6], the individual learns not only through internal affective and cognitive processes, but especially from the demands caused by their social relations. In fact, the relationships established between the teacher, student, object of knowledge, and environment represent essential aspects in teaching and learning. These exchanges are intended to prepare the subject beyond the construction of knowledge, such as how to live in society. Immersed in them are affective attributes and social processes, which deeply condition the cognitive processes [5; 7].

From this perspective, it is understood that although the tools for providing DL are constantly being improved and perfected, there are still issues that require further attention. Primarily the recognition of the students' affective manifestations and the interactions possible in these spaces. This information can provide teachers with essential elements to meet the demands of their students by offering them adequate help [8].

The need to analyze the interactions performed in these spaces is necessary in order to enhance the relationships that occur in the teaching and learning processes, understand the interests and particularities of the students, and bring the actors involved closer together. The area of Learning Analytics (LA) research emerged in 2010 as a possible solution. Originating in web analytics, it initially was intended only to serve students who presented difficulties. It is currently used to monitor and accompany all students, enabling individualized analysis [9; 10].

However, studies applying LA in the Brazilian context of VLEs are still quite recent and scarce. In fact, only 20 Brazilian educational institutions using LA were found [11]. Although LA can be applied in any modality, most of the work covers distance learning courses. For example, in the Moodle VLE, the student's navigation route is analyzed using two parameters, which allow the sections the student views and the use of available resources to be tracked. The indicators allow for the monitoring of performance, interaction, and individual student's trajectory within the environment [12].

Hence, this research starts with a reflection on the social and affective aspects found in VLEs. In this context, the objective of the research is to map the possible recurrent socio-affective scenarios in the ROODA VLE using LA. In this study the scenarios are understood as the intersection between the Affective Map and Social Map indicators identified in a VLE. With this information, the teacher can then apply strategies and make decisions based on the student's particular socio-affective profile.

This article is organized into six sections. The following section discusses the ROODA environment, as well as Affective and Social Maps. The third section develops an understanding of Learning Analytics. The fourth describes the research methodology, and the fifth section presents the results. Lastly the final considerations are elaborated.

2. ROODA Virtual Learning Environment – Cooperative Learning Network: A focus on Affective and Social Maps

The ROODA (in English the Cooperative Learning Network) VLE began to be developed in 2000 by a research group at a Brazilian public university. ROODA is user-centered. It allows students access to materials and tools and also provides spaces for exchanging and sending activities enabling interaction between participants. Because it is an institutional environment, it is constantly updated in order to keep up with the emerging changes in the academic community [13].

The research for this article was developed in the ROODA VLE because it is the VLE used for the courses studied here. The ROODA virtual learning environment has a total of 26 synchronous and asynchronous communication features, including the Social Map (SM) and the Affective Map (AM). The SM and AM are used to identify a student's social and affective aspects. Maps are features used exclusively by professors to graphically visualize the aspects manifested by students participating in the ROODA VLE. The data are obtained from communication resources such as the journal, forum, contacts (similar to e-mail) and chat, as well as comments inserted in the Webfolio and Library [13; 14].

The AM was designed to infer the student's mood (excited, discouraged, satisfied, or dissatisfied) by analyzing their interactions in the environment and present them graphically [14]. Inference is conducted through probabilistic reasoning, based on the data collected which are subjectivity in text, actions carried out in the virtual environment, and personality traits. The teacher can therefore choose to view the student by week or month. Clockwise, the first quadrant indicates a satisfied mood; the second, excited; the third, discouraged; and the fourth, dissatisfied, as can be seen in Figure 1.

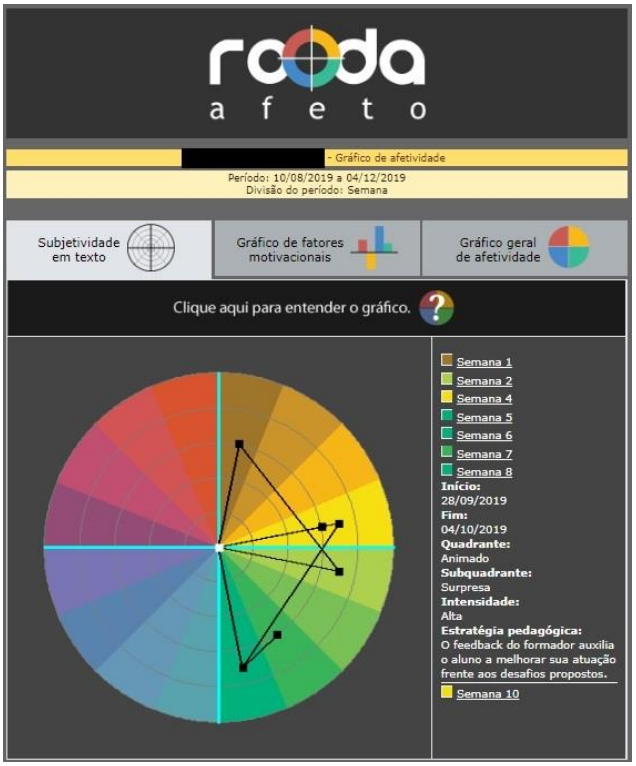

Figure 1. Affective Map. Source: https://ead.ufrgs.br/rooda/.

The first quadrant, satisfied, indicates that the student reveals satisfaction, joy, enthusiasm, and pride in the task accomplished. The second, excited, shows that the student demonstrates surprise, interest, hope and serenity in some way to face the learning challenges. The third quadrant, discouraged, suggests that the student in some way expresses sadness, fear, shame, and/or guilt for not being able to keep up with the course content. And finally, dissatisfied students express irritation, contempt, aversion, and/or envy [14].

The SM is a tool that aims to present the social relations formed in the environment, enabling the identification of the participating subjects as sociograms. This makes it possible to visually demonstrate the position occupied by the individual in the group and the nucleus of relationships that form simultaneously around them. Through a sociogram, one can therefore perceive the social position of each participant and their relationship with the rest of the group [15]. Indicators of social interaction make it possible to visualize the bonds, influences, and preferences that exist in a certain course or in a group [13]. Based on this SM, the social category level is calculated, namely: absence, collaboration, distance from the class, evasion, informal groups and popularity [16], as shown in Figure 2.

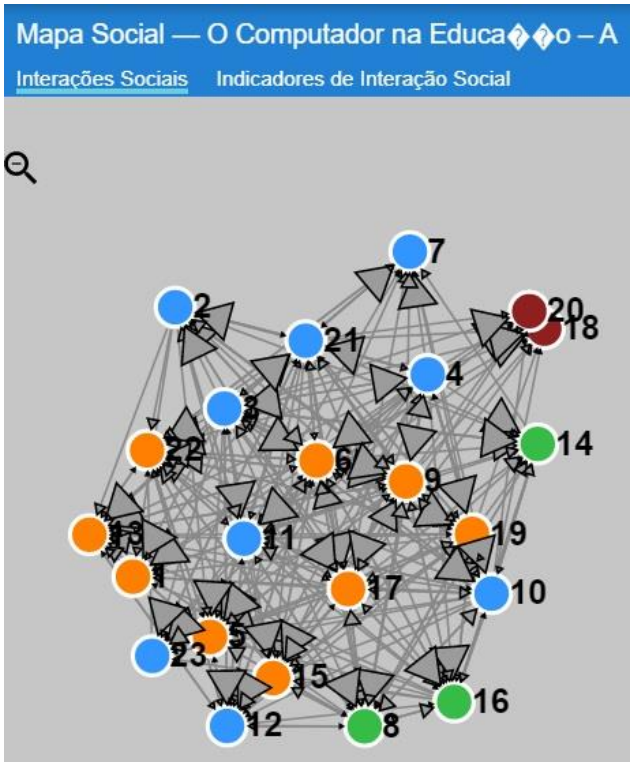

Figure 2. Social Map. Source: https://ead.ufrgs.br/rooda/.

The following section develops an understanding of Learning Analytics, the reference model, and the overall process on which this work is based.

3. Learning Analytics (LA)

LA emerged as a solution to address the need to enhance the relationships that occur through technology in the teaching and learning processes. It also helps to understand the interests and needs of students, especially to meet the needs of students that face difficulties in building knowledge [9; 17; 18]. Thus, LA is defined as the measurement, collection, analysis, and reporting of data about students and their learning contexts. It aims to bring the principal actors involved closer and analyze the students' interactions in virtual spaces [10; 19; 20].

In this study the work of Moissa et al., [19] and Dyckhoff et al., [21] are used as a reference model. This model considers four dimensions, which are: what, why, how and who, as can be seen in Figure 3.

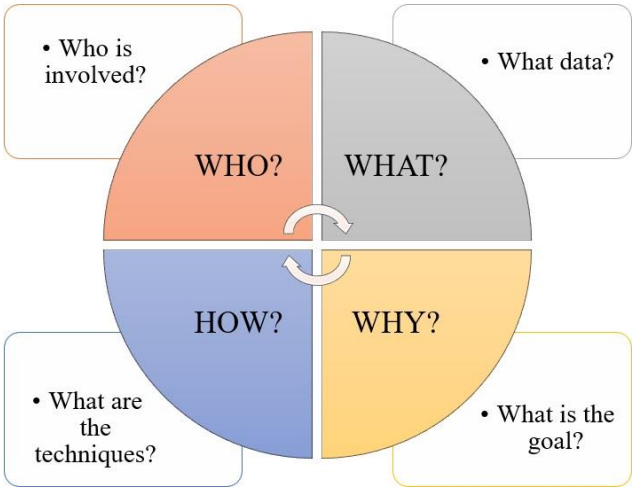

Figure 3. Reference Model of LA. Source: Based on Anna Lea Dyckhoff et al., [21] and Barbara Moissa et al., [19].

The four dimensions of this model are:

(i) **What?** Refers to the types of data collected. These can come from virtual learning environments, instructional sources, social networks, among others;

(ii) **Why?** Is related to the objectives and results of the analysis, which may be: monitoring and analysis, prediction and intervention, tutoring and monitoring, evaluation and feedback, adaptation, reflection, personalization, and recommendation.

(iii) **How?** Is linked to the different techniques that can be employed to detect patterns contained in the data.

(iv) **Who?** Is aimed at the subjects involved, which may be students, teachers, educational institutions, researchers, system designers, among others.

The types of data collected in this research come from the ROODA VLE, the objectives and results are monitoring and analysis; prediction and intervention; and customization and recommendation. The technique employed was manual mapping of the indicators and the subjects were teachers and students.

The importance of LA can be further emphasized in terms of understanding and optimizing learning, accompanying the students' learning trajectory, enabling specific and individualized analysis. Thus, the overall LA process is an interactive cycle performed through three main steps, as illustrated in Figure 4: (1) data collection and preprocessing, (2) analysis and action, and (3) postprocessing [22].

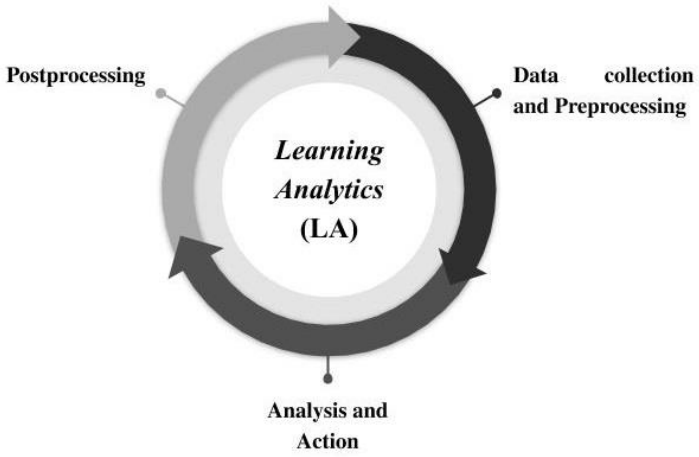

Figure 4. General LA process. Source: Based on Mohamed Amine Chatti [22].

Data collection and preprocessing: The first step involves collecting data in educational environments and systems. The second, *preprocessing*, aims to eliminate irrelevant attributes. At the end of this step the data are made available in a format that can be used as input for LA.

Once the data have been *preprocessed*, different techniques can be applied in order to discover useful hidden patterns in the data. This is the purpose of the *Analysis and Action* phase, which includes analysis, action, and visualization of the information. Taking action is the main objective of every analytical process, which incorporates adaptation, analysis, evaluation, *feedback,* intervention, mentoring, monitoring, personalization, prediction, recommendation, reflection, and mentoring.

Next is *postprocessing,* where the data are compiled and refined from additional sources, attributes for iterations are established, indicators/metrics are identified, and the analyzed variables are modified.

Thus, considering the phases of the LA, as well as the indicators mapped in the SM and AM, the methodology used to conduct the research is presented below.

4. Methodology

This research aims to map the possible recurrent socio-affective scenarios in a Virtual Learning Environment using Learning Analytics. A qualitative and quantitative case study approach was therefore developed with two groups in order to map the indicators. The case study format, based on Yin [23], was chosen because it allows for comparisons of contemporary phenomenon within context, enabling the researcher to broaden the perception of circumstances that may not be clearly evident, exploring various aspects and points of view.

The case consisted of two undergraduate classes at a Brazilian public university, totaling 33 students, over a period of fifteen weeks, corresponding to one semester. To participate in the research, subjects had to meet the following criteria:

(i) Be a student registered in ROODA;
(ii) Have basic computer knowledge;
(iii)Have access to a computer with Internet;
(iv)Sign the Informed Consent Form (ICF).

To address the ethical questions of the research, all participants were informed about the intended objectives and the methodology that would be used. The Informed Consent Form (ICF) was shared with the participants in order to formalize the research and clarify possible doubts, giving them the choice of whether or not to participate in the research. Privacy was also highlighted, emphasizing that all information including their identities would be kept confidential.

Based on the data collected in the case study, we used Learning Analytics. The following three steps were performed:

1. *Data collection and preprocessing*: Collection was performed through ROODA in two undergraduate classes. Of the initial total of 33 students, three dropped out and one canceled their enrollment, leaving 29 students. Of these, 17 were women and 12 men. Firstly, the results collected from the four mood indicators in the AM (excited, discouraged, satisfied, and dissatisfied) were organized in a table. Then, the data from each quadrant were compared with the social indicators available in the social map (absence, collaboration, distance from class, evasion, informal groups and popularity) in the same table. Lastly, the scenarios were created based on the data collected.
2. *Analysis and action*: Analysis was performed by comparing the mood and social indicators. Similarities were found in the 15-week period and all of the 29 students' data were compiled, totaling 435 socio-affective scenarios. Of this amount, a total of 95 had no student representation that week and were thus indicated as "undefined" on the Affective Map. Therefore, these did not appear that week on the Subjectivity Chart, in addition to not being linked to a social indicator. Thus, when an indicator was missing or "undefined", it was accounted for but not analyzed because the focus was on mapping interactions and communications. After removing the aforementioned cases, a total of 340 scenarios remained.
3. *Post-processing*: Lastly, the final table was refined by accounting for recurring scenarios in order to identify possible socio-affective indicators. Thus, of the 340 total scenarios, 234 did not have one of the social or affective indicators. Thus, for the purposes of this study, these were not included, since the objective was the intersection of both indicators. Therefore, a total of 106 scenarios were considered. The following section presents the results obtained from this work.

5. Results

This research aimed to present the mapping of socio-affective indicators that help Learning Analytics for use in the ROODA VLE and its Social Map and Affective Map features. Thus, for this study we considered the Subjectivity Graph based on the AM and the social indicators from the SM. The Subjectivity Graph does not show the weeks in which the subject had an "undefined" state, that is, weeks where the student did not communicate and/or did not enter the environment. Thus, it was not possible to visualize the student's quadrant during that period. The SM examined students in terms of each of the indicators every week. It should be noted that a student may have had more than one social indicator in a given week, but only one affective indicator. In this study, all possible intersections were analyzed, totaling 106 resulting scenarios.

Figure 5 was organized to present the final result of the intersections between affective and social indicators

in the scenarios found. The first column presents the four indicators of students' moods, followed by the social indicators that corresponded to each week. The recurrence of combinations, i.e. the number of times each scenario appeared forming relationships between the indicators, was calculated and presented. Thus, the last column has the number of times the combination occurred in the student group. Then, the results were analyzed for recurring scenario indicators based on the combinations.

This study determined an average to determine whether the resulting crossover was standard. To do so, the number of scenarios found (106 scenarios) was divided by the number of students (29 in all). The result of this calculation in this study was 3.65, and was thus established as the cut-off value to identify the most commonly recurring scenarios that were flagged with the color blue, as shown in Figure 5. The scenarios that appear the most frequently per quadrant are presented.

Affective Indicator	Social Indicator		Number of times
excited	absence	-	**15**
	absence	collaboration	9
	collaboration	-	9
	collaboration	distance from the class	1
	collaboration	popularity	6
	distance from the class	-	1
	popularity	-	1
satisfied	absence	-	8
	absence	collaboration	4
	collaboration	-	**18**
	collaboration	popularity	6
	distance from the class	-	4
	popularity	-	1
discouraged	absence	-	2
	collaboration	-	5
	collaboration	distance from the class	1
	collaboration	popularity	**8**
	popularity	-	2
dissatisfied	absence	-	2
	collaboration	distance from the class	1
	collaboration	popularity	1
	popularity	-	1
	Total		**106**

Figure 5. Intersections of the affective and social indicators based on the number of times they were identified in the analysis. Source: The authors (2019).

Therefore, it is possible to analyze that over the 15 weeks, the majority of students were “satisfied” and “excited”, and the social indicator “collaboration” was identified the greatest number of times. Another analysis was the comparison of recurrence of the scenario of the mood "Satisfied" with "Collaboration", since it was repeated during the 15 weeks of class.

The moods "discouraged" and "dissatisfied" had few repetitions, almost always less than 4 and are linked to the social indicator of "absence" and "distance from the class". This indicates that these students most likely had difficulties at some point during the course, but did not drop the class.

The data also points out that many students who were “excited” were also “absent”. The hypothesis is that these occurrences were due to the pedagogical strategies adopted by the teachers during these weeks analyzed, since they were in the initial classes (2 scenarios), or in shorter weeks with holidays (6 scenarios). In other scenarios it was not possible to find a constant.

For the affective indicator “satisfied”, it can be concluded that in most scenarios (18) when the student is in this quadrant, they are also “collaborative”. On the other hand, in most scenarios (8) where the student is in the “discouraged” quadrant, they were also in the “collaboration” and “popularity” indicator. Therefore, the student interacted and even posted materials in ROODA even though they were discouraged. Finally, the student in the "dissatisfied" quadrant did not engage in social interactions with other users. Figures 6, 7 and 8 show the main intersections of the scenarios that were mapped.

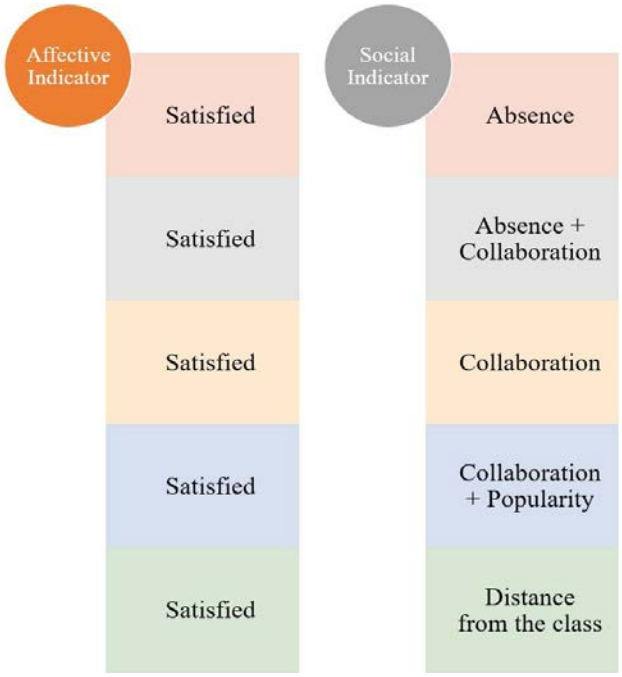

Figure 6. Main intersections of the scenarios mapped from the affective quadrant "Satisfied".
Source: The authors (2019).

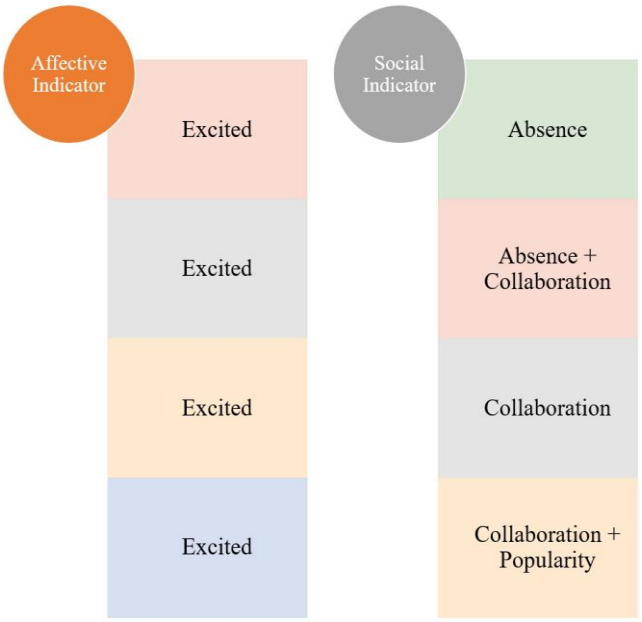

Figure 7. Main intersections of the scenarios mapped from the affective quadrant "Excited". Source: The authors (2019).

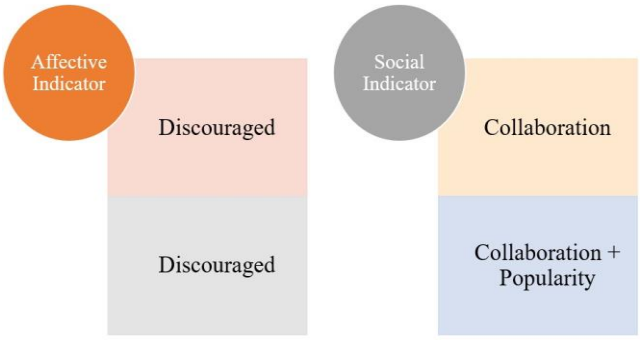

Figure 8. Main intersections of the scenarios mapped from the affective quadrant "Discouraged". Source: The authors (2019).

Thus, the likelihood that the socio-affective scenarios found may be repeated in other situations depends on the pedagogical practices, communication tools adopted in each situation, and the student profile. Therefore, it is pertinent to perform new mappings in order to find other possible socio-affective patterns of students within a virtual learning environment for these scenarios. Hence, the main contribution of this work is to point out the existence of certain socio-affective scenarios that can be inferred and teachers can then use these findings to know the students' needs and apply pedagogical strategies based on each student's particular profile.

6. Conclusions

In DL the physical distance between the actors in the educational process makes their relationships unique. Given this, the ways of knowing the other, communicating and acting in a VLE are elements that must be analyzed for the continuous qualification of this teaching modality. Given these particularities, we must

also consider the relevance that socio-affective processes play in learning. Therefore, it is necessary to develop analytical tools to provide new VLE features able to promote pedagogical practices that are more appropriate for the new educational paradigm. Indeed, it is assumed that distance education should not diminish or disregard the influence of social and affective relationships on learning. Thus, it is advantageous for the teacher to master these new tools and understand the student's socio-affective profile. Aiming to contribute to the process of knowledge construction through the socio-affective profile, this research aims to meet students' interests and individual needs as well as help teachers to analyze and extract this information. This profile will help reveal the interests and preferences for student's learning, promoting teacher reflection on the teaching process and providing resources for creating strategies and making decisions. This may help with strategies to prevent students from dropping out as well as optimize the process of analysis and definition of actions that can motivate, guide, and evaluate students.

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Quantitative Analysis Powered by Naïve Bayes Classifier Algorithm to Data-Related Publications Social-Scientific Network

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ABSTRACT

Quantitative evaluation of a dataset can play an important role in pattern recognition of technical-scientific research involving behavior and dynamics in social networks. As an example, are the adaptive feature weighting approaches by naive Bayes text algorithm. This work aims to present an exploratory data analysis with a quantitative approach that involves pattern recognition using the Mendeley research network; to identify logics given the popularity of document access. To better analyze the results, the work was divided into four categories, each with three subcategories, that is, five, three, and two output classes. The name for these categories came up due to data collection, which also presented documents with open access, dismembering proceedings, and journals for two more categories. As a result, the performance for the test examples showed a lower error rate related to the subcategory two output classes in the criterion of popularity by using the naive Bayes algorithm in Mendeley.

Keywords: Scientific Social Networks; Mendeley; Naïve Bayes; Machine Learning.

1. INTRODUCTION

Although an academic research article starts a study with a predetermined hypothesis, its research usually begins with the collection of data in which online social media tools can be some of the most rewarding and informative resources. Consequently, the use of social networks in scientific communication, whether for searching or sharing content in different areas of knowledge, has become a new reality in the last years (Nassi-Calò, 2017). Besides, this entire access procedure generates an adequate amount of digital information for data-based decision making, in which the methods of statistical pattern recognition are well suited to exploratory data classification methods (Jain et al., 2000).

Considering the advancement of social media in the popularity of scientific communication, a variety of platforms are turning attention to the academic community (Bik and Goldstein, 2013). At the same time, metrics such as webometry and altmetry are emerging in contrast to traditional impact factor measures based on bibliographic, which foster a culture of self-citation and citation cartels, neglecting their context, i.e., how and why certain articles are cited and, mainly, without observing their popularity (Nassi-Calò, 2017).

The work presented by Hoffmann et al. (2014), based on data from the academic research platform ResearchGate, a leading social network site (SNS) for scientists, presents results between relational metrics and others established impact measures, was tested in order to contribute for current debate on impact assessment based on online data altmetrics, focusing on a personal and relational network perspective. Although their measures of network centrality based on the analysis of social networks of online SNS were not considered in the context of impact assessment, their results on a small exploratory study suggest that such measures are related to established impact metrics and therefore can be useful, at least complementing existing forms of impact assessment.

Usually, the traditional evaluative bases of scientific articles use metrics to generate an impact factor, according to the number of citations that a journal receives. However, in this measurement of popularity, so to speak, the periodic is evaluated and not necessarily an individual survey. In order to propose a little of this but using pattern recognition techniques, the objective of this work is not exactly to measure the scientific impact but to contribute for the recognition of logics in the attributes of documents that help to identify patterns about accesses and their dynamics in the social networks. Moreover, this recognition will be done thinking about the popularity of most accessed documents (frequency), among which there may be cases about topics considered fashionable that are not accessed. Therefore, the survey will point to the popularity of access, regardless of the topic, and the SNS Mendeley will be used.

2. METHODOLOGY

The work of Wu et al. (2008) presents a ranking of some most influential algorithms in Data Mining identified and elected at the IEEE International Conference on Data Mining (ICDM), in December 2006. These ranking algorithms cover the tasks of classification, clustering, machine learning, association rules, link mining, which are among the essential topics in data mining research and development. Among these approaches to algorithms, we chose to apply the naive Bayes text classifier which has been widely used because of its simplicity in both the training and stage classifying (Remu *et al*. 2020; Pang and Bian, 2019; Mohammed *et al*. 2019; Sudha, 2019; Zang et al., 2016; Ting, 2011; Chakrabarti and Soundalgekar, 2003). In this sense, the pattern recognition method consists of three fundamental steps: data collection and selection, pre-processing, and data mining.

2.1. Mendeley Data Datasets

Mendeley's data repository is free-to-use and open access, which includes nearly 11 million indexed datasets. It enables us to deposit any research data, including raw and processed data, video, code, software, algorithms, protocols, and methods associated with the research manuscript (https://data.mendeley.com/datasets).

The first phase to do this was performed using an algorithm developed based on the Mendeley platform. This API allows the collection, as provided authentication between the user and the server. Subsequently, the algorithm performs authentication and starts the automatic collection. This collection is based on using the Mendeley API methods to perform queries, returning data regarding documents such as title, document type, year of publication, abstract, keywords, among others.

The entire collection is generated using links that are created according to the instruction available on the Mendeley website for developers. In the case of this study, we used the method search catalog, which allows a vast collection of documents, requiring the use of a specific parameter, which can be a title, author, source, or abstract. After this, it is necessary to separate the query words into four categories, as was observed to separate the documents which have open access concerning others.

Among other things, the research caused the breakdown of Proceedings and Journal creating two more categories, which were named Open_Proceedings and Open_Journal. This separation was possible due to a parameter in Mendeley called open access. If true for this rule is assigned, the return will be all documents that have open access in Mendeley. Table 1 shows the universe of 16,091,264 documents collected.

Table 1. Data categories with the total universe of documents found

Categories of data	Universe	Publication's last revision date
Open_Proceedings	3,416	26/07/2017
Proceedings	1,696,118	26/07/2017
Open_Journal	815,794	26/07/2017
Journal	13,575,936	26/07/2017

2.2. UCI Machine Learning Repository

UCI is a repository containing at least 100s of datasets from the University of California, School of Information and Computer Science. It classifies the datasets by the type of machine learning problem, allows us to find datasets for univariate and multivariate time-series datasets, classification, regression, or recommendation systems. Some of the datasets at UCI are already cleaned and ready to be used (https://archive.ics.uci.edu/ml/index.php).

The second phase of the method was based on the pre-processing in a series of actions to reduce noise in the data collected. In this context, pre-processing techniques support algorithmic research, improving efficiency, and facilitating the data mining process. At the same time, they allow the researcher to understand the nature of the data better to be mined.

All the procedures used were designed considering the criteria established by the naive Bayes algorithm, which presents a model based on the UCI machine learning repository database. This site is a repository of machine learning databases developed by the University of California Irvine that presents some standards for dataset composition. In this sense, a model for nominal data was used, since the naive Bayes algorithm has the supervised learning paradigm, and after all necessary treatments, such as selection and elimination of possible duplicate documents, the data collected was reduced.

Table 2 points to a significant reduction in data, which indicates that the collected universe contains noises that may impact other future processes. Therefore, it presents the subset that will be used when generating the files with the transformed data for classification by naive Bayes algorithm.

Table 2. Data categories with the universe, sample, and percentage of sample in relation to the universe after pre-processing

Categories of data	Universe	Sample	Sample (%)
Open_Proceedings	3,416	359	10.51%
Proceedings	1,696,118	70,615	4,16%
Open_Journal	815,794	166,450	20,40%
Journal	13,575,936	3,351,413	24,68%

2.3. Pre-processing and Data Mining

The third and final phase is responsible for handling the documents selected in the pre-processing to be adapted for the naive Bayes classifier. This adaptation basically consists of converting the attributes of the documents obtained to nominals, carrying out a process called discretization. Herein, such a process is based on establishing value ranges for numeric attributes, which allow us to try to adapt the best way possible to the Naive Bayes algorithm since it does not support the implementation of this type.

The naive Bayes classifier was implemented in Java code, and then experiments were carried out using the cross-validation method, in order to provide statistical support for the correct evaluation of the results, thus allowing the determination of a more suitable model for the proposed application (Dietterich, 1997). For this work, we developed a percentage discretization model, which basically consists of distributing each document to a respective output class based on the number of readers, in such a way that it can name the output classes.

Percentage values were obtained by searching the database for the document with the largest number of readers. After that, each document, the numerical value is converted into a percentage and then allocated to the corresponding value range. The calculation basically works as a rule of three, where a ratio is made between the value to be discretized and the highest value in the database. The results obtained in this process are allocated according to the appropriate range, which is divided into three subcategories, so-called: five output classes, three output classes, and two output classes. Table 3 shows the naming for the attributes of the classes in these subcategories.

Table 3. Subcategories with their respective possible classes

Subcategories	Possible classes
Five Output Classes	Not_Popular, Little_Popular, Popular, Very_Popular, Extremely_Popular
Three Output Classes	Not_Popular, Popular, Extramely_Popular
Two Output Classes	Not_Popular, Extremely_Popular

3. RESULTS AND DISCUSSION

In this work, a set of test examples was used considering the name of the subcategory. Thus, we chose to collect an example for each output class from the database at random. However, the result obtained after the classification, may not present the same class, since it will depend on the training of the classifier

in the database. The classes in the examples follow the order to the naming of outputs, which are shown in Table 3, and their results will be presented in a specific graph for each subcategory.

3.1 Five Output Classes

Tables 4 to 7 show, as a measure of the random error, the confusion matrix, and the percentage of correctly classified examples (PCCE) for five output classes at Open_Proceedings, Proceedings, Open_Journal, and Journal, in that order.

Table 4. Confusion matrix and PCCE for the subcategory five output classes at Open_Proceedings

	Negative	Positive	Negative	Positive	Negative
Negative	**131**	21	10	12	4
Positive	46	**24**	6	0	1
Negative	27	6	**17**	6	3
Positive	7	2	1	**9**	2
Negative	6	3	3	0	**8**
			PCCE	53%	

Table 5. Confusion matrix and PCCE for the subcategory five output classes at Proceedings

	Negative	Positive	Negative	Positive	Negative
Negative	**50,009**	1,572	212	1	1
Positive	11,242	**2,192**	213	0	0
Negative	2,961	49	**216**	1	1
Positive	666	9	65	**9**	1
Negative	493	1	37	0	**4**
		PCCE		74%	

Table 6. Confusion matrix and PCCE for the subcategory five output classes at Open_Journal

	Negative	Positive	Negative	Positive	Negative
Negative	**46,353**	7,926	2,440	2,239	1.252
Positive	22,770	**9,780**	3,476	2,985	1,057
Negative	11,547	6,536	**4,379**	4,221	1,579
Positive	6,189	4.,015	3,458	**6,077**	3,293
Negative	2,323	1,268	1,322	3,821	**6,139**
			PCCE	44%	

Table 7. Confusion matrix and PCCE for the subcategory five output classes at Journal

	Negative	Positive	Negative	Positive	Negative
Negative	**683,043**	160,138	42,382	390,240	240,703
Positive	257,658	**334,004**	204,221	154,326	10.242
Negative	4,636	16,810	**405,076**	6,645	407
Positive	52,020	49,866	33,831	**111,331**	81,139
Negative	31,018	22,390	11,047	6,531	**41,709**
			PCCE	47%	

When looking at the tables, it is clear that the PCCE was between 40% and 60%, with the exception of Table 5 with 74%. All in all, however, everything points to this being the best solution, because it is a workable solution for this subcategory due to the lower margin of error. Figures 1 to 4 show the results found by the algorithm after the execution of the test examples for subcategory five output classes.

Figure 1. Test examples for the subcategory five output classes at Open_Proceedings.

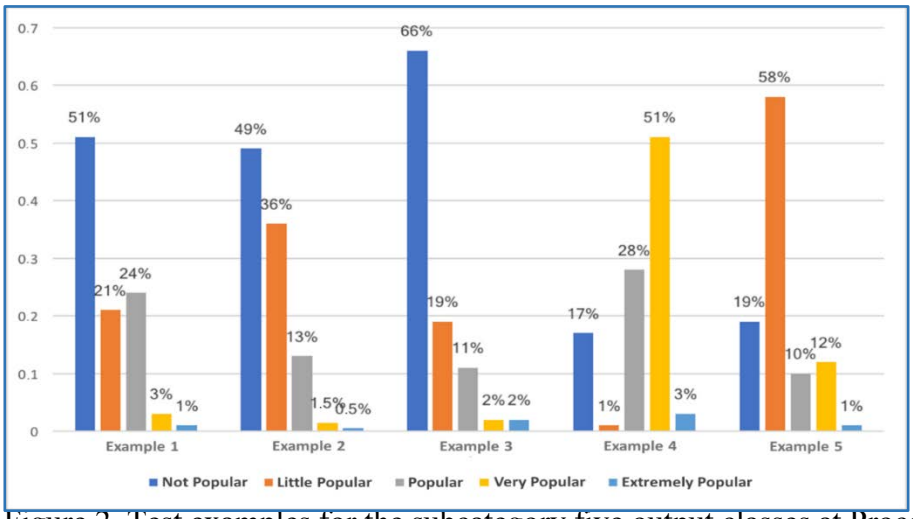


Figure 2. Test examples for the subcategory five output classes at Proceedings.

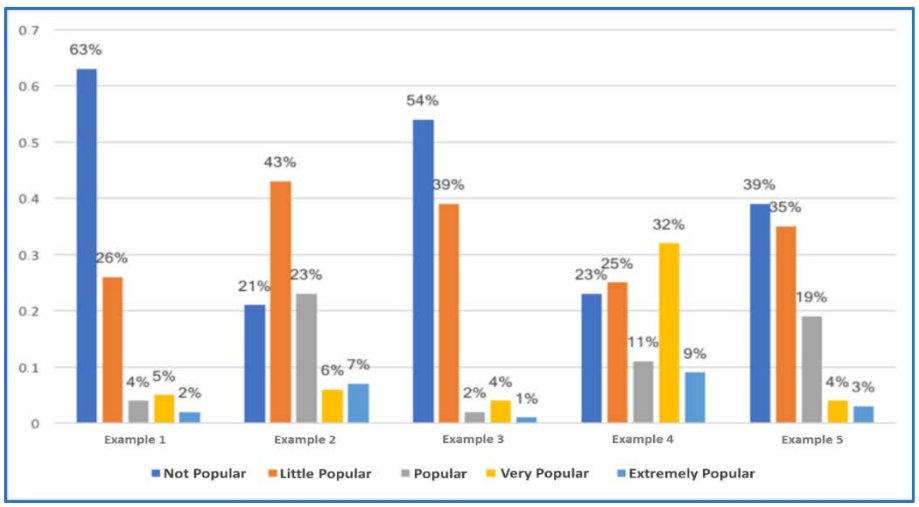


Figure 3. Test examples for the subcategory five output classes at Open_Journal.

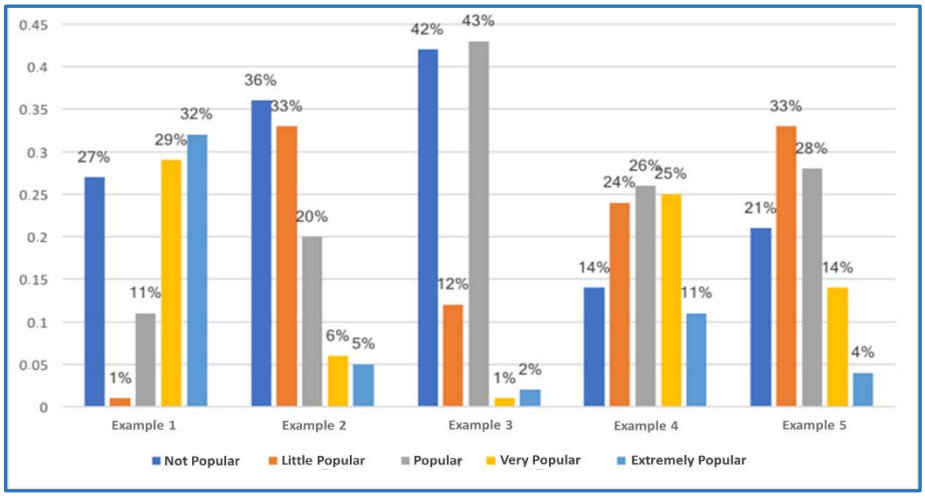


Figure 4. Test examples for the subcategory five output classes at Journal.

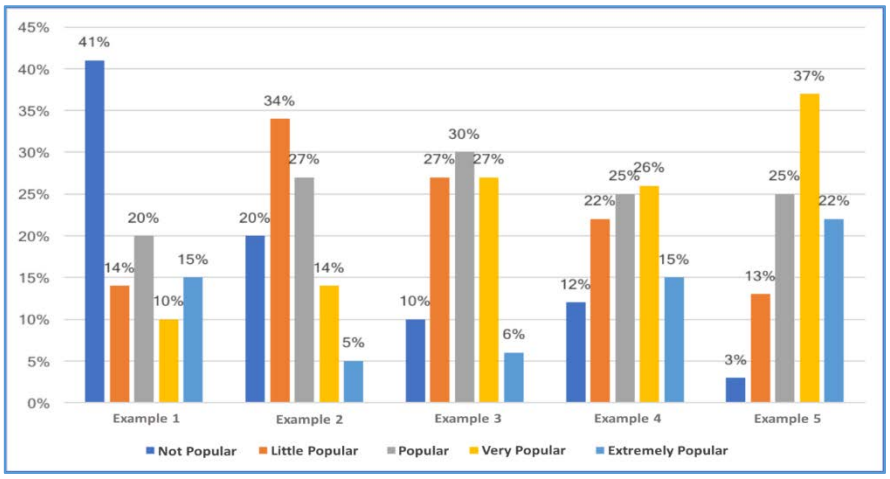


Figure 1 shows the algorithm performance for examples 1, 2, and 3 as not popular, while example 4 presented the class very popular, and example 5 as little popular. In Figure 2, it can be seen that the naive Bayes algorithm foresaw examples 1, 3, and 5 as not popular, for example 2 as little popular, and example 4 as very popular. In Figure 3, it can be seen that the algorithm classified example 1 as extremely popular, example 2 as not popular, examples 3 and 4 as popular, and example 5 was classified as a little popular. Finally, in Figure 5, it is noted that the algorithm classified example 1 as not popular, example 2 as a little popular, example 3 as popular, and examples 4 and 5 as very popular.

3.2. Three Output Classes

Table 8. Confusion matrix and PCCE for the subcategory three output classes at Open_Proceedings.

	Negative	Positive	Negative
Negative	**124**	20	34
Positive	63	**32**	19
Negative	20	7	**37**
	PCCE	54%	

Table 9. Confusion matrix and PCCE for the subcategory three output classes at Proceedings.

	Negative	Positive	Negative
Negative	**50,217**	1,018	560
Positive	11,296	**1,767**	584
Negative	3,978	558	**637**
	PCCE	75%	

Table 10. Confusion matrix and PCCE for the subcategory three output classes at Open_Journal.

	Negative	Positive	Negative
Negative	**59,313**	23,540	594
Positive	22,859	**43,238**	2,030
Negative	1,528	9,802	**3,543**
	PCCE	64%	

Table 11. Confusion matrix and PCCE for the subcategory three output classes at Journal.

	Negative	Positive	Negative
Negative	**1,060,913**	420,061	221,919
Positive	154,063	**739,921**	121,656
Negative	189,649	416,461	**226,770**
	PCCE	60,5%	

The PCCE values presented in Tables 9, 10, and 11 show a smaller error result for the subcategory three output classes when compared to five output classes. Figures 5 to 8 present the results found by the algorithm after the execution of the test examples for three output classes.

Figure 5. Test examples for the subcategory three output classes at Open_Proceedings.

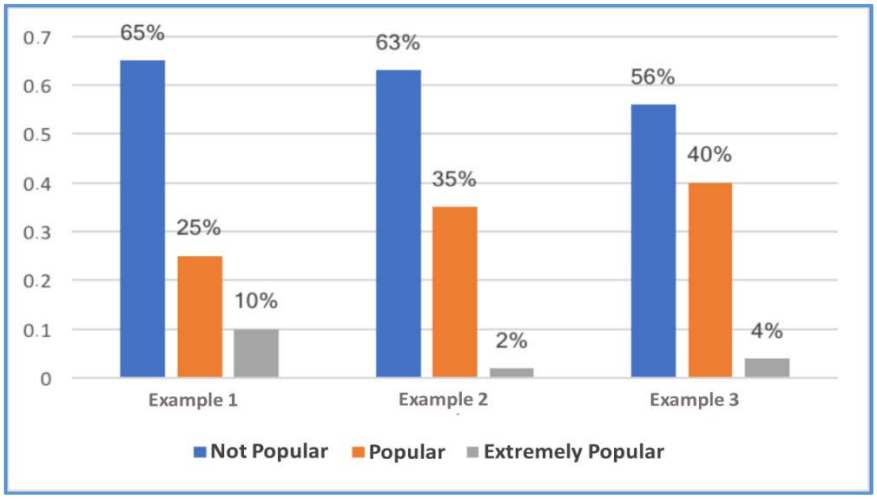


Figure 6. Test examples for the subcategory three output classes at Proceedings.

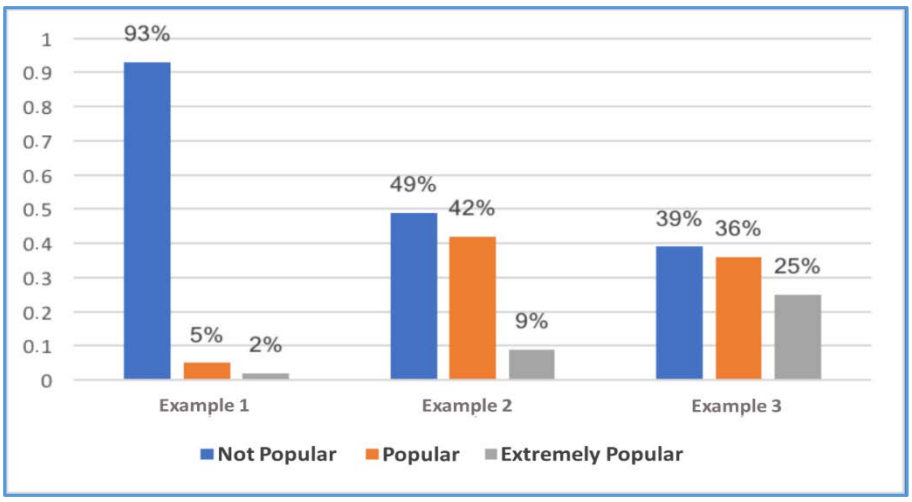


Figure 7. Test examples for the subcategory three output classes at Open_Journal.

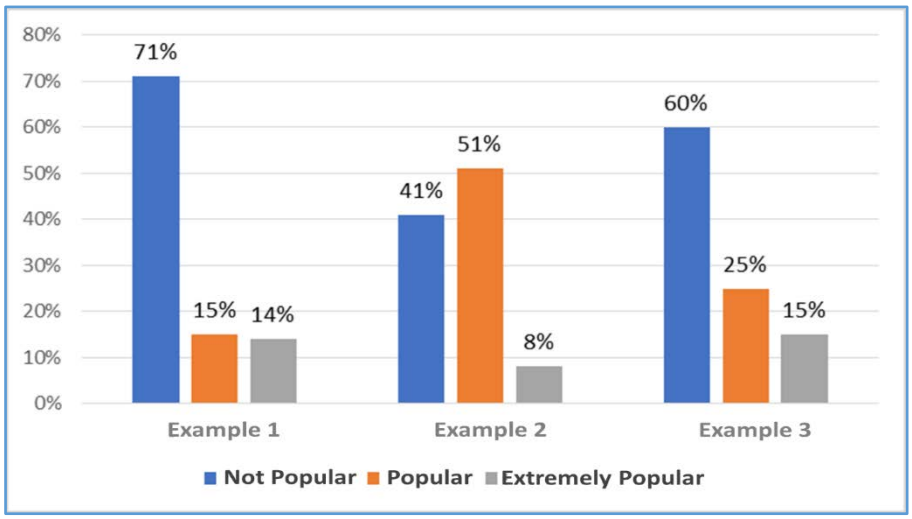
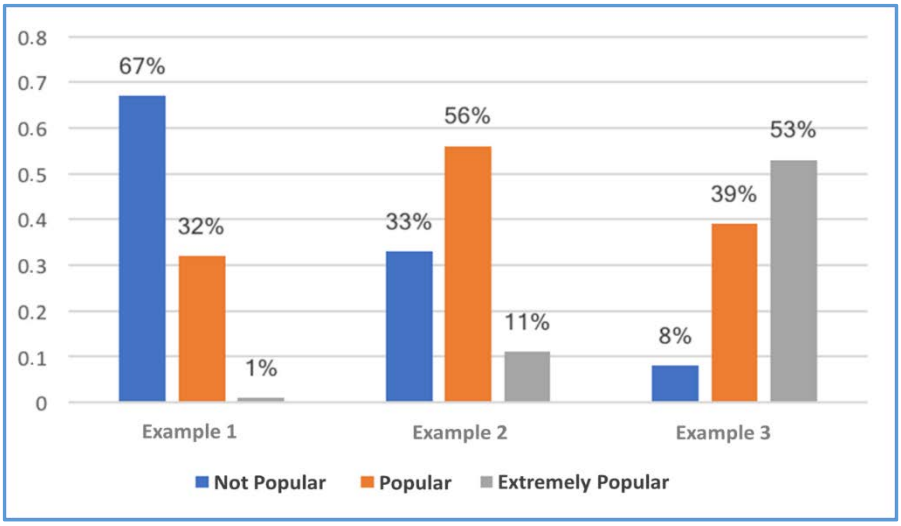


Figure 8. Test examples for the subcategory three output classes at Journal.



Figures 5 and 6 show the best algorithm performance for the test examples as not popular. While example 4 presented the class very popular, and example 5 as a little popular. In Figure 7, as well as in Figure 8, it

is noted that the algorithm classified example 1 as not popular, example 2 as popular and 3 as extremely popular.

3.3. Two Output Classe

Table 12. Confusion matrix and PCCE for the subcategory two output classes at Open_Proceedings.

	Negative	Positive
Negative	**214**	41
Positive	56	**43**
PCCE	73%	

Table 13. Confusion matrix and PCCE for the subcategory two output classes at Proceedings

	Negative	Positive
Negative	**42,404**	9,391
Positive	7,196	**11,624**
PCCE	77%	

Table 14. Confusion matrix and PCCE for the subcategory two output classes at Open_Journal

	Negative	Positive
Negative	**98,316**	13,989
Positive	25,643	**28,490**
PCCE	76%	

Table 15. Confusion matrix and PCCE for the subcategory two output classes at Journal

	Negative	Positive
Negative	**2,040,763**	245,312
Positive	525,513	**539,825**
PCCE	77%	

This subcategory showed a significant increase in PCCE when compared to the subcategories, three classes of output, and five classes of output. The algorithm still has a margin of error, but much smaller compared to the others. Figures 9 to 12 show the results found by the algorithm after running the test examples for the subcategory two output classes.

Figure 9. Test examples for the subcategory two output classes at Open_Proceedings.

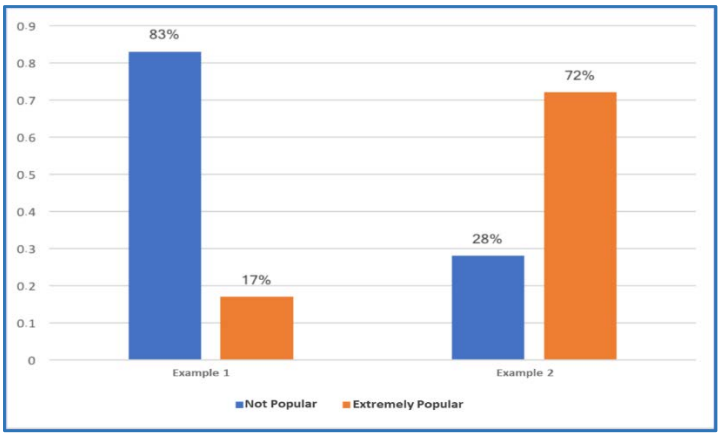


Figure 10. Test examples for the subcategory two output classes at Proceedings.

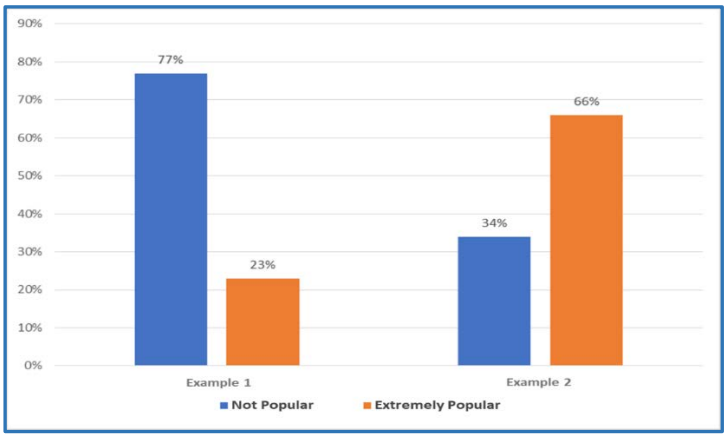


Figure 11. Test examples for the subcategory two output classes at Open_Journal.

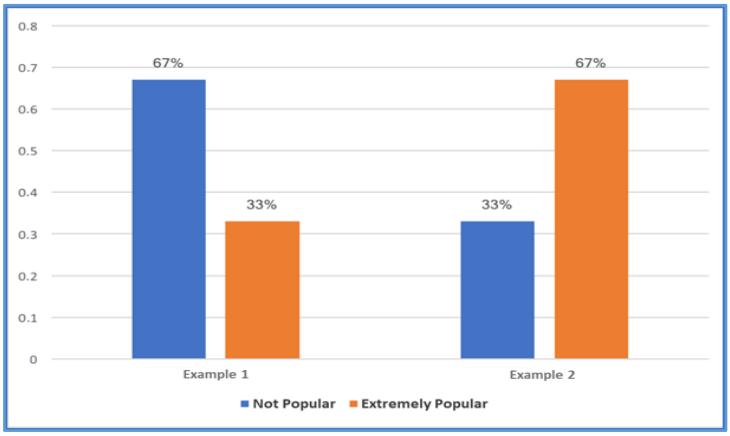
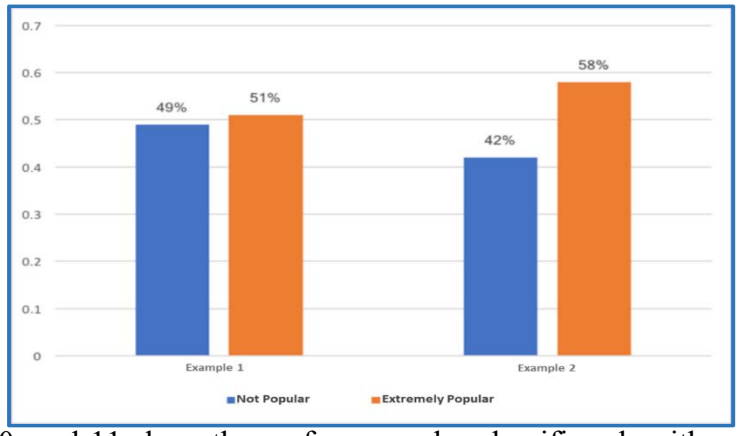


Figure 12. Test examples for the subcategory three output classes at Journal.



Figures 9, 10, and 11 show the performance by classifier algorithm for the test examples as not popular and extremely popular, respectively. In Figure 10, both tests were rated as extremely popular. All data categories showed better results in this situation.

4. FINAL CONSIDERATIONS

While citations appear as the relational metric of influence in the impact factor of the evaluative bases of scientific articles, the popularity of scientific themes has a strong relationship with the statistical analysis of scientific social networks. Thus, this work presented an exploratory research that involved the classification of scientific documents using the Mendeley database and the Naive Bayes algorithm. Based on the results, the percentage discretization model reiterates that the subcategory "two output classes" showed better results, taking into account that the PCCE was higher compared to the other subcategories. The training examples in this case showed better distribution, leaving the subcategory more balanced. It is worth mentioning that this proposal does not intend to enter into the merits of the discussions about impact factors, although it presents a contribution within the scope of the SNS and its importance by using naive Bayes classifier.

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Influence of Headteachers' Communication Planning Practices on Management performance in Public Primary Schools in Thika West Sub-county, Kiambu County, Kenya

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Abstract

Communication is very critical in primary school management by ensuring that there is improved efficiency. However, in many primary schools in Thika West Sub-county encounter challenges which border on school management such as unhealthy staff relations, imprudent use of financial resources, poor maintenance of facilities, imprudent time management and under-utilization of instructional materials are on the rise. Thus, this study sought to assess the influence of headteachers' communication planning practices on management performance in public primary schools in Thika West Sub-county, Kiambu County, Kenya. The study was guided by the communication theory and school management theory. The study adopted mixed methodology and concurrent triangulation research design. Qualitative data were analyzed thematically along the objectives and presented in narrative forms. Quantitative data were analyzed descriptively using frequencies and percentages and inferentially using ANOVA Test Analysis using Statistical Packages for Social Science (SPSS Version 23) and presented using tables. The study established that headteachers' communication planning practices influence on management performance in primary schools. The study recommends that headteachers should ensure that they design the content of message to be relayed and also identify the specific recipients of their information to be communicated. Headteachers should adopt layers of communication which are efficient and provide immediate and objective feedback. Headteachers should adopt forms of communication to suit every occasion to avoid interruptions. Headteachers should adopt a feedback mechanism which guarantees efficiency and prudence in school management.

Keywords: Headteachers' communication planning practices, management performance in primary schools

Introduction

Communication is a common activity among people. According to Alvesson (2002), a historical genesis of communication point to the fact that a traditional way to describe communication is as a process including a sender, a message, channels, a receiver and feedback. Before 1980, there was one dominating perspective in organizational communication, that is, the classical perspective, which means a positivistic transmission perspective building on classical organizational theories (Alvesson, 2002). During the last 10 to 15 years, the field has evolved through influences from other research areas. New perspectives such as interpretative, critical, postmodern and feminist perspectives have changed the rhetoric and understanding of organizational communication (Begley, 2001). In other words, there are and have always been conversations about schools and how they should be managed and lead to achieve good results. During the last years, there has been an increased attention on how to measure and understand what activities and actions that lead to certain results.

However, for communication to be effective, headteachers ought to draw a communication plan. A communication plan describes what an organization wants to accomplish with the information it sends out. It lists objectives, the tools used to produce communications and intended recipients. According to De Ridder (2003), a communicant plan describes what information will be shared and how it will be distributed. The plan also identifies the people responsible for building and managing information, when it should be communicated and where records should be stored (De Ridder, 2003). Effective communication planning is crucial to any organization and schools are no different. With a comprehensive communication plan, headteachers are able to promote their schools to parents and the community, connect with current learners, attract future ones and even successfully engage staff members.

To corroborate these assertions, Dolphin (2005) posits that a solid, actionable plan is critical for school communications success, but things are moving pretty fast these days for even the savviest communicators. Dolphin (2005) further asserts that an up-to-date school communication plan helps headteachers to utilize the increasing array of tools available to school communicators. To lend credence to these assertions, Goodman and Dean (2014) conducted a study in San Francisco which revealed that, given the variety of kinds of information and the modern channels for delivering school info, planning and allocating resources has never been more important. Goodman and Dean (2014) indicated that, from crisis communications and urgent, time-sensitive matters to the lunch menu postings, to developing a speaker's bureau for their schools, a communication plan makes the life of a school head a lot easier. These findings point to the fact that how schools handle websites, social medias, emergency notifications, simple school newsletters depends on and should come into play in one comprehensive communications plan. Even such mundane communications such as posting scores to athletics events and keeping school calendar current, can be addressed in a comprehensive school communications plan. Such plans have a well-defined source, recipients, time and the kinds of information to be communicated. Goodman and Dean (2014) further suggested that schools need to use teamwork to plan and gather the right content. In Germany, for example, Jablin and Putnam (2001) report that once the school heads have clarified school objectives and got a full understanding of the different audiences they need to communicate with, it's time to plan the

communications, that is, they need to work out the messages needed to meet their objectives and when and how such messages will be delivered.

Jablin and Putnam (2001) reported that the first step in defining school head's communication plan is figuring out what kind of communication his or her intended audience need from the project so they can make good decisions. In most countries in Sub-Saharan Africa, there is recognition of the relevance of communication planning in school management. Lewis (2008) asserts that many school heads in Africa note that a communication plan acts as proactive measure to ensure that everyone has the right information in a timely manner. For example, in a study conducted in Nigeria, Adeniyi (2003) established that communication plan describes who produces each type of communication and how frequently it gets updated or distributed. Adeniyi (2003) notes that prioritizing the communication needs helps the schools identify how much time needs to be allotted to these tasks in overall organizational planning. The study further established that communication plan specifies the types of messages and who should receive them. Clear identification of the audience and its needs makes writing the communication much easier (Adeniyi, 2003). For example, school newsletters directed at staff members should contain details about upcoming events, provide recognition for outstanding performance and solicit input on mission statements and other school discussion points. Adeniyi (2003) further noted that communication objectives should signal desired audience outcomes such as increased awareness or a desired individual behaviour. In most primary schools in Kenya and Thika West Sub-county in particular, planning for communication has been identified as critical for school management (Kindiki & Stewart, 2011). In a study conducted in a sample of primary schools in Machakos County, Musyoka and Peterson (2012) underscored the fact that a school's strategic communications plan should have internal and external components. Musyoka and Peterson (2012) noted that an internal communications plan is for everyone who has ever been involved in the planning of your initiative. This includes people such as all of your foundation staff and board members who have been involved conceptualizing and developing the initiative, planning team members, advisory council members, the community members who have ever participated in planning meetings, and other involved stakeholders (Musyoka & Peterson, 2012). Internal communication strategies for those most closely involved in current planning efforts, such as an e-newsletter to keep all the planning team members appraised of what each other is doing, will be very different from strategies to connect with broader stakeholders who don't yet know about your efforts, such as policymakers, media and community members.

In Thika West Sub-county, primary school heads usually communicate with their staff on different ways which require an organized plan. However, Okoth and Anderson (2010) report that many primary school headteachers rarely adopt educational communications system which employ sufficient communications paths and operational capabilities among all participants to facilitate functional school division, school and public communications. Okoth and Anderson (2010) noted that, as modern communications channels expand and evolve, it's important that a school's communications plan keep up with the ever-changing landscape. Factor in keeping up with the technology, staffing, privacy and confidentiality issues, and it can be challenging to put together a relevant, effective plan. For public primary schools that are under increasing scrutiny to be fiscally responsible with public funding, to private schools that need to be marketing savvy in competition for enrollment, all institutions need to make the most of the precious

resources allotted for communications budgets. However, Okoth and Anderson (2010) as did other empirical researchers failed to interrogate the extent to which different components of communication plans adopted by primary school heads influence management performance in primary schools.

Statement of the problem

Communication is essential for understanding roles and assignments; planning and carrying out learning activities; coordinating approaches with learners; providing information to teachers on learner progress and behaviours; and building a positive relationship with learners, teachers and other staff. However, in Thika West Sub-county, many primary schools still encounter challenges which border on school management and decision-making. Public primary schools have received warnings from the Ministry of Education concerning imprudent management of school resources following complaints from stakeholders such as parents and Quality Assurance Officers. Cases of unhealthy human resource relations, imprudent time management and under-utilization of curriculum support materials are on the rise. In Thika West Sub-county, managerial efficiency is still wanting in many primary schools. Despite these observations, many empirical studies have not interrogated how headteachers' communication planning practices influence management performance in public primary schools.

Theoretical Framework

This study was guided by the communication theory which was proposed by Anderson (1996). This theory postulates that all living beings existing on the planet communicate although the way of communication is different. One of the principles of this theory is that all living beings whether they are plants, animals, human beings communicate through sound, speech, visible changes, body movements, gestures or in the best possible way to make the others aware of their thoughts, feelings, problems, happiness or any other information. Anderson (1996) hold that communication theory provides a clear understanding of how different aspects of discussions about decision-making are important. Different views about this theory each provide clear means of conceptualizing and discussing communication problems and practices. These ways derive from and appeal to certain commonplace beliefs about communication while problematizing other beliefs. Anderson (1996) argues that communication is the process of transferring information from the sender to the recipient where the recipient decodes the information and acts accordingly.

In the context of this study, communication theory fits in that, for headteachers to effectively run school operations, they need to communicate with education stakeholders. This theory underscored the fact that the central social issues have to do with who participates in what ways in the social processes that construct personal identities, the social order and codes of school communication. Although theoretical ideas about communication have been developed in various disciplines with incommensurable intellectual agendas, it is nevertheless a reasonable working assumption that every one of those ideas is potentially relevant to practice of effective school management. For this to be realized, careful planning, proper channels and forms of communication, school bureaucracy and expected feedback should be identified. The study was also guided by the school management theory which was postulated by Kuo (2009). This theory addresses how managers and administrators relate to their organizations in the knowledge of its goals, the

implementation of effective means to get the goals accomplished and how to motivate employees to perform to the highest standard.

The central focus of this study is that although school managers in different parts of the world could have achieved managerial success without having basic theoretical knowledge in management, those managers, who have adopted this theory in their day-to-day practice, have had better chances of managing their organizations effectively by considering communication to ensure prudent management of schools. Thus, the rationale of using this theory in this study is that to enhance effective school management performance in public primary schools, headteachers ought to understand how to organize school management resources and effectively communicate the same to the teachers, learners and other education stakeholders within and outside the schools.

Delimitations of the Study

This study was conducted in public primary schools in Thika West Sub-county only. The study focused on the influence of headteachers' communication planning practices on management performance in public primary schools. The study adopted mixed methodology and thus applied concurrent triangulation research design. Questionnaires were applied to gather quantitative data from teachers whereas interview guide was applied to collect qualitative data from headteachers and support staff.

Research Methodology

The study adopted mixed methodology and concurrent triangulation research design. The target population totaled 960 respondents comprising of 36 headteachers, 744 teachers and 180 support staff from which a sample of 300 respondents was selected using Central Limit Theorem. Stratified sampling was applied to create five strata based on the number of zones in Thika West Sub-county. From each zone, two headteachers and nine (9) school support staff were selected using purposive sampling. However, 49 teachers from each zone were selected using simple random sampling. This procedure enabled the researcher to sample 10 headteachers, 245 teachers and 45 school support. Data analysis began by identifying common themes. Qualitative data were analyzed thematically along the objectives and presented in narrative forms. Quantitative data were analyzed descriptively using frequencies and percentages and inferentially using ANOVA Test Analysis using Statistical Packages for Social Science (SPSS Version 23) and presented using tables.

Results and Discussions

The study sought to:

i. Assess the status of management performance in public primary schools in Thika West Sub-county.
ii. Examine the influence of headteachers communication planning practices on management performance in public primary schools in Thika West Sub-county.

Response Rate

In this study, 245 questionnaires were administered to teachers and, in return, 218 questionnaires were filled by teachers and returned. The researcher also interviewed eight headteachers and 39 school support staff. This yielded response rates shown in Table 1;

Table 1: Response Rates

Respondents	Sampled Respondents	Those Who Participated	Achieved Return Rate (%)
Headteachers	10	8	80.0
Teachers	245	218	89.0
School Support Staff	45	39	86.7
Total	**300**	**265**	**88.3**

Source: Field Data (2020)

Table 1 shows that headteachers, teachers and school support staff registered a response rate of 88.3%. 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.

Status of Management Performance in Public Primary Schools

The study sought to assess the status of management performance in public primary schools. Descriptive data were collected and results are shown in Table 2;

Table 2: Views of Teachers on Status of Management Performance in Primary Schools

Indicators of School Management	Very Good	Good	Fair	Below Average
	%	%	%	%
Human resource relations	0.0	44.0	21.1	34.9
Time management	0.0	51.8	22.9	25.3
Utilization of curriculum support materials	0.0	53.2	23.9	22.9

Source: Field Data (2020)

Table 2 shows that 44.0% of the teachers indicated that human resource relations in public primary schools is good, 21.1% indicated fair whereas slightly more than a third (34.9%) indicated that human resource relations in schools are below average. These findings corroborate the findings of Kennedy (2005) that schools with a common sense of purpose and strong communal organization involving healthy and collegial relationships among staff and positive learner relationships are efficient in promoting a range of academic and social outcomes reflecting learners' engagement and commitment. These findings point to the fact that human resources such as teachers, pupils and staff form a major component of school management and thus, the nature of their relations is key to the success of any primary school. On the question of time management, slightly more than half (51.8%) of the teachers indicated that time management in public primary schools is good, 22.9% indicated fair while slightly more than a quarter (25.3%) indicated that time management is below average.

In the same token, slightly more than half (53.2%) of the teachers noted that utilization of curriculum support materials is good, 23.9% indicated fair whereas 22.9% indicated below average. These findings further lend credence to the assertions of Allan (2001) that accounting systems provide a source of information to primary school managers in the measurement of school performance. According to Allan (2001), it is crucial therefore that the management practices of school headteachers supply complete and relevant information needed to improve efficiency in decisions they make, meet deadlines and improve time management. Hence, these findings point to the fact that, despite the challenges with management of different aspects in primary schools, prudent management of school resources is key to the success of such schools. In other words, perceived profitability and success in achieving school objectives are positively associated with planning detail, suggesting that strategic planning is a key component in improving school discipline, managerial efficiency and learners' performance.

Qualitative findings were also obtained by interviewing the headteachers and school support staff. During the interviews, unlike teachers, headteachers responded in favour of the view that human resource relations in public primary schools is good. Headteacher, H1, noted;

> *"In my primary school, there has been healthy relations amongst members of staff and learners. We have had very few cases which border unhealthy interpersonal relationships among staff members and pupils"*

These views were also echoed by the school support staff. Just like quantitative findings, these views also corroborate the views expressed by Kennedy (2005) that schools with a common sense of purpose and strong communal organization involving healthy and collegial relationships among staff and positive learner relationships are efficient in promoting a range of academic and social outcomes reflecting learners' engagement and commitment. On the question of headteachers and school support staff also concurred with teachers that time management in public primary schools is fairly good just like utilization of curriculum support materials. These views further lend credence to the viewpoints held by Allan (2001) that it is crucial therefore that the management practices of school headteachers supply complete and relevant information needed to improve efficiency decisions they make, meet deadlines and improve time management. Therefore, as noted earlier, despite the challenges with management of different aspects in primary schools, prudent management of school resources is key to the success of such schools.

Headteachers' Communication Planning and Management Performance in Primary Schools

The study sought to examine the influence of headteachers' communication planning on management performance in public primary schools. To achieve this, descriptive data were collected from teachers and the results are shown in Table 3;

Table 3: Views of Teachers on the Influence of Headteachers' Communication Planning on Management Performance in Public Primary Schools

Summary of Test Items	SA %	A %	U %	D %	SD %
Headteachers sometimes send information to wrong recipients during communication	71.1	12.1	1.3	10.1	5.3

Headteachers rarely organize meetings with prior notice which has not improved school management	66.9	13.2	2.4	12.7	4.8
Staff usually receive information from headteachers without taking into consideration their time schedule	80.5	12.4	1.6	3.3	2.2
In public primary schools, sometimes headteachers send wrong information content to staff and has negatively affected school management	67.4	19.7	3.5	5.3	4.1

Source: Field Data (2020)

Table 3 shows that 71.1% of the teachers strongly agreed with the view that headteachers sometimes send information to wrong recipients during communication. 12.3% agreed. However, only a paltry 1.3% were undecided, 10.1% disagreed whereas 5.3% strongly disagreed. The study also revealed that 66.9% of the teachers strongly agreed with the view that headteachers rarely organize meetings with prior notice which has not improved school management as did 13.2% of the teachers. 2.4% were undecided, 12.7% disagreed whereas 4.8% strongly disagreed. These findings corroborate findings of a study carried out in Germany in which Jablin and Putnam (2001) established that once the school heads have clarified school objectives and got a full understanding of the different audiences they need to communicate with, it's time to plan the communications, that is, they need to work out the messages needed to meet their objectives and when and how such messages will be delivered. This implies that the first step in defining school head's communication plan is figuring out what kind of communication his or her intended audience need from the project so they can make good decisions.

The study also revealed that 80.5% of the teachers strongly agreed with the view that staff usually receive information from headteachers without taking into consideration their time schedule as did 12.4% who agreed. 1.6% were undecided, 3.3% disagreed whereas 2.2% strongly disagreed. These findings lend credence to the assertions of Lewis (2008) that many school heads in Africa note that a communication plan acts as proactive measure to ensure that everyone has the right information in a timely manner. The study also revealed that 67.4% of the teachers strongly agreed with the view that, in public primary schools, sometimes headteachers send wrong information content to staff and has negatively affected school management whereas 19.7% agreed. 3.5% were undecided, 5.3% disagreed whereas 4.1% strongly disagreed.

These findings are inconsistent with the findings of a study conducted in Nigeria in which Adeniyi (2003) established that communication plan describes who produces each type of communication and how frequently it gets updated or distributed. Adeniyi (2003) notes that prioritizing the communication needs helps the schools identify how much time needs to be allotted to these tasks in overall organizational planning. The study further established that communication plan specifies the types of messages and who should receive them. These findings affirm the fact that clear identification of the audience and its needs makes writing the communication much easier. This indicates that communication objectives should signal desired audience outcomes such as increased awareness or a desired individual behaviour.

In other words, despite not being a common practice among headteachers of public primary schools, different components of communication plans influence prudent management performance in primary

schools. To verify the possibility of difference between headteachers' communication planning practices and management performance in public primary schools, data were collected on how often headteacher draw communication plans (very often = 5, often = 4, sometimes = 3, rarely = 2 and never = 1) and number of staff cases, instructional time, frequency of using instructional materials in public primary schools. The results are shown in Table 9:

Table 4: Results of Frequency of Communication Planning, Status of Staff Relations, Time Management and Use of Instructional Materials in Primary Schools

Frequency of Communication Planning	Status of Staff Relations	Time Management	Use of Instructional Materials
1	1	1	1
1	1	1	3
1	1	1	3
2	1	2	3
2	2	2	3
3	2	2	4
4	3	3	4
5	4	4	4

Source: Field Data (2020)

Table 4 indicates that in public primary schools where headteachers draw communication plans very often or frequently, management of such primary schools is efficient and prudent. That it, primary schools where communication planning is very frequent, status of staff relations, time management and use of instructional materials are good. These findings further corroborate the assertions of Adeniyi (2003) that prioritizing the communication needs helps the schools identify how much time needs to be allotted to these tasks in overall organizational planning. In other words, communication planning objectives should signal desired audience outcomes such as increased awareness or a desired individual behaviour to enhance efficient and prudent management performance in primary schools. These results were subjected to ANOVA Analysis and results are shown in Table 5:

Table 5: ANOVA Analysis Showing the Difference Between Frequency of Communication Planning, Status of Staff Relations, Time Management and Use of Instructional Materials

		Sum of Squares	df	Mean Square	F	Sig
Frequency of Communication Planning		39.667	7	5.667		
Status of Staff	Time Management	9.667	5	1.933	8.120	.000
Relations	Use of Instructional Materials	8.333	35	.238		
	Total	18.000	40	.450		
Total		57.667	47	1.227		

Grand Mean = 2.4167

Source: SPSS Generated (2020)

From the ANOVA Statistics in Table 5, the processed data generated a significance level of 0.000 which shows that the data is ideal for making a conclusion on the population's parameter as the value of significance (p-value of 0.000) is less than 5%, that is, p-value=0.000<0.05. It also indicates that the results were statistically significant and that there is a significant difference between means of the frequency of communication planning, status of staff relations, time management and use of instructional materials. These results further point to the fact that prioritizing the communication needs helps the schools identify how much time needs to be allotted to these tasks in overall organizational planning. Thus, communication planning objectives should signal desired audience outcomes such as increased awareness or a desired individual behaviour to enhance efficient and prudent management performance in primary schools. The researcher also interviewed headteachers and school support staff. During the interview, headteachers refuted the claims that they rarely identify source and recipients of information during communication. Headteacher, H2, noted:

> *"In my primary school, I usually identify who the information is meant for, send information to the right recipients and set time for the expected feedback. There are messages meant for every staff and those meant for individual staff member. So, I must identify the recipient of my information to avoid confusion"*

However, the school support staff contradicted the views of the headteachers. School support staff, SSS1, indicated:

> *"In my school, the headteacher sometimes sends information to wrong recipients and organizes meetings without prior notice"*

Just like in quantitative findings, these views indicate that the first step in defining school head's communication plan is figuring out what kind of communication his or her intended audience need from the project so they can make good decisions.

On the issue of content to be communicated, headteachers disagreed with the teachers that they rarely set content to be relayed or communicated to any staff member. Headteacher, H3, noted:

> *"In my primary school, I have to design what is to be communicated to any staff member for which the information is intended"*

Similar views were expressed by school support staff who also stated that setting of content to be communicated is often set by the headteacher before relaying the information to concerned party or parties. Despite these contradictions, these views also indicate that setting or designing content or message to be relayed to any recipient is critical in any communication planning process. Hence, the audience and its needs make writing the communication much easier. In summary, these findings are indicative of the fact that communication objectives should signal desired audience outcomes such as increased awareness or a desired individual behaviour. However, despite not being a common practice among headteachers of public primary schools, different components of communication plans influence prudent management performance in primary schools.

SUMMARY OF FINDINGS AND CONCLUSIONS

From the study findings, it is evident that headteachers' communication planning practices and practices such as identification of sources and recipients of information during communication and setting of content to be communicated, though refuted by headteachers, are rarely practiced. Communication objectives should signal desired audience outcomes such as increased awareness or a desired individual behaviour. Thus, different components of communication plans influence prudent management performance in primary schools.

RECOMMENDATIONS

The study recommends that primary school heads should ensure that they clearly and objectively design the content of message to be relayed and also identify the specific recipients of their information to be communicated. This may help avoid confusion and unnecessary conflicts among staff and school management. The Ministry of Education and policy-makers should put in place policies which require headteachers to adopt bottom-up kind of communication where students are considered in school decision-making in order to reduce to cases of students' unrest and to improve staff relations.

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Exploring of teaching effect of course “vehicle chassis structure” based on the teaching mode of divided class

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Abstract

University is an important transit station for students to enter social life, undertaking the important mission of personnel training. Nowadays, a series of challenges exists in university education. It is very important to strengthen the teaching effect of cases in the classroom. The course “Vehicle chassis structure” is a compulsory professional course for undergraduate students majoring in automotive engineering. This work has proposed a teaching mode of divided class for the course of “Vehicle chassis structure”. And it can be concluded that the teaching effect can be improved largely via the teaching mode of divided class. The main purpose of this method is to improve students' initiative learning ability and mutual help and cooperation ability.

Keywords: Teaching method; divided class; vehicle chassis structure; teaching effect

1. Introduction

"Divided class" is a new teaching model proposed by Prof. Zhang Xue-xin in Fudan University, which is an innovative project of classroom teaching. This new teaching mode makes a systematic change from "teaching-oriented" to "learning-oriented" in the classroom via adjusting the relationship between teaching and learning. The so-called "bisection class" is the teacher and students "in half" class time. But this kind of segmentation is not as simple as splitting a lesson into two parts, with teachers "teaching" in half the time and students "learning" in the other half. Compared with the traditional class, the key point of "divided class" is to stagger "teaching" and "discussion" for a period of time, so as to form clear separation three processes: presentation, internalization and assimilation, discussion. The process of "internalization and absorption" is arranged after class and marked by the completion of high-quality study work. In general, at the beginning of the unit, students have to "exchange and discussion" on the unit one end of the teacher "white space" content, which is the most significant feature of "divided class" teaching, so it is also known as "separated class discussion". The basic flow is shown in Fig. 1.

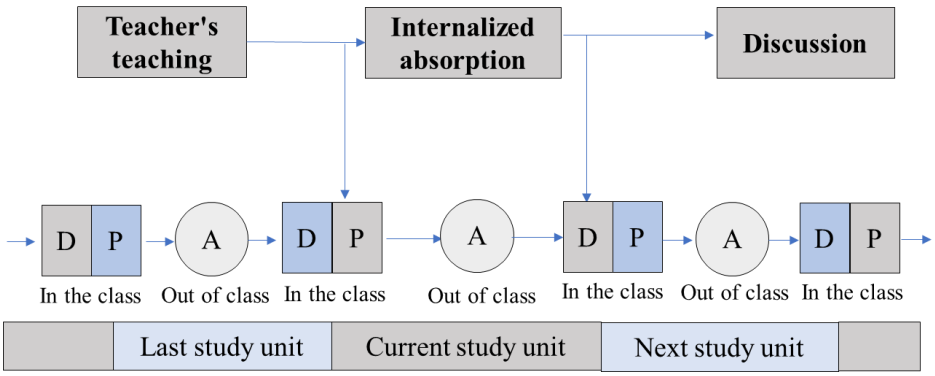

Fig. 1 The basic process of "interval discussion" in divided classes

2. Design and operation of the teaching mode of "divided class"

The course “Vehicle chassis structure” is a compulsory professional course for undergraduate students majoring in automotive engineering in Shanghai University of Engineering Science. There are various systems for the motor-vehicle chassis and much teaching emphasis needed to be mastered by the students. But there are still the similar learning methods to master these knowledges.

The object of this work is to design the teaching pattern of section of “transmission arrangement plan” in the course of "Vehicle chassis structure". On the basis of the existing teaching methods, means and examination methods, the teaching methods have been analyzed and improved. This teaching mode is uniformly arranged according to the three systems of "teacher's teaching + internalized absorption + discussion", and decomposed into six elements: "(teacher's teaching + literature supply) + (literature reading, report submission) + (student discussion + teacher-student discussion + optimal comment)".

(1) The teaching from teachers

The teacher explains one of the key transmission arrangement plan “Engine front-rear wheel drive” according to knowledge points set in advance.

(2) Literature supply

According to the chapter content, the teacher selects the representative literature about other transmission arrangement plans, except for “Engine front-rear wheel drive”, and then asks the students to read after class.

(3) Literature reading

This teaching process is completed by students after class. On the basis of the knowledge points about “Engine front-rear wheel drive” taught by the teacher, the students read the representative literature about other transmission arrangement plans. In order to avoid using translation software only, students are required to summarize the topics and main results of the literature, evaluate the advantages and disadvantages of other transmission arrangement plans. Through the literature reading, students can exercise their scientific research thinking ability and spirit, improve their ability to analyze, solve and find problems, and lay a solid foundation for their subsequent scientific research activities.

(4) Student discussion

In the discussion, 3-4 students can be set as one group. And the students can discuss about their own perspective and understanding about the transmission arrangement plans, which can not only improve their cognition of the literature, but also improve the enthusiasm of students in the process of eliminating doubts by themselves through mutual inspiration and promotion. At the same time, students in the discussion can exercise the ability of expression and critical thinking, learn to learn from the perspective of others, students to enhance understanding and deepen friendship. The teacher observed the participation of each student in the class and made corresponding records as the basis for the usual performance. It should be noted that the teacher should set the testing standard and the score distribution in advance for the performance difference between "group" and "individual" in the discussion process.

(5) Teacher-student discussion

The teacher can join with the students and answer the problems of the students, and a student spoke on behalf of the group to summarize the literature and analyze the problems. The teacher comments on the students' summary, answers the difficult questions, shares the scientific research thinking ability and spirit reflected in the literature with the students, summarizes the scientific research methods, carries on the scientific spirit education to the students, cultivates the students' scientific attitude, lays the foundation for the students' future scientific research life.

(6) Optimal comment

After the discussion, the teacher presents and comments on the excellent reading report, expounds the reasons for the excellence and points out the existing problems, which can help the students learn to fill in the gaps and make up for their own shortcomings with their own strengths, so that they can make continuous progress in the process of learning.

The basic flow is shown in Fig. 2.

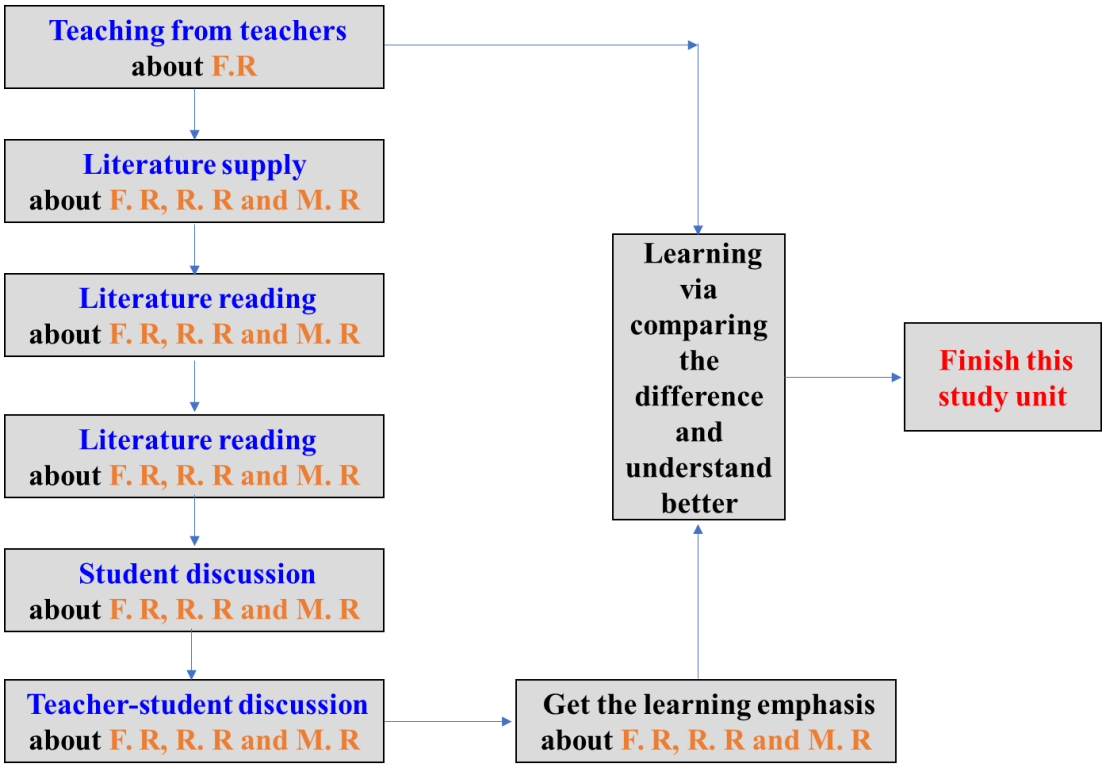

Fig. 2 The studying process of divided classes for "transmission arrangement plan" in the course of "Vehicle chassis structure"

3. Methods practice and results

Seen in Table 1, it is worth noting that via the teaching mode of divided class, the students can grasp and apply knowledge better. This is result from the students can enhance the understanding of the knowledge points through the exercising the ability of expression and critical thinking.

Table 1 The teaching effect of the course "vehicle chassis structure" course based on the teaching mode of divided class

Course	Understanding of the knowledge	Memory of the knowledge	Application of the knowledge	The final exam
Vehicle chassis structure	Improved	Improved	Improved	Improved

4. Conclusions

This paper proposed a teaching mode of divided class for the course of "Vehicle chassis structure". The main purpose of this method is to improve students' initiative learning ability and mutual help and cooperation ability. This method considers the interaction between teachers and students, and divides a

large number of students into module groups to realize the small class management mode. The advantages of this mode are mainly reflected in increasing the competition and mutual aid mechanism between the groups, which can make students realize the importance of team cooperation and cultivate competitive consciousness.

5. Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Visibility of Hospitalized Children: Right to Learning

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Abstract

The article results from a research developed in the Postgraduate Program in Health and Development of the Midwest Region, at the Federal University of Mato Grosso do Sul, carried out in the hospital classes of two public hospitals in Campo Grande / MS, between 2014 - 2016. We carried out a bibliographic survey on the topic, allowing us to reflect and discuss the visibility of hospitalized children. We verify how the children's learning process takes place in the hospital environment. The right to basic education belongs to all children, including those who are away from school due to illness. It is necessary to think about the locus of pediatric hospitals in order to develop activities in which the hospitalized child feels productive, in development, and with activities similar to other children of his age. The child must participate in activities that allow him to live on equal terms with other children and have the opportunity to be included in the knowledge acquisition process. Ceccim et al. (1997) affirm that the hospitalized child cannot be doubly penalized: to be sick and to be away from school, friends, games and organizations of space and time. Education is a right for all and a duty of the State and the family and is expressed as a right to learning and schooling. These rights are consolidated in article 214 of the Federal Constitution when expressing that the actions of Public Policies should lead to the universalization of specialized school attendance and in the Law of Guidelines and Bases of National Education in art. 5, by ensuring that the Public Power will create alternative forms of access to different levels of education. This service is characterized as Special Education for serving children considered to have special educational needs as a result of having curricular difficulties due to conditions of specific health limitations recovering the child in an inclusion process offering learning conditions.

Keywords: Hospital class; Hospitalized child; Education and health.

1. Introduction

The right to Basic Education belongs to all children, including those who are away from school due to illness. It is necessary to think about the *locus* within pediatric hospitals to develop these activities. It is important that the hospitalized child feels productive, developing, and with activities similar to other children his age. The child must participate in activities that live on equal terms with other children and the opportunity to be included in the process of acquiring knowledge.

Ceccim et al. (1997) recognize that the hospitalized child cannot be doubly penalized: first to be sick and, second, to stay away from school, friends, games and organizations of space and time that are contextual. Education is a right for all and a duty of the State and the family and is expressed as a right to learning and schooling.

These rights are consolidated in article 214 of the Federal Constitution when stating that the actions of Public Policies should lead to the universalization of specialized school attendance and in the Law of Directives and Bases of National Education when ensuring that the Public Power will create alternative forms of access at different levels teaching (art. 5 § 5), being able to be organized in different ways to guarantee the learning process (art. 23).

To work in the hospital, the teacher is legally supported at the national level, by the document entitled Hospital Class and Pedagogical Home Care: Strategies and Guidelines, created by the Ministry of Education (MEC), in 2002, this material points out some guidelines on the profile of the educator in this space.

The teacher works together with the multidisciplinary team (doctors, nurses, nursing technicians, pediatrician, psychologist), being part of the team assisting the student, both to contribute to health care and to improve teaching planning (BRASIL) , 2002). This research was carried out in the Postgraduate Program in Health and Development of the Central West Region of the Federal University of Mato Grosso do Sul, carried out in 2 (two) public hospitals in the city of Campo Grande-MS in the hospital class sector between 2014 - 2016.

In the course of its realization, we carried out a bibliographic survey on the theme, which allowed us to reflect, discuss the child's visibility as well as the Hospital Class Teacher. We verify how the children's learning process takes place in the hospital environment. Although the Hospital Class is considered a “new” educational field, it is nothing new in other states, including Rio de Janeiro, a reference in this service, when the first hospital class was created, at Hospital Municipal Jesus, in Vila Isabel, in 1960. Such assistance is characterized in the Special Education modality for attending children and/or teenagers considered to have special educational needs as a result of having curricular difficulties due to conditions of specific health limitations recovering the child in an inclusion process offering learning conditions (FONSECA, 1999).

2. THE HOSPITALIZED CHILD AND ITS RIGHTS

For many centuries, the child's fragility in the early years of his life was ignored. The importance of looking at the child as a being that exists and, in the face of its fragility, looking for ways to protect it, led several segments of society and institutions to fight for the approval of laws in their defense. In a simple way, it can be said that this fight aims to ensure that children have the right to visibility in society, so that they can be configured as subjects of rights and duties, with all the complexity involved in personal originality and

in the significant similarities between the subjects.

It is worth highlighting the importance of giving social visibility to childhood and children in the current context of society. Listening to the child is still in the process of being recognized by the authorities, seeking to value what they tell us. As researchers, we need to learn ways to involve children at all stages, from identifying issues in their own research and disseminating good practices, including those children who are hospitalized for long-term treatments.

The concept of child has been built over the centuries, currently involved with rights, admitting that the child as a social actor, or belonging to a social group, is a recent appropriation, especially for the scientific area, which obviously has implications for the journey construction of associated rights.

Sarmento (2005, p. 370) portrays children as being “social beings and, as such, they are distributed by the different modes of social stratification: social class, ethnicity to which they belong, race, gender, region of globe they live in ”. Prount and James (2005) claim that children build their social worlds, that is, they build their worlds around them.

Until 1874, care for Brazilian children was linked to the so-called “Casa dos Expostos” or “Roda” of some cities. These were institutions that sheltered abandoned children under the age of twelve. Because they were abandoned, they needed care and protection, which was then dispensed there. Later in national history, preventive measures were taken with children, "[...] such as childcare, hygiene and protection" (KRAMER, 1984, p. 52). In terms of public policies for childhood itself, they were implemented more recently, in the 1990s. At the end of the last century, more attention was given to childhood problems, generating discussions in all areas of knowledge. As highlighted by Sarmento and Pinto (1997), children have always been present in the world, and the living conditions of the present times produce new discussions and concerns. Childhood emerges as a social reality, mediated by society itself. Thus, we have different childhoods in different contexts.

In Brazil, the Federal Constitution provides structuring principles for the lives of Brazilian children. It was also the subject of the United Nations Convention on the Rights of the Child in 1989, showing similarities in the lives of children in general. These principles could be incorporated into Federal Law No. 8069/1990 (Law of the Child and Adolescent Statute), in which the requirement to give the highest priority to this child and youth population was enshrined. The right to life is constituted as the primary right, so that it is the guarantee of all other rights, to health, education, etc.

The lack of these rights constitutes social exclusion, resulting from “[...] a social process that favors illegitimate appropriations by certain sectors of society and prohibits others from accessing goods, resources, conditions or statutes that allows them to enjoy opportunities in conditions of equality ”(SARMENTO, 2003, p. 2). Thus, giving children the opportunity to enjoy their rights is to play a fundamental role in social protection.

These reflections allow us to affirm that little has been done to effectively change the harsh reality of children. Thus, as the concept of childhood was historically constructed, the same is true of the achievement of rights for this social category. Children themselves are unaware of their rights. The fundamental rights of children are, first of all, social rights, which extend to society as a whole. (SARMENTO, SOARES AND TOMÁS, 2004, p. 2).

Children and teenagers enjoy all fundamental rights guaranteed by law, providing physical, mental, moral, spiritual and social development, under conditions of freedom and dignity. Human, universal, indivisible and inalienable rights. The defense of human dignity - and its right to life with health and quality education - permeates, thus, the recognition of jurisdiction and demandability.

Despite the legal progress that has been made, such as those promoted by the Convention on the Rights of the Child, and the increase in public policies, inequities and discrimination against children have also increased (SGRITTA, 1998 apud SARMENTO, 2003), emphasizing the "[. ..] specific characteristics of the most vulnerable generational group and effectively subject to conditions of social exclusion". Still, we have a lot to achieve effectively in the areas of Health and Education.

In childhood, the disease refers to problems that interfere with the functioning of the child's body, so that health and education professionals must provide comprehensive care, it is worth mentioning that the disease in childhood is characterized by making it impossible to children to perform many of their daily activities, interfering in their growth and development (NASCIMENTO, 2005). This demonstrates the importance of integrating practical actions in the educational context.

3. Reality Of The Hospital Context: Guaranteed Right

Despite the laws and advances in the legislative achievements of human rights, as far as children are concerned, there is still a deep gap between what is written and what happens in reality. What we need, at the moment, is to protect the rights inscribed in laws and other documents, so that they are enjoyed by children. It is important and urgent the need to guarantee the full enjoyment of these rights previously exposed, so that the child, as citizens who are respected in their dignity, as these rights are achievements of a social construction of long history.

The hospitalized child, like any other child, is in a network of multiple relationships. The hospital is a space for the participation of several actors - such as the school. The life of the hospitalized child is not restricted to the hospital walls, nor are his human ties to the outside suspended. The child and its immediate surroundings do not exist in isolation, but are related to other social instances. Such a children's world for children with cancer ends up being transmuted, so the child perceives his life threatened and his routine unstructured by treatments and recurrent hospitalizations. Once the diagnosis is concluded, the period of loss and removal from various spheres of daily life begins.
Educational care in a hospital environment must be inserted in the context of humanization of care provided

in hospitals, as the child patient treated as just a sick body has impairments in learning. In this new perspective, however, of being perceived as an integral being, a more promising panorama opens up. The hospitalized child cannot be denied his right to education, nor can his right to cognitive, social and emotional development be ignored.

4. Conclusion

The research in question shows that educational care in a hospital environment must be inserted in the context of humanization of care provided in hospitals, as the child patient treated as just a sick body has learning impairments. In this new perspective, however, it is important that the child is perceived as an integral being, so that an educational work that considers him / her as a potential learning subject is dimensioned. The hospitalized child or adolescent, within this new vision, cannot be denied their right to education, nor be ignored in their full development, in their cognitive, social and affective aspects.

It is emphasized that, effectively, there is a need for these hospitalized children to continue their studies at the hospital. There is no doubt that it is through education that the subject creates possibilities to overcome problems related to fragmentation and the distance between teaching and learning. What is seen is that the child is effectively recognized as a subject of rights.

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Big Data and IoT applications: the use of Information and Communication Technologies to obtain a competitive advantage

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Abstract

Currently, the search for a competitive advantage is a reality in all business sectors. While several reports in the literature that address this theme, only a few discuss the relationship between competitive advantages and the implementation of Information and Communication Technologies. Thus, in the present study, we sought to investigate how the application of emerging ICTs, such as the IoT and Big Data, can provide a competitive advantage to organizations. To achieve this goal, we conducted a qualitative bibliographic survey of the literature, to identify and analyze the presently available publications on the subject of ICTs and organizational management. Additionally, we defined the elements that corroborated the conceptual construction of the results. Based on the literature, we were able to demonstrate that organizations that utilize Big Data and IoT applications can gain a competitive advantage over their competitors.

Keywords: Competitive advantage, Information and Communication Technologies, Big Data, Internet of Things.

1. Introduction

With the systematic and increasing competition among organizations, whether by the entry of new companies that operate in the same segment of institutions that are already established in the market or of existing companies that start to operate in segments that they did not previously operate, strategies that can afford a competitive advantage are in constant demand. According to Thompson et al. (2008), a competitive strategy is a plan implemented by a company that allows it to successfully compete against and gain a competitive advantage over the competitors in a specific industry [34].

While there is a plethora of factors that can contribute to the achievement of a competitive advantage, the deployment of existing or emerging Information and Communication Technologies (ICT) has been gaining recognition. Existing ICTs include different types of information systems such as Transaction Processing Systems, Management Information Systems, Decision Support Systems, Executive Support Systems, Enterprise Resource Planning, among others [16]. On the other hand, notable examples of emerging technologies include Big Data and the Internet of Things (IoT). The rapid rise of Big Data and the IoT is primarily due to the resulting increase in connectivity among people and objects, enhancements in sensor and hardware technologies and rise in internet availability. As a consequence of the applications and technologies, anyone or anything can be accessed or monitored anywhere at any time.

The concept of Big Data, in recent years, is largely due to the enormous amounts of data that is generated from a variety sources such as social networks, social media, mobile devices, scientific activities, simulations, experiments, sensors as well as from other devices and activities and traditional sources [5]. Thus, the term Big Data refers to a set of data that grows exponentially and whose dimension is beyond the ability of typical tools to capture, manage and analyze [19]. It is for this reason that Manyika et al. (2011) previously suggested that the use of cloud computing would be necessary for managing these incalculable amounts of generated data [19].

It should be pointed out that with Big Data it is not only the volume that needs to be taken into consideration but also the variety of information and the speed of accessing and processing it [23]. Indeed, by paying attention to these important aspects, Big Data facilitates the best use of this information and allows the user(s) to achieve a specific goal(s). During this process, it is extremely important to point out that only useful information should be extracted and analyzed.

Previously, it was proposed by Mayer-Schönberger and Cukier (2013) that Big Data can be characterized by the five V's: volume, variety, velocity, veracity and value [20]. In this context, volume refers to the amount of data, which can be structured as with texts and files or unstructured as with photos, videos, social media posts, etc., that Big Data deals with; variety comes from the fact that the obtained data or information originates from different sources; velocity has to do with the speed and agility required for handling and managing the data, which is sometimes utilized for decision-making processes; veracity relates to the authenticity of the data; and value concerns how the acquired information benefits the user(s) and, thus, symbolizes how useful it is.

The other emerging ICT is the IoT. Simply put, the IoT is a system of devices connected to the internet. According to Pacheco, Klein and Righi (2016), the IoT is both an opportunity and a challenge for companies in different industries or sectors, since it provides a digital capacity that is embedded in products

and objects, including cars, televisions, refrigerators, books and other products, consequently offering new functions and applications and enhancing their utility [26]. It has been reported that about 55% of IoT applications are related to public services and smart cities and that the other 45% are embedded in appliances and vehicles [32]. Due to the growing prevalence of this technology, Atzori, Iera and Morabito (2010) stated that the IoT will influence various aspects of daily life, including the behavior of users both at home and work [2]. For example, possible applications of this new paradigm are related to assisted living, e-health, industrial automation and manufacturing, logistics, business and process management, intelligent transportation of people and goods, among others.

Since IoT applications can connect people with people, people with objects and objects with objects, and because Big Data can collect, organize and analyze data with the speed necessary for decision-making processes, these emerging ICTs could revolutionize our society. Indeed, through the development of products and services, based on these emerging ICTs, it is plausible that organizations could gain a competitive advantage over their competitors. Therefore, the present study sought to evaluate how IoT and BIG Data are related to organizations achieving a competitive advantage.

Towards this goal, we conducted a bibliographic survey, understood as a formal procedure with reflective thinking that allows researchers to identify new facts and relationships in any area of knowledge [15]. Herein, the bibliographic survey was of a qualitative character [38], that sought to identify and analyze the currently available literature, in the field of ICTs and organizational management, and to define the elements that corroborate the conceptual construction of the results.

2. Theoretical foundation

2.1 Competitive advantage

A competitive advantage can be achieved when is a company implements a generic strategy to obtain and sustain an advantage in its market segment [27]. Previous studies have shown that this advantage occurs when an organization utilizes a value creation strategy that cannot be simultaneously launched by other current or potential competitors [4, 13]. Additionally, Porter stated that a competitive advantage arises from the value a company creates for its buyers, and when that value exceeds the cost of manufacturing the product or delivering the service [27]. In other words, value is the amount that consumers are willing to pay for a product or service, and value is created when the purchase price exceeds the cost of any generic strategy [13]. A competitive advantage also occurs when the strategies adopted by the companies lead to levels of economic performance that are above the market average, which can be explained by different currents of thought about strategy [17].

For example, Vasconcelos and Cyrino (2000) state that the issue of a competitive advantage can be divided into four major models, further segmented into two explanatory currents of thought: external factors and internal factors [36]. Concerning external factors, the model of Michael Porter stands out because he analyzed the industrial structure. In this model, Porter considers five competitive forces present in the business environment that must be studied to determine an efficient business strategy [27].

The first competitive force has to do with the threat of new entrants, that is, new competitors. This force is related to how easy or difficult it is for a new competitor to enter a sector. Typically, there is an inverse

relationship between ease of entry and competition, with more complex levels of entry resulting in less competition. The second and third forces are the bargaining power of buyers and suppliers. These two forces are similar since both are related to the power each party has. On the one hand, buyers use it to reduce prices, while on the other hand suppliers use it to affirm dependency since their products are essential to the buyer. The fourth force is substitute products and has to do with how simple or complicated it is for a buyer to replace one product or service with another that is similar or perhaps better. Finally, the fifth force is industry competitors or the degree of competitiveness within the industry.

The second model that deals with a competitive advantage, presented within the current of external factors, is market process theory, which originally came from the Austrian school. This theory primarily refers to the understanding of the market phenomenon by reformulating and reconstructing fundamental neoclassical ideas and secondarily by studying the processes through which the markets reach equilibrium. Put another way the Austrians prioritize the market process as an object of study and relegate the analysis of the equilibrium conditions to a plane that is nothing more than instrumental [12]. Previously, the market was seen as a force that keeps economic agents in balance, and any economic phenomenon that shifts this equilibrium was categorized as a transient event. However, with the recent constant waves of change, innovation and new competitors, these above-average economic performance phenomena are now desired. In fact, according to market process theory, a permanent process of discoveries that generates information and knowledge will increase the occurrence of above-average performance phenomena and create competitive advantages. Indeed, it is this vision that leads to the constant search for innovations that competitors are unable to imitate or supplant. However, these innovations are difficult to produce, because the role of the entrepreneur is not only to make discoveries but also to imitate competitors in an agile way. Notably, four fundamental aspects of market process theory have been identified and include competition, knowledge and discovery, incentives and rewards and market prices [14, 36].

The third model presented within the current of external factors is the theory of resources and capabilities. According to this theory, obtaining a competitive advantage is linked to endogenous factors organizations employ, and the maintenance of this advantage is defined by the present and future endowment of its resources and capabilities and their nature in the face of income generation [24]. This theory follows the assumption that organizations, even ones that operate in the same segment, are not identical in terms of resources and capabilities. It is this heterogeneity that defines the organization and becomes its identity. Notably, organizations that adapt to the external environment, because their internal resources can develop competencies above their competitors, consequently create a competitive advantage.

Another model that deals with competitive advantages is the resource-based view [4]. This model describes how organizations can obtain a competitive advantage using its distinctive resources and competencies and is primarily based on four types of internal resources: financial, physical, human and organizational, which can be characterized as tangible or intangible. Financial, physical and human resources are considered tangible since they can be “touched” and/or easily measured. On the other hand, human and organizational resources are considered intangible, because they do not have a physical form. Concerning competitive advantages, it is the intangible resources that lead to the generation of strategic competitiveness, since they are based on information and knowledge and can expand without limits [24]. It should be pointed out that

in the resource-based view, the external environment is an important source of resources that can be acquired and used to complement the existing internal resources of the organization.

The fourth and final model is the dynamic capability theory, which can be understood as the integration of internal and external factors in constantly changing environments [33]. This theory addresses the aforementioned market process and resources and capabilities theories and the conceptual structure is largely based on the elements of the resource-based view [3]. Additionally, in the dynamic capabilities theory, the identification of changes in the external environment are considered because these changes are the generators of resource reconfigurations that the organization already possesses [18]. Moreover, this theory can be viewed as the ability an organization has to promote strategies that give them a competitive advantage in a dynamic environment [25] and seeks to relate this competitive advantage with how it reconfigures its resource base using evolution and external renewal, thus determining its competence.

Table 1 - Characteristics of competitive advantage models

INTERNAL FACTORS	EXTERNAL FACTORS
Resources and Capabilities • Resources and capabilities of organizations. • Heterogeneity of internal resources and capabilities. • Resource-based view [4]. • Tangible and intangible resources.	Industrial Vision • Competitive Forces [27]. • Generic Strategies [27].
Dynamic Capabilities • Interaction between internal and external factors (market + resources and capabilities) • "Inventory" of resources to supply constant market changes. • Knowledge and innovation.	Market Process • Views the market as a continuous process of discoveries. • Generates above-average performances (competitive advantage).

As shown in Table 1, the main characteristics of the competitive advantage models are summarized. It should be pointed out that, to obtain a competitive advantage, companies must take into account the analysis of how they can gain an advantage over the competition. Moreover, because of the aspects observed, the term competitive advantage stands out as a basis for the business context and is key to the positioning of a company within its business environment.

2.2 Big Data and IoT and their applications

Within the context of Big Data, there are two other important terms, Business Intelligence (BI) and Big Data Analytics (BDA). To meet business-related goals and solve problems, BI tools, including software and services, are used to extract data that is important to the company and then arrange the information into hierarchical levels. After this phase of data processing, BDA is employed to analyze the information and generate value that can be used to justify potential investments and achieve a competitive advantage. Concerning a competitive advantage, McAfee and Brynjolfsson (2015) demonstrated that organizations

that effectively utilized Big Data were 5% more productive and 6% more profitable than their competitors [21]. Moreover, Hoppen and Baptista (2015) generated generic industry sectors data sets and identified banks/credit and insurance, security, health, oil, gas and electricity, retail, production, representative organizations, marketing, education, financial/economic, logistics, e-commerce, games, social networks and platforms and recruitment as the types of businesses that can use Big Data to obtain business opportunities [11]. The same authors also point out that analyzing lists of assets and values and transaction history data can identify the optimal purchase value of complex assets, determine trends in asset values and discover opportunities [11].

In the retail sector, Big Data must first consider consumers that are not recognized channels, but rather people that can discriminate brands, value proposals and shopping experiences [31]. In this sense, Big Data makes it possible to monitor and track consumption trends in the retail market.

Another sector that can take advantage of Big Data is in the transport sector. This sector produces large amounts of data that Big Data could use to improve cargo handling and optimize delivery times, ultimately providing a competitive advantage.

In the marketing sector, Big Data contributes to achieving business objectives, by analyzing large volumes of data and predicting behaviors, segmenting campaigns and offering personalized products and services [9].

In the human resources sector, Big Data creates business opportunities. by using registration information, social networks, histories and professional curricula. In this sense, the employer can carry out a more detailed assessment of the prospective job applicants and/or improve the allocation of existing personnel and resources [11].

It has also been demonstrated that Big Data also benefits information security, which happens to be a major concern of organizations [10]. Here, by aligning the tool with information security, it is possible to detect threats and suspicious activities, log attempted intrusions and monitor the spread of viruses in real-time with precision and responsiveness.

Concerning the medical sector, the health portal Saúde Business (2017) mentioned that data analytics could be used as a facilitator in scientific evidence, by making diagnoses and recommending treatments; predicting patient health events based on medical records and artificial intelligence algorithms and resources; and assisting in hospital administrative decision-making [30].

According to Bronson and Knezevic (2016), the agri-food sector could benefit from using Big Data collection and analytics tools. For example, the Monsanto Corporation has developed a suite of digital tools (Integrated Field Systems platform) that allows farmers to collect information about soil conditions, weed varieties and weather [8].

In the legal sector, there is an increase in the use of Big Data by law professionals and firms. In fact, some applications can assist in the analysis of the probability of gain, decision-making, creating scenarios and verifying the results [6].

With regard to the IoT, the term “Internet of Things” was first introduced in 1999 by Kevin Ashton, a researcher at the Massachusetts Institute of Technology (MIT) Auto-ID Lab, who used the term during his presentation on the use of Radio-Frequency IDentification (RFID) in the supply chain of a large company [1, 35]. However, it was not until 2001, when the term was officially presented by Brock, also a researcher

at the Auto-ID Lab [7]. Since its conception, the IoT uses objects that are equipped with the ability to communicate and process data. In most cases, the objects are embedded with sensors that can collect and share data over a network.

Due to its inherent versatility, the IoT can be and has been used in a variety of different settings. Notably, in the industrial sector, IoT technologies have facilitated the new industrial revolution, through the establishment of the Industry 4.0 era and integration of technology into production and logistics lines. As exemplified by Xu, Xu and Li (2018), IoT applications in the manufacturing industry, such as Product Lifecycle Management (PLM), allow for the collection and management of data that can be used to monitor and optimize processes and decisions throughout the entire product development stage [37]. In this sense, unique identifiers for products or parts are essential for PLM applications during the predefined lifecycle, since products in PLM are disposed of in a distributed, mobile and collaborative environment at both the intra- and inter-organizational levels [37]. Romeder (2016) mentions IoT applications that can be used in PLM, using mainly RFID sensors and tags [28]. Broadly speaking, from a manufacturing process perspective, IoT solutions can be employed to define and use suitable production equipment, monitor production, detect problems and decision-making activities. When successfully deployed IoT can increase the uptime of the machines and improve manufacturing efficiency.

Other sectors that can take advantage of IoT technologies include design and marketing, in which sensors report exactly where, when and how a product is used and/or assist in design and marketing processes [28]. Additionally, in the retail sector, components connected to products allow companies to predict when consumers will need replacement parts, thus encouraging proactive sales. In healthcare, doctors and hospitals can collect and organize data from connected medical devices, that are worn by the patient or installed in their homes. In agriculture, sensors can monitor humidity and temperature, automatically activate irrigation systems and increase productivity in the field, and it has also been proposed that sensors could be employed to monitor the amount of feed available to farm animals, automatically replenishing when it is low.

3. Relationship between IoT and Big data and competitive advantage

Based on the previously discussed competitive advantage models and the segmentation of the various application sectors, we were able to observe that each of the models has different approaches for each area of activity of the companies (see Table 1). In Table 2, a summary of the relationships between each competitive advantage model and Big Data and IoT technologies are presented. Interestingly, it was possible to observe that in all of the models, there are applications that can be employed in various market sectors that help organizations achieve a competitive advantage. Importantly, the information in Table 2 demonstrates that a new relationship can be applied to the four models of competitive advantage and their respective areas of greater focus in conjunction with the applications of Big Data and IoT.

For example, when applying the Resources and Capabilities Model to the area of human resources, Big Data can be used to improve the hiring process of prospective employees, by automating the collection and extraction of information from registration information and resumes. As a result, applicants can be screened and only the ones that meet the characteristics the vacancy offered would be selected, thus reducing the

waiting and response time. Moreover, in the security sector, the use of IoT technologies, such as sensors, make it possible to monitor access to physical locations like data centers, control environments, identify risks and prevent human errors, ultimately protecting the information of the organization.

In the Dynamic Capabilities Model, the marketing sector can use Big Data to monitor consumer trends and identify target audiences, by sending out personalized surveys and using services that forward ads and promotions to potential consumers interested in the company. Concerning IoT in the marketing sector, it can create solutions that spike the interest of consumers, such as connecting customers with the nearest store. Additionally, in the design sector, IoT applications could report where, when and how a product is used, assisting in design and marketing processes.

Table 2. Relationships between competitive advantage models and Big Data and IoT applications.

MODELS	APPLICATIONS	
	BIG DATA	IoT
RESOURCES AND CAPABILITIES	• Use *Analytics*, transforming information into value; • Contribute to justify investments better; • Discover market trends; • Improve the process of hiring human resources; • Discover patterns of consumption trends; • Analyze price statistics, create consumer profiles; • Improve the profile assessment for the position; • Efficiently allocate resources; • Improve information security	• Use RFID tags in products for smart inventory • Connect customers with the nearest store; • Use sensors and RFID tags to monitor production; • Use access sensors to obtain total control of the environment, identifying failures, threats.
DYNAMIC CAPACITIES/ MARKET PROCESS	• Use Analytics, transforming information into value; • Contribute to justify investments better; • Discover market trends; • Discover patterns of consumption trends; • Analyze price statistics, create consumer profiles; • Improved profile assessment for a position; • Efficient allocation of resources; • Information security; • Database protection and encryption.	• Use RFID tags on products for smart inventory; • Connect customers with the nearest store; • Use access sensors, obtaining total control of the environment, identifying failures, threats. • Collect and organize data from connected medical devices. • Report where, when, and how a product is used to assist with design and marketing processes.

INDUSTRIAL VISION	• Use Analytics, transforming information into value; • Use machine learning for decision making • Seek efficiency in route planning to save fuel and time; • Improve the allocation of the logistics fleet; • Contribute to justify investments better; • Determine trends in asset values; •Analyze price statistics, create consumer profiles; • Improve the profile assessment for the position to be filled; • Efficiently allocate resources; • Generate information for information security.	Detect problems with machinery; Use RFID tags in products for smart inventory; Use access sensors, obtaining total control of the environment, identifying failures, threats; Use real-time monitoring sensors to generate transport and production data such as location, handling frequency, speed, mileage, and vehicle problems.

In the Market Process Model, Big Data can be used to discover insights that can guide the strategies of an organization. For example, using software to extract information from employee documents or informational assets could predict patterns and trends and consequently transform this information into value. In the retail sector, IoT technologies such as sensors or RFID tags can more intelligently control and monitor inventories and monitor sales, both made and lost, in real-time.

In the Industrial Vision Model, one of the main relationships between Big Data and IoT applications is incorporated in the production and logistics sectors. In the production sector, both Big Data and IoT contribute to the so-called Industry 4.0. Big Data guarantees that all the data coming from the machinery is collected and uses machine learning for making decisions without the need for human intervention. On the other hand, the IoT provides the hardware that is attached or embedded into Industry 4.0 machines, facilitating connectivity and integrating production chains and systems, which allows for the automation of all the manufacturing processes. Additionally, in the logistics sector, Big Data can optimize the allocation of transport resources to determine the most efficient transport routes and identify unnecessary expenses. IoT uses sensors and GPS to monitor transport data in real-time, recording data such as location and mileage traveled. Moreover, this ICT allows companies to monitor the status of the transported products and in cases of theft can be used to quickly pinpoint the location of the cargo, consequently minimizing losses.

Based on the observed relationships between the different competitive advantage models and Big Data and IoT applications and technologies, the examples discussed above demonstrate that, in most cases, the use of these ICTs can benefit numerous business sectors. This is primarily because these technologies facilitate the automation of a variety of processes, enhance control and perform real-time monitoring. As they increase efficiency and reduce unnecessary expenses, these technologies provide organizations with greater

sustainability, the ability to perform above the market average and reinforce the idea that Big Data and the IoT provide a competitive advantage to the organizations over their competitors,

4. Conclusion

In the context of ICTs, such as Big Data and the IoT, academic studies and publications, as well as the practical use of applications by organizations are still relatively new; however, the adoption of these technologies by organizations, academic and research institutions is rapidly increasing. This result is driven by the fact that the use of these technologies progressively please an increasingly innovative and competitive market. In the present study, we listed and discussed specific competitive advantage models and Big Data and IoT applications and demonstrated that the use of these emerging ICTs helps organizations achieve a competitive advantage.

In addition to process automation, these technologies are a driving force for promoting relevant changes in the competitive market as a whole. Moreover, we were able to show that relationships between competitive advantage models and ICT applications exist, regardless of the characteristics of the competitive advantage model. In conclusion, we affirm that Big Data and IoT provide a competitive advantage to the organizations that use them by making each organization technologically updated, identifying new business opportunities and reducing costs.

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Patentometric Profile of Social Water

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Abstract

There are regions of the planet that are affected by climatological conditions that cause water scarcity. Thus, innovative techniques have emerged with the purpose of mitigating the reflexes caused by the natural factor: drought. These innovations arise with the objective of capturing, storing and carrying out rainwater treatment for the population. These, called social water technologies, comprise products, techniques or replicable methodologies that are developed specifically to solve the problem of water shortages. The present work aims to analyze the profile of innovations generated by social water technologies through the LATIPAT, INPI and WIPO bases. To search for patents, keywords that were relevant to the research were used and combined with Boolean operators. 907 patents were identified, the largest concentration of deposits in China, justified by the fact that the country adopts development policies that invest in R&D, differentiating itself from other countries. Among the patents analyzed there is a higher concentration of deposits related to the area of human needs and water treatment.

Keywords: patents; social water technologies; drought.

1. Introduction

On our planet, more than a billion people do not have access to any type of drinking water (SWYNGEDOUW, 2001). Upon careful analysis, it is clear that water is a resource that enables and sustains life on the planet, be it in the diversity of species (both animals and plants) or in food production. Water is then considered a strategic resource for survival, having economic, ecological and social importance (TUNDISI & TUNDISI, 2005).

In the semi-arid region, based on the rainfall regime, it is possible to draw a scenario for the availability of water in the soil. When the drought comes, the rivers dry up quickly and the groundwater deepens and diminishes, making it impossible to use its waters. Temperatures recorded at the site are high, contributing to an imbalance between the amount of water present and the rate of evapotranspiration. Thus, the accumulated waters tend to evaporate quickly (AB'SÁBER, 1999).

The lack of water leads to production stoppage, consequently to the inability to generate food for the family and the creations. The death of herds affects almost all of the country people and the emigration of the poorest population is the only way out, in addition to human health problems, competition and conflict over the use of water, water privatization, among others (GOMES, 2001; SALATI et al. 2002; DUQUE, 2008).

There is great concern regarding the need to solve the problem of lack of water in the semi-arid region, as the use of social water technologies emerges as a strategy coupled with technological innovations that aim to meet human needs, aimed at capturing, storing and treating rainwater in the semi-arid region.

Technological innovations in favor of the environment directly contribute to the longed for sustainable development, through the treatment of residues generated in the production processes, the reduction of pollutant emission levels and the increase of efficiency during the production of new products (MORAIS, 2014).

Among the topics covered in international agreements, the incentive to technological innovation through its patenting is present and this research aims to analyze the technological innovations that arose from the need to capture, store and carry out rainwater treatment for the population. That lives in an area of climatological vulnerability, precisely the semi-arid region.

2. The importance of technological development

Information is the raw material for technological development and takes on a new role as a factor of production that, together with work, raw material and capital, becomes the inducer of essential technological changes for companies that are fighting for their survival (FUJINO, 1994).

The growing recognition of the relevance of science, technology and innovation (ST&I) policies for economic and social development has led several countries to set goals to expand their R&D efforts (MORAIS, 2008).

The Science and Technology (S&T) or Innovation Indicators are tools created to measure a country's innovative performance and develop public policies to increase it, directing support to areas perceived as most important (GRUPP; MOGEE, 2004).

Thus, in general, an indicator can be understood as an aggregate and complete measure that allows describing or evaluating a phenomenon, its nature, its state and its evolution, making it possible to articulate or correlate variables (MARTÍNEZ & ALBORNOZ, 1998).

The patent is an extremely important indicator to analyze the activity and technological production of organizations, therefore instituting one of the oldest forms of protection of intellectual property (MARICATO, NORONHA, FUJINO, 2010).

2.1 Defining a Patent

Patent can be defined as a temporary title granted to those responsible for the invention of new processes, new products or improvements, always intended for industrial activity (JUNGMANN AND BONETTI, 2010).

Patent protection aims to safeguard inventors' rights against competitors who may reproduce and sell inventions without charge with research and development costs and, therefore, achieving lower costs and more competitive prices (INPI, 2018).

Surveys provide information about innovation, but some of them have some limitations, such as lack of objectivity when they are based on interviews or the high costs and high time they can involve. Patent-based research does not have such limitations, as it contains real information about the innovation process (KANG, 2016).

Patents can enable various economic gains, mainly through royalties from the initial payment or access fee to technologies, fixed payments, transfer of know-how, technical assistance and, finally, penalties and indemnities (QUINTELA, 2013).

Patentiometry is a competitive intelligence tool in science and innovation, used for quantitative and qualitative analysis of patents in the field of technology (SUNG, et al., 2014). Metric used for the study of patent indicators with the purpose of identifying innovation and technology activities in countries, through technological information contained in patent documents (MORAIS; GARCIA, 2014).

3. Methodology

This research is configured in a descriptive study from a patentometric perspective, where the characteristics and profiles of patents related to social water technologies are described, deposited in the database with LATIPAT[1], National Institute of Industrial Property - INPI and World Intellectual Property Organization - WIPO.

Data collection was performed in January 2020, using relevant keywords, combined using Boolean operators. The words used in Portuguese and English were: technology, social, collection, storage, treatment, water and rain (Table 1).

[1] LATIPAT is an Espacenet database, with patent documents in Spanish and Portuguese and can be found at lp.espacenet.com.

Table 01 - Keywords used in the construction of the string

Keywords in Portuguese	Keywords in English
Tecnologia	Technology
Social	Social
Captação	Fundraising
Armazenamento	Storage
Tratamento	Treatment
Água	Water
Chuva	Rain

Source: Prepared by the authors (2020).

After elaborating the general string, searches were carried out on three patent bases, LATIPAT, INPI and WIPO (Figure 1). These bases were used due to their degree of reliability, the latter being justified for analysis, for obtaining the resource of data extraction in addition to having its scope at an international level.

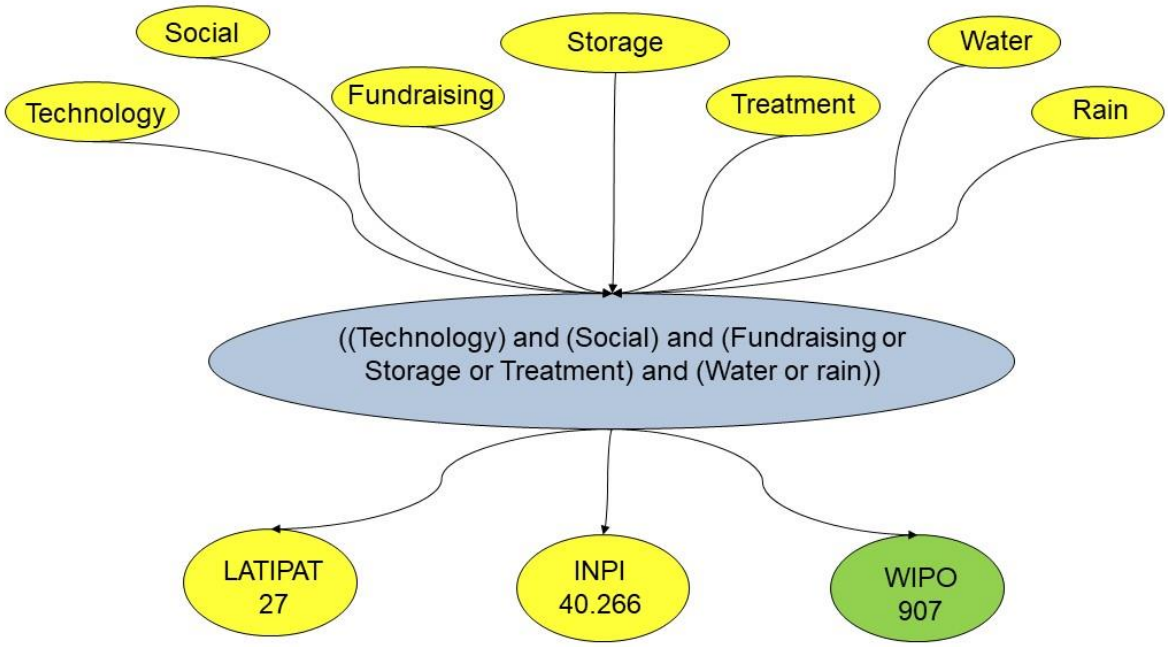

Figure 1. Methodological structure for patent search

Source: Prepared by the authors (2020).

In order to obtain more accurate results in the research, all the patents found indexed in the base of WIPO were analyzed. The extracted data were exported to the Microsoft Excel software, making it possible to standardize and organize the information through graphs with the names of the inventors, institutions, countries, IPC code and years that patent deposits were made.

4. Results and Discussion

907 patents on social water technologies were identified. Although this term was initially discussed in India and spread to other countries in other years, approximately 98% of these patents were filed by China, with 2% remaining for other countries, including the United States with 4 patents, the Republic of Korea with 3 patents, India with 2 patents, Canada remaining with 1 patent and 1 patent via PCT (FIGURE 2).

China's success in the large amount of patent filings is closely related to the promotion of market forces, well-illustrated by the liberalization of agriculture, the permission for rural businesses to function, the liberalization of foreign trade, and the reforms of the business system and financial. Such measures aroused the potential for entrepreneurship and made it possible to address the economic difficulties in effect during the central planning period. In addition, they favored the direction of the economy towards sectors with higher productivity, allowing the exploitation of comparative advantages to other countries (JACQUES, 2012).

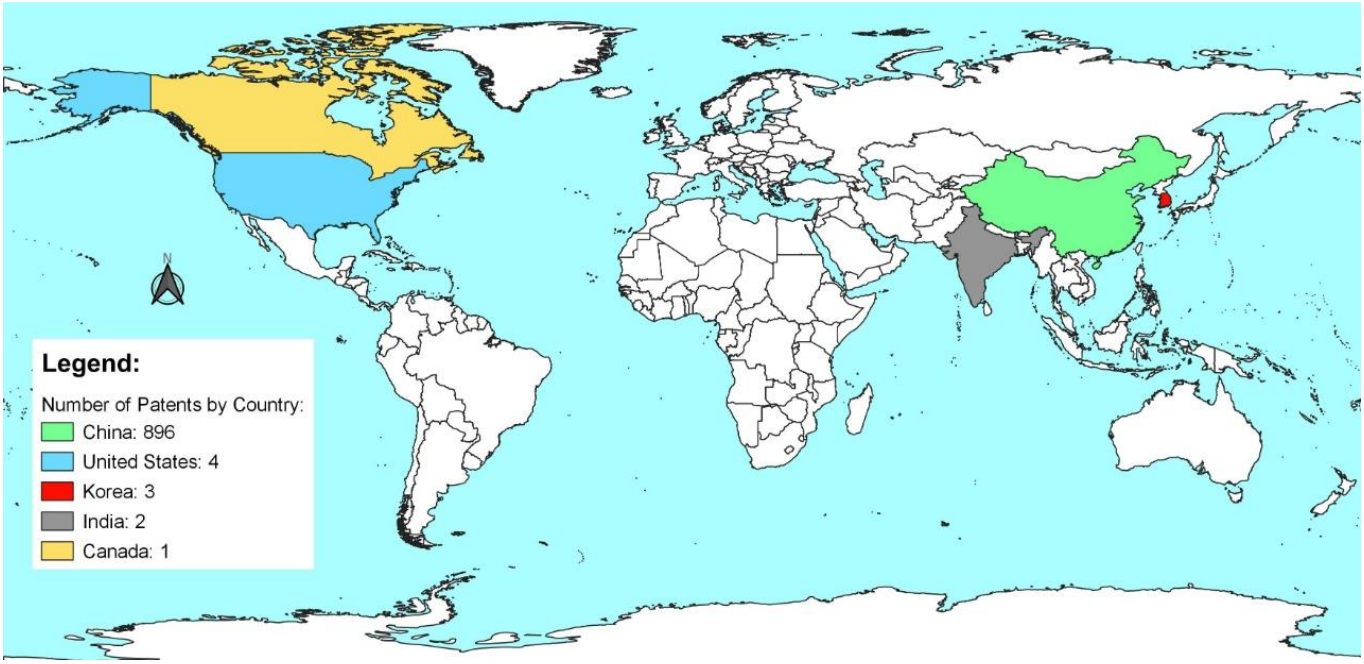

Figure 2. Countries depositing patent applications in Social Water Technologies

Source: Prepared by the authors (2020).

The effort to advance in the industrial and technological field leads to a central question: the effectiveness of industrial policy measures in the current stage of capitalism. The situation found in several sectors is that of absolute leadership of large multinational companies, which have a strong brand, control large market fractions and invest heavily in R&D. In several indicators, such as sales and revenue volume and number of patents, these companies were far ahead of their competitors (NOLAN, 2005).

These indicators reaffirm the strength of the Chinese market and point to the focus of R&D efforts by companies in the technological sector. The predominance of China as the major patent holder is related to the impetus generated by government policies aimed at an environment favorable to R&D (ROCHA et al., 2013).

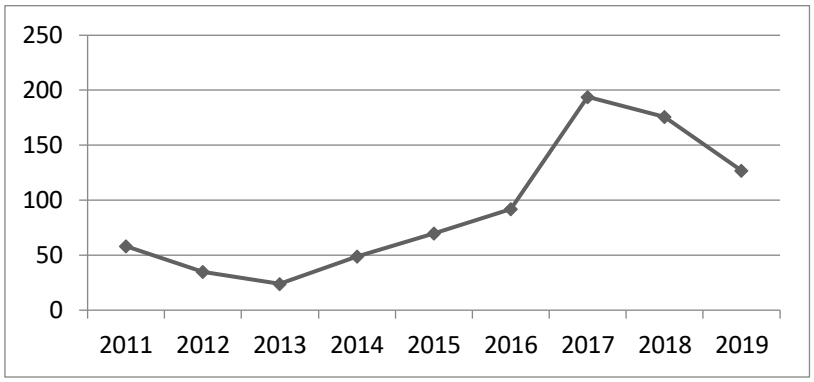

Figure 3. Annual evolution of patent application filing in the database
Source: Prepared by the authors (2020).

Over the past ten years, a greater concentration of patent filing applications can be seen between the years 2016 to 2019, which corresponds to 65% of all applications, with 2017 being the most prominent year compared to the others (FIGURE 3). The introduction and adaptations of patent laws in the countries facilitated the process of reducing bureaucracy in all the necessary procedures, observing a jump in the number of patents deposited.

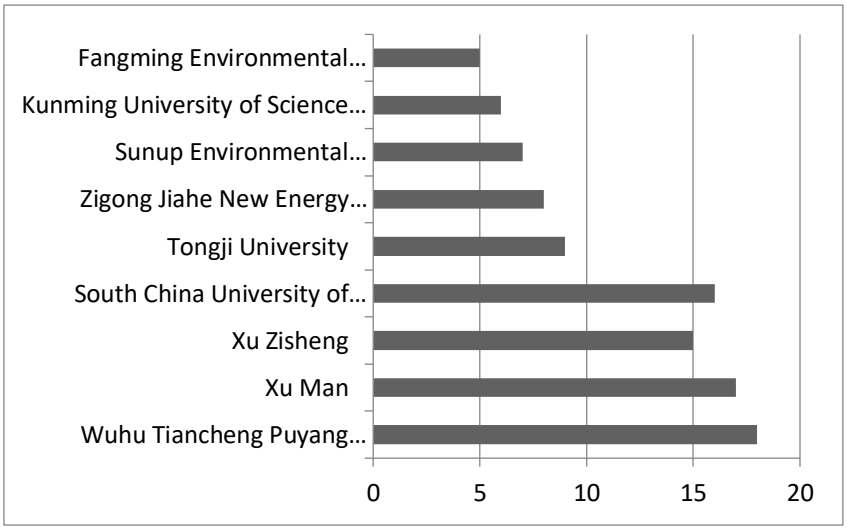

Figure 4. Largest filers of patent applications
Source: Prepared by the authors (2020).

Of the patents filed, it can be identified that there is a greater concentration of orders originating from companies, with a percentage of 38%, followed by deposits from universities with 31% and inventors in individuals also with 31% (Figure 4).

The largest filers of patent applications are Wuhu Tiancheng Puyang Traditional Chinese Medicine Technology LTD, which corresponds to approximately 2%, followed by Xu Man with 17 applications, Xu Zisheng with 15 applications and the South China University of Technology with 16 applications of patents. Of the patent applications filed, 22 inventors did not mention their names in the inventions, and the inventors who filed more patents were Huang Zhuqing with 19 deposits, Xu Man with 17 deposits and Xu Zisheng with 13 deposits (FIGURE 5).

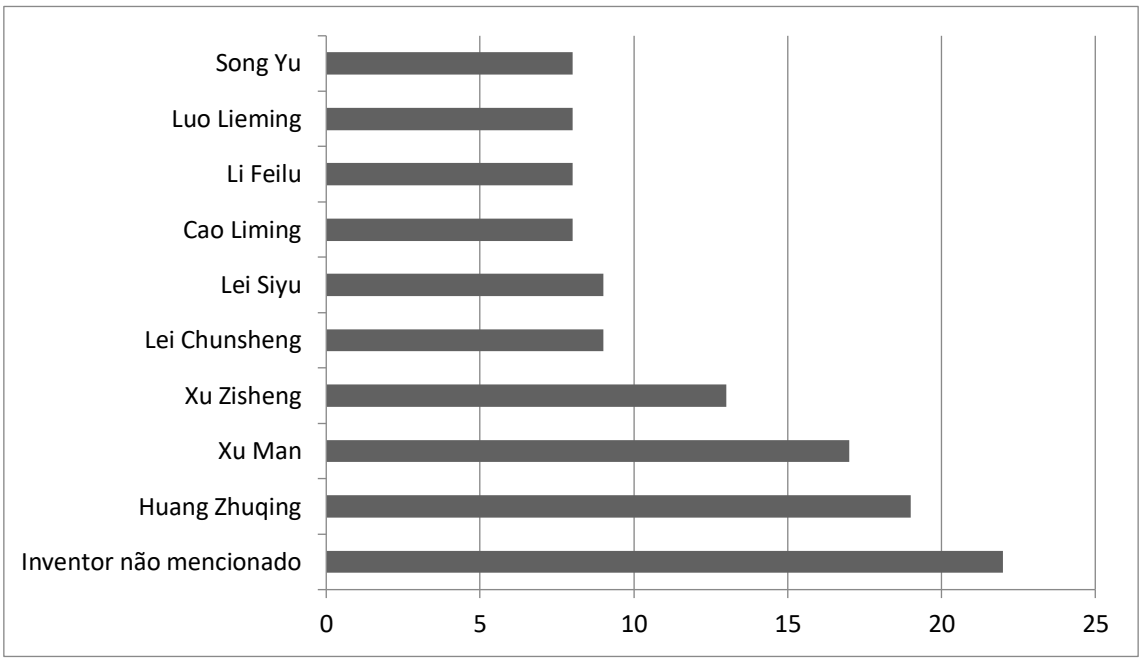

Figure 5. Number of patent applications by inventors (2011-2019)

Source: Prepared by the authors (2020).

Through the International Patent Classification - CIP codes, it is possible to infer the similarity of themes between patents according to how close these codes are. The more prefixes the patents have in common, the more similar they will be. Citing the example of three patents, H01L27/18, H01L27/00 and H01L31/00, it is possible to say that the first two have a closer relationship compared to the last (CHEN; CHIU, 2013). Patents are classified by 7 sections ranging from section A to section Y, each with its own specific area in relation to its series to be contemplated. It was observed in this research that the most frequent patents are classified in section C, Chemistry and Metallurgy, followed by section A, which refers to Human Needs, and section B of processing and transportation operations.

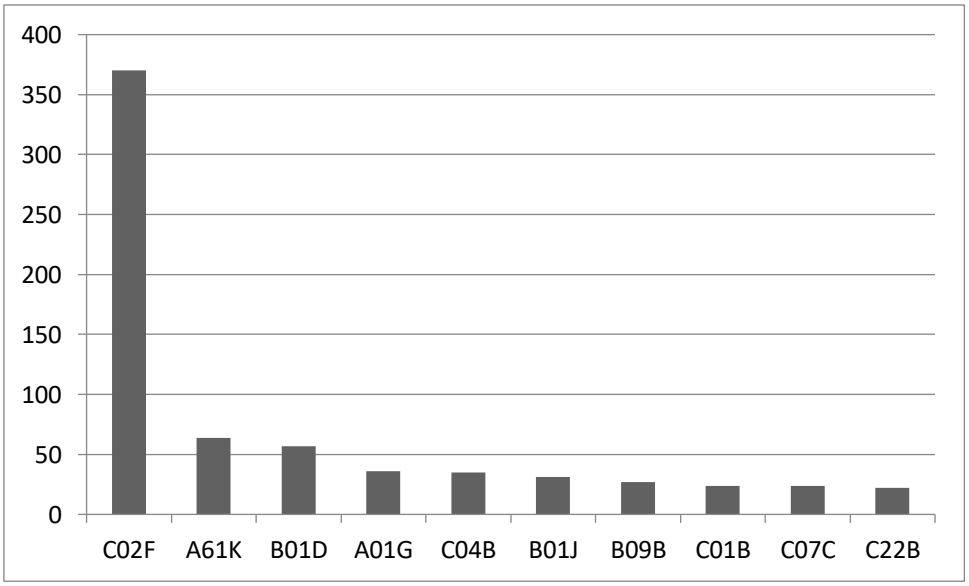

Figure 6. Distribution of patent deposits by CIP code on the WIPO basis

Source: prepared by the authors (2020).

In view of the distribution regarding the classification of patents, approximately 41% of patents correspond to the treatment of water, waste water, sewage or sludge and sludge, followed by 11% are patents deposited that aim to meet human needs (Figures 6; Table 2).

In addition, 7% of the patents deposited correspond to Processing and Transport Operations, with a relationship in view of their classification with social water technologies.

Table 2. Classification of patents for Social Water Technologies

Code	Specification
C02F	Water, wastewater, sewage or sludge and sludge treatment.
A61K	Preparations for medical, dental or hygienic purposes.
B01D	Division
A01G	Horticulture; cultivation of vegetables, flowers, rice, fruits, vines, hops or algae; forestry; irrigation.
C04B	Lime; Magnesia; Slag; Cements and their compositions.
B01J	Chemical or physical processes
B09B	Elimination of solid waste
C01B	Non-metallic elements and their compounds
C07C	Acyclic or carbocyclic compounds
C22B	Production or refining of metals; pre-treatment of raw materials.

Source: Prepared by the authors (2020).

The collection of patent documents is extremely important for mapping know-how, technological innovation and concentration of intellectual capital in strategic areas for the country's development. Knowledge of the temporal situation of technologies is also valuable in projecting technological trends, possible areas of investment by the government and private organizations (SPEZIALLI and SINISTERRA, 2015).

Government investment in the environment, through programs and public policies aligned with the country's vast territorial dimension, climate and vegetation, generates strategic and competitive interest on the part of foreign countries, since Brazil, as well as other countries in the world, lacks the development of green technologies (RASSENFOSSE et al., 2013).

5. Conclusion

Social Technologies are the result of knowledge acquired and related between popular knowledge and scientific knowledge that aim to meet human needs, whether through creation, or through innovation.

In view of the importance of using social water technologies, they have a strategic differential, as they address a natural problem, the lack of water. Thus, there is a need for investments in R&D, due to these instruments having relevance in carrying out the entire process of capturing and treating water for communities that are affected by the drought problem.

China, in turn, is gaining prominence when comparing itself with other countries, for implementing an

economic policy that favors and stimulates innovation, or patent deposits, with the purpose of solving problems of social demands and generating economic, social development. and environmental.
There has been an increase in patent filings in the last 10 years with equity between university, companies and inventors per individual, with the largest patent filers being professors linked to universities in China. With patentometry, it was possible to identify that the patents deposited linked to social water technologies are related to water treatment and that they meet human needs. Thus, it is clear that there are innovations linked to social water technologies, with a lack of Brazil in investments in public policies that corroborate with the country's technological advancement.

6. Acknowledgement

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The adoption of an indicator panel in educational management to decision-making support: perception of managers through UTAUT model

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Abstract

The use of technology to assist in the performance of daily activities and to carry out communication between individuals has become a necessary task in the face of technological advances. In the context of public institutions, the insertion of technology is also based on the possibilities of making the activities of this sector more efficient and better quality, in addition to allowing greater transparency and accessibility of information for society. For public managers, the information and communication technology tools allow for a more accurate assessment of the variables and possibilities involved in a decision-making process and, thus, to make better decisions in a sector whose main customer is society (users). Therefore, this paper aimed to analyze the use and acceptance of a decision support tool in a public educational institution called the Indicators Panel. For this, the Unified Theory of Acceptance and Use of Technology (UTAUT) was used, and the results were measured using the paraconsistent logic. The results indicate that it is possible to consider the use and acceptance of the decision support system in the public educational institution by reducing the propositions of the UTAUT Model in three factors: Usability, Performance, and Relationship. Regarding the UTAUT Model, it was found that the moderating variables of gender, age, and experience do not significantly influence the adoption of the decision support system. It is important to note that managers point the tool as very important for the development of their activities and emphasize that ease of use is one of the main points for the adoption of technology.

Keywords: UTAUT. Technology acceptance and use. Public sector. Information Technology. Decision support system. Paraconsistent logic.

1. Introduction

Information and Communication Technologies (ICT) are present in people's daily lives, and the adoption and use of ICT by society are irreversible, as their use has allowed advancement in several areas of activities in the community (Sanchez, Sanchez, & Albertin, 2015).

Organizations are also part of this scenario of using technology in favor of daily activities. The adoption of technology has an impact on decision making, improvement in customer service, and the execution of specific tasks (Gomes et al., 2019, p. 47).

Thus, the development of systems capable of offering technology to the manager in the decision-making process has been a challenge for organizations, researchers, and developers. Among the various

systems, such as an Enterprise Resource Planning (ERP) or a Management Information System (MIS), Heinzle, Gauthier, and Fialho (2010) highlight the Decision Support Systems (DSS). DSS has an important characteristic of supporting decision making through the use of technologies. These technologies perform data comparison, analysis, and simulation operations, allowing a significant number of variables to be considered in the decision-making process.

DSS is designed to assist organizations in the current global context where information is available and requires managers to make decisions that are increasingly faster and more accurate. However, a DSS has distinct characteristics, such as the centralization of various data sources and manipulation performed by the user, when compared to other systems such as MIS or ERP. Thus, the implantation in an organization must be planned according to the reality in question.

The benefits of ICT can be tangible and intangible. In the first case, they directly affect the company's results and, in the second case, they improve the business, but they do not directly affect the company's achievements (Albertin, & Albertin, 2008; Santa, Mussi, & Nascimento, 2016).

In the scenario of decision making by managers, Simon (1959) highlights that deciding is a cognitive act governed by characteristics of human cognition that affects decision making due to how the individual interprets information. Therefore, managers must understand the benefits of using and accepting technologies to support decision making.

However, one of the major challenges in the implementation of Information and Communication Technologies systems is the use and acceptance of new technology by users. Bobsin, Visentini, and Rech (2009), through a literature review, found that many works were dedicated to research and develop theories to evaluate how the process of acceptance and use of systems occurs, mainly with the use of the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2003).

The UTAUT model aims to assess the use and acceptance of information technology. Therefore, in the context of information systems in organizations, this theory makes it possible to understand how users use and accept information systems. In this study, the term information systems will be used as a set of data and information organized in an integrated manner, in order to meet users and anticipate their needs, as defined by Guimarães and Évora (2004).

The benefits of using information technology for business strategies are linked to the reduction of time to perform tasks and to increase the qualification of employees, improvement in the quality of information, growth in operating revenue and investments, security, and compliance. In the period from 2001 to 2011, the industries that invested the most in IT were those that obtained the best financial performance, revenue growth, and best operating results, when compared to sectors that invested less in the same period (Moura et al., 2017).

Regarding the implementation of information management and decision support is the Federal Institute of Education, Science, and Technology (IFRO), an educational institution established in 2009 and which brings with it the mission of internalizing professional education in the State of Rondônia (Brasil, IFRO, 2014). Despite the centennial of the Federal Education Network in Brazil, in Rondônia, the IFRO was effectively installed in 2008 with the creation of the Federal Institute, since up to that moment it had only one agricultural teaching unit in the interior of the state, since 1993 (Brasil, IFRO, 2014).

IFRO has excellent relevance in contributing to the growth of the state and in the development of

research and extension for society. In 2017, it reached nine traditional learning units and 23 distance learning centers across the state, in addition to 176 distance learning centers in partnership with the State Government (Brasil, IFRO, 2018). This vertiginous growth demonstrates the importance of the institution for the state. However, it raises a high level of information and requires managers to be able to evaluate for decision making.

In this continually evolving scenario and with the challenges imposed, in 2015, IFRO sought to develop and implement a tool to support decision-making, called the Indicators Panel. This tool is aiming at improving and managing efficiency in terms of resource allocation, people management, and customer service, quality standards for civil servants, and students across the state.

Thus, the general objective of the research was to analyze the managers' perception regarding the use and acceptance of Decision Support Systems (DSS) at the Federal Institute of Education, Science, and Technology of Rondônia. In addition, as a specific objective, the importance of Decision Support Systems for Federal Institutes was verified, the acceptance of DSS, the IFRO Indicators Panel, identifying the predictive factors of the intention to use and the users' behavior during the application of technologies and sought to relate the variables (gender, age, experience, and voluntariness) with the factors that moderate the intention and behavior in the effective use of the DSS. For data treatment and analysis, paraconsistent logic associated with factor analysis and average ranking was used.

This article is organized as follows. Section 2 presents the theoretical framework, section 3 the methodology used (data collection instrument, population and sample and the description of the treatment and analysis of the data), section 4 presents the results and analyzes carried out from the data collected, and finally, section 5 points to the conclusions.

2. Theoretical background

After World War II, three basic trends began to transform organizations and the way they are managed. According to Porto and Belfort (2001), marketing was beginning to emerge as an increasingly important element in conquering markets. The impact of new technologies was expanding at an accelerated rate - especially in the fields of electronics, information, and communication and materials, making the world subjected to a process of high expansion and diversification of businesses, markets, and products. In this evolution, communication has become one of the pillars for organizational development, especially to support decision-making processes (Moreira, Bruno & Ribeiro, 2014).

In recent years, organizational changes have promoted changes in habits and in the way of managing (Silva, Silva & Gomes, 2016, p. 2781). There have been major changes in the managerial and organizational environment of institutions that are directly related to ICT, whether due to the emergence of new technologies or new applications, even opportunities created from new technologies, or in the way they are applied. Investing resources to modernize their technological infrastructure as a way to automate and support managerial capabilities has been the option to keep organizations competitive (Moreira, Bruno, & Ribeiro, 2014).

The use of information and communication technology offers benefits such as reduced costs, increased productivity, improved quality, flexibility, and innovation (Albertin & Albertin, 2008). For an organization,

determining how to use ICT to add value to its business is critical, and the results of the organization's success depend on how its users and stakeholders benefit from investments in technology.

Thus, technologies allow managers to have adequate tools for decision making based on the results of data converted into information more quickly. Therefore, its value has been added as another differential in the increase of work in organizations. Considering several sources (internal and external), the processing of information provides the organization of processes and improvement of the conditions for making information available to stakeholders, many times through the management of specific projects, allowing a more precise decision making with the perspective of generating competitive advantage (Guimarães & Évora, 2004; Larieira & Albertin, 2015).

Decision Support Systems (DSS) appeared between the 60s and 70s, being pioneering systems in the process of solving unstructured management problems. A DSS is a set of software and hardware that processes information interactively and assists decision-makers in a semi-structured or unstructured way (Bidgoli, 198; 9Pearson & Shim, 1995; Costa, 1997; Bispo, 1998; Fisher, 1998; Clericuzi, Almeida, & Costa, 2006; Courtney, 2001; Silva et al., 2013; Laudon & Laudon, 2018).

For decision-making, organizations rely on many variables, economic and political interests, whether explicit or implicit. Thus, it is necessary to have support in this decision-making process to find the most viable alternative among the possible ones. For this, information systems, in this new reality of technologies daily and with increasing complexity for decision making, have established themselves as an important support tool, as they use proven data and facts, enabling a more informed decision agreed by the manager (Bispo, 1998; Heinzle, Gauthier & Fialho, 2010).

In research on acceptance and use of technologies, the seminal model used is called the *Technology Acceptance Model* (TAM) and was published by Davis (1989), based on *Theory of Reasoned Action* (TRA), to predict acceptance and the use of technology in the work context (Faria et al., 2014).From these studies, new ones emerged, with the proposal to fill in the gaps and create constructs that could contribute to the initial studies of Davis (1989). Based on several studies already carried out, Venkatesh et al. (2003) developed the *Unified Theory of Acceptance and Use of Technology* (UTAUT).

UTAUT (Venkatesh et al., 2003) came up with the proposal to unify the following theories: Theory of Rationalized Action (TRA) (Fishbein & Ajzen, 1975); the Technology Acceptance Model (TAM) (DAVIS, 1989); the Motivational Model (MM) (Davis, Bagozzi, & Warshaw, 1989); the Theory of Planned Behavior (TPB) (Ajzen, 1991); the combination of TAM and TPB (Taylor & Todd, 1995); the PC Utilization Model (MPCU) (Thompson, Higgins, & Howell, 1991); the Innovation Diffusion Theory (IDT) (Rogers, 2003) and the Social Cognitive Theory (SCT) (Compeau & Higgins, 1995).

In this way, UTAUT added and generated a complete model with the main constructs related to the use and acceptance of information and communication technology. According to the model, as can be seen in Figure 1, the four determinant constructs are performance expectation, effort expectation, social influence, and facilitating conditions (Venkatesh et al., 2003). There are still four moderators who are personal characteristics of individuals (users) who have a moderating role and can influence the acceptance and use of the technology in question: Gender, Age, Experience, and Voluntary use.

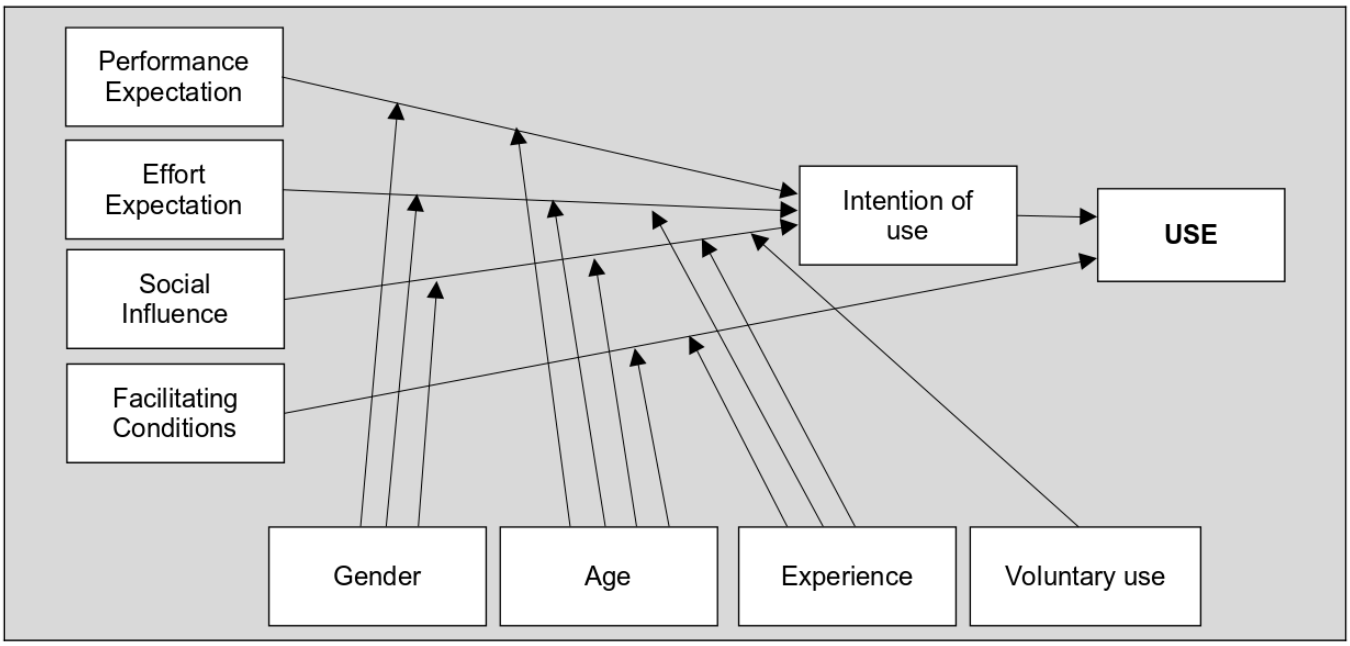

Figure 1. UTAUT model (Venkatesh et al., 2003).

Performance expectation measures the degree to which the individual believes that using the system will increase his performance at work. The expectation of effort assesses the degree of ease associated with using the system. Social influence determines the degree to which the individual considers the opinion of others about whether or not to use the system important. And the facilitating conditions assess the individual's degree of perception about the existence of technical and organizational infrastructure to use the system.

Subsequently, with the perspective of applying the model to the consumer context, Venkatesh, Thong, and Xu, in 2012, extended UTAUT by incorporating constructs of hedonic motivation, price, and habit (Venkatesh, Thong, & Xu, 2016). This extension was called UTAUT2; however, as the present research analyzed the use and acceptance by users of the system, the theory used was UTAUT.

3. Research methods

This research is quantitative, based on two pre-established theories as methodological support (Creswell, 2009). The adopted methodology is descriptive, approaching the explanatory since it aims to discover the existence of association or relationship between variables (Gil, 2002). The adopted method starts as descriptive as a way to present the quantitative analyzes performed and goes to inferential evaluating cause and effect from the samples (Trochim, 2018). Therefore, as this research intends to relate the cause (implementation of the Indicators Panel) and impact (use and acceptance in the IFRO decision-making process) between the events, this research is close to the explanatory one, expanding its scope of analysis.

3.1 Research instrument

A direct investigation was carried out to participants through a structured data collection instrument (survey). The survey was based on the Integrated UTAUT model and elements related to the Theory of

Bounded Rationality (Simon, 1959), since it is expected to evaluate the relevance of research in the area.

3.2 Research Population and Sample

The chosen organization of study was the Federal Institute of Education, Science, and Technology of Rondônia. It was requested to approve the project at the institutional level, with the Rectory / IFRO and the Research Ethics Committee of the Federal University of Rondônia (UNIR) in 2018.

The Federal Institutes of Education, Science, and Technology are institutions of higher, basic and professional education, pluricurricular, and multicampus specialized in offering professional and technological education in different teaching modalities (BRASIL, 2008). These make up the Federal Network for Professional, Scientific, and Technological Education, linked to the Ministry of Education and created by Law No. 11,892 of 22 December 2008.

The Federal Institute of Education, Science, and Technology of Rondônia (IFRO), located in the state of Rondônia, was created in the state through the junctions of the Federal Technical School of Rondônia and the Federal Agrotechnical School of Colorado do Oeste. Thus, IFRO started its activities in the state in 2009 and is consolidating itself in this scenario with the provision of free public education (BRASIL, I., 2014). IFRO's activities in the state are limited to 10 units, with a rectory in the capital (Porto Velho) and nine campuses.

The technology under study is the decision support system that IFRO implemented in 2015, called the "Indicators Panel", based on Business Intelligence (BI), an open-source OLAP (Online Analytical Processing) tool aimed at business intelligence. The proposal was initiated in late 2014 to facilitate the information collection process, previously decentralized in different systems, which required time and effort by the people involved in the process. The system performs analysis of large volumes of data and integrates with the other systems of the institution to process data in a distributed way. The software "Indicator Panel" is composed of data originating from the academic system of the institution in the case of classroom teaching, virtual environment database of learning in the case of distance learning and systems of the federal government, such as Integrated Management System of Personnel (SIAPE), National Information System for Professional and Technological Education (SISTEC) and Integrated System of Financial Administration of the Federal Government (SIAFI). Figure 2 shows the system screen.

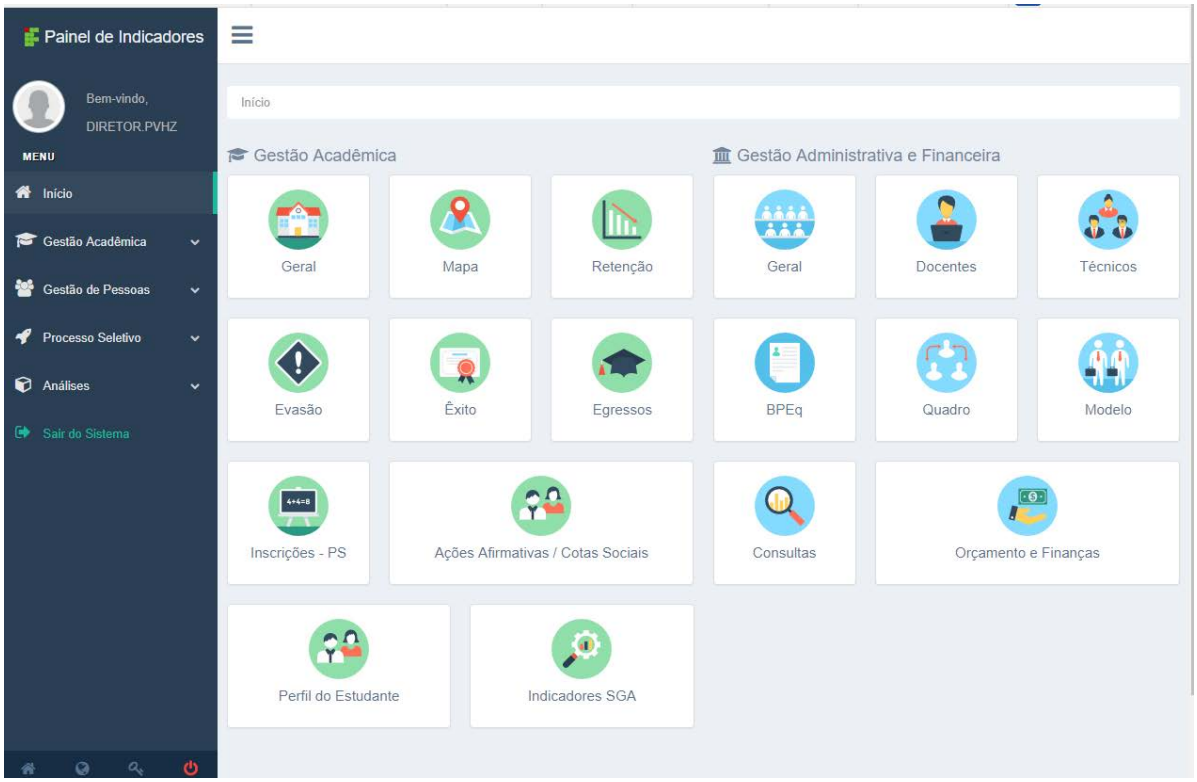

Figure 2. IFRO Indicator Panel screen (Print screen http://painel.ifro.edu.br, accessed on 9 October 2018)

As for the application of the data collection instrument using the UTAUT Theory, the target population was the 74 managers of the Federal Institute of Education, Science and Technology of Rondônia of the nine units that make up the IFRO, characterizing the study as to the elements of the population as a census (Babbie, 2003).

However, even to collect data to have a census characteristic, that is, it sought that all individuals participate in the research, it was a research with voluntary collaboration. Thus, it was not possible to obtain the answer from all managers. The total responses received, after three e-mails sent to managers in seasonal periods, were 67 responses. Thus, the data analysis has a 99% confidence level and a 5% margin of error, with the collection being conducted from 9 April to 30 May 2018.

Thus, the sampling of this research is characterized as non-probabilistic, which according to Cooper and Schindler (2003, p. 152), is an "arbitrary (non-random) and subjective" technique since the elements of the sample were not elected "Randomly", therefore, is not random sampling.

3.3 Data Treatment and Analysis

As a way of analyzing the reliability of the data collection instrument, we opted for the paraconsistent logic and Cronbach's alpha coefficient. Lee J. Cronbach presented the Cronbach's alpha, in 1951, as a way of estimating the reliability of a questionnaire applied in a survey (HORA, MONTEIRO, & ARICA, 2010, p. 90). It is the average correlation between questions since all items in a questionnaire using the same scale to measure it (Hora, Monteiro, & Arica, 2010, p. 91).

However, the use of classical logic for processing data and information can sometimes not be the most appropriate to portray real-world situations and propositions. In this case, it was also chosen to use

Paraconsistent Logic, a non-classical logic, which by accepting contradictions as theses in its structure, can be applied in several areas of knowledge (Silva Filho, 2009). While the studies resulting from Evidential Logic limit the premises to only partial evidence, in Annotated Paraconsistent Logic (APL), the degree of credibility or belief that the premises confer on the conclusion is considered. The determination of premises is the task of scientific research, and the validity or not of the argument is determined by a logical study (Silva Filho, 1999, p. 9).

The data collection instrument, based on the theory of the UTAUT Model, collected data regarding the acceptance and use of the Decision Support System (DSS) using the Likert scale. Such theory provides a structured data collection instrument, already validated and tested, which has been adapted to the reality of the present research.

Data analysis took place through Factor Analysis, which is a multivariate approach and aims to discover patterns in the values of several variables, "essentially by the generation of artificial dimensions (factors) that correlate highly with several of the real variables" (Babbie, 2003).

Thus, this study sought to simplify, through Exploratory Factor Analysis (AFE), the data from the data collection instrument based on the UTAUT model to identify which major factors can be considered in improving the deployment for the use and acceptance of the Panel system. Indicators of the institution, that is, which propositions form a scope of relationship that can determine what is really important to be measured and monitored in the use and acceptance of DSS in the institution.

The Principal Component Analysis method was used to extract the factors, which takes into account the total variance in the data by verifying a linear combination between the variables so that the maximum variance is explained. This process is always repeated to seek a new linear combination and demonstrate the greatest amount of variance remaining (Corrar, & Paulo and Dias Filho, 2014).

The mode of analysis of the variables chosen was the R-mode factor analysis, which seeks to identify underlying structures capable of being perceived only by building relationships between several variables (Corrar; Paulo and Dias Filho, 2014).

The choice of the number of factors can be defined using the eigenvalue criterion, slope graph criterion, or screen plot, and by the percentage of the explained variance. In this research, we opted for the percentage of explained variance, as it was defined that the set of propositions must answer for at least 70% of the variance. The rotation of the Varimax factors was performed to expand the explanation of the factor analysis, which is a type of orthogonal rotation (keeps factors perpendicular to each other), which makes it easier to identify the relationship with a single factor (Corrar, & Paulo and Dias Filho, 2014). The initial analyzes were performed based on the responses of the data collection instrument using the data analysis software IBMS SPSS Statistics.

There was a verification of the reliability analysis of the scales used in the research (Cronbach's alpha). Thus, the values obtained should be consistent with those that are usually cited in the literature, 0.70 as an acceptable minimum (Hora, Monteiro, & Arica, 2010).

In the present study, initially, the coefficient obtained was 0.849. With these results, it is considered that there is good reliability of the data, being adequate for this research. However, Cronbach's Alpha of the four determinants of the UTAUT model was also analyzed individually. Each construct is outlined in Table 1.

Table 1. Cronbach's alpha value for each UTAUT construct

Construct	Cronbach's Alpha value
Performance expectation	0.768
Expected of effort	0.894
Social influence	0.709
Facilitating conditions	0.443

Source: Elaborated by the authors

As the construct "Facilitating conditions" obtained an alpha value below 0.7, it was disregarded from the analysis. After a new verification, the Cronbach's Alpha obtained was 0.844, which still allows certifying the reliability of the data.

The next step in the analysis of the reliability of the research data used the analysis by the paraconsistent logic applied to the propositions of the UTAUT Model.

Thus, the calculations were performed and shown in Figure 3, taking as a basis the concepts of Paraconsistent Logic.

After identifying the factoring agreement and the factor disagreement, Sanches, Meireles, and Sordi (2011, p. 11) establish the need for the conversion of beliefs and disbelief using the logical operators OR and AND. The connective logic is determined by comparing μ1 (degree of belief) and μ2 (degree of disbelief), as shown in Figure 3, where the result operated by OR is the output of the highest value of the two inputs and the result operated by AND is the output of the lowest value of the two inputs. Thus, it can isolate the factors of greatest influence in decisions.

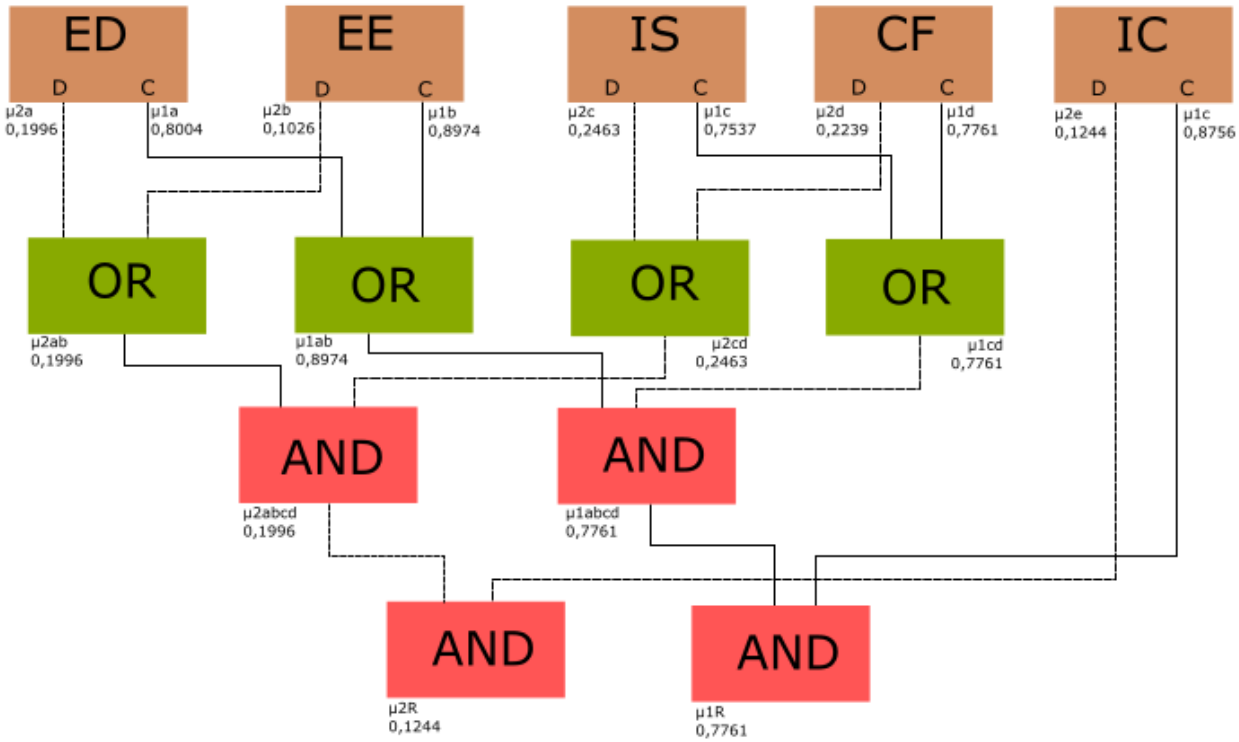

Figure 3. Logical networks for converting the degree of belief and disbelief

Therefore, from the Paraconsistent Logic, the degrees of belief (μ1) and disbelief (μ2) were calculated in relation to each factor, and the degree of certainty (G1) and the degree of contradiction (G2) were obtained. With the results of the degree of certainty and uncertainty, it is necessary to normalize and interpret the result, seeking to standardize the language to enable further comparisons, the proposed model has step 5 in which the outcome is normalized so that the final result is expressed in the range of [0; 1] (Silva Filho, 2009).

Degree of certainty:

(G 1 = μ1R - μ2R) = 0.7761 – 0.1244 = 0.6517

Normalization of the degree of certainty:

$$G_{1n} = \frac{G_1 - (-1)}{1 - (-1)} = \frac{G_1 + 1}{2} = \frac{0.6517 + 1}{2} = 0.82585$$

Degree of uncertainty:

(G 2 = μ1R - μ2R - 1) = 0.7761 + 0.1244 – 1.00 = - 0.0995

Normalization of the degree of contradiction:

$$G_{2n} = \frac{G_2 - (-1)}{1 - (1)} = \frac{G_2 + 1}{2} = \frac{-0.0995 + 1}{2} = 0.45025$$

Then, the result of G1 and G2 is applied for interpretation, in the Cartesian Plan Unit Square (QUPC), as can be seen in Figure 4.

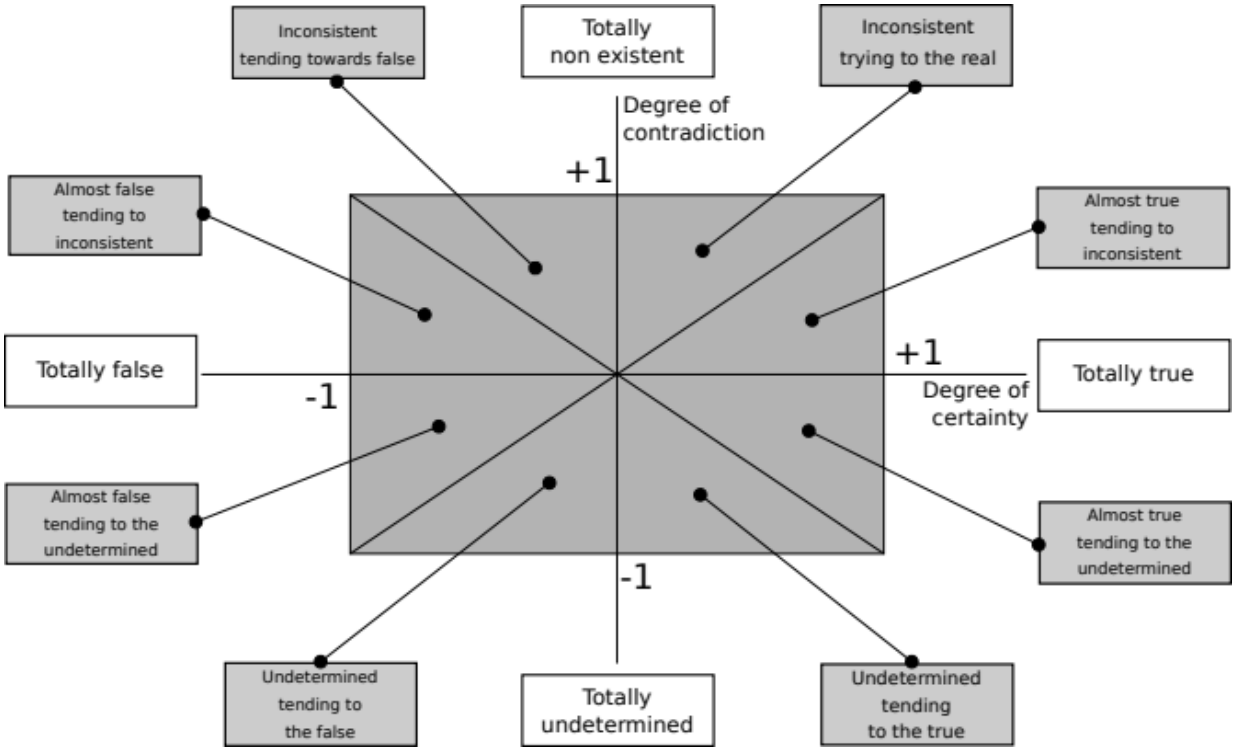

Figure 4. QUPC - Unitary Square of the Cartesian Plan

After the conversion from normalization, Davis (1976, p.70), also cited by Sanches, Meireles, and Sordi (2011, p11), proposes an interpretation for the normalized degrees of certainty and contradiction. Thus, Davis's framework was used (1976) adapted by Sanches, Meireles, and Sordi (2011).

Table 2. Convention to describe the interpretation and synthesis of information obtained by Likert scale regarding the G1n normalized degree of certainty and the G2n normalized degree of contradiction

Standardized degree of certainty G_{1n}		**Standard contradiction degree G_{2n}**	
Expresses how much the subjects adhere to the factor propositions (horizontal axis in QUPC)		Expresses the quality of the data used (vertical axis in QUPC)	
Observed Value	**Recommended interpretation**	**Observed Value**	**Recommended interpretation**
0.900 ou mais	Broad adherence	0.900 ou mais	Very contradictory data
0.700 a 0.899	Substantial adherence	0.700 a 0.899	Conflicting data
0.300 a 0.699	Moderate adherence	0.300 a 0.699	Consistent data
0.100 a 0.299	Low adherence	0.100 a 0.299	Incomplete data
0 a 0.099	Insignificant adherence	0 a 0.099	Ignored data

Source: Davis (1976), adapted by Sanches, Meireles, and Sordi (2011, p. 11)

Therefore, when verifying the degree of certainty data (G_{1n}) at 0.82585 and the degree of contradiction (G_{2n}) at 0.45025, the data show “Substantial adherence” and “Consistent data”, respectively.

In the last step of the data analysis, the Factor Analysis of the data collected by the data collection instrument based on the UTAUT model was performed. In this case, the objective was to verify how to reduce the propositions to demonstrate which prepositions represent the study model and which variables are identified, which better determine the acceptance and use of the institution’s decision support system.

Thus, the factor analysis was able to group the components into three essential factors for the acceptance and use of the Decision Support System of the Federal Institute of Rondônia, which were classified into Effort Expectation, Performance Expectation) and Social Influence. Based on these three identified factors, analyzes were carried out concerning the UTAUT moderators to list specific characteristics regarding the use and acceptance of the DSS.

The Gender, Age, and Experience moderators were analyzed using Pearson’s Correlation, which measures the degree of correlation between two variables of the metric scale and the Average Ranking (AR) that allows verifying the agreement or disagreement regarding the propositions.

Thus, for the average ranking, the identified weighted average was considered, which is calculated according to the frequency of responses of the scales indicated by the respondents using the formula: Weighted Average (WA) = $\sum(fi * Vi)$. Thus, AR = WA/(NS), where fi is the observed frequency of the propositions for each answer, Vi is the value of each answer, and NS is the sample number (Malhotra, 2018). Since the moderator voluntariness was removed from the analyzes since the system is mandatory in its use and according to Venkatesh et al. (2003), is more significant in environments where the use of a system is mandatory; thus, this construct has not shown relevance.

4. Results

The characterization of the respondents is presented as follows according to the four moderators of the

UTAUT model (Gender, Age, Experience, and Voluntary use). In the first case, regarding gender, it was verified that 58% of the managers of the institution are men and 47% women.

The graph in Figure 5 shows the age of the IFRO managers. It can be seen that 25% of managers are between 25 and 30 years of age and that 59% of managers are younger than 41.

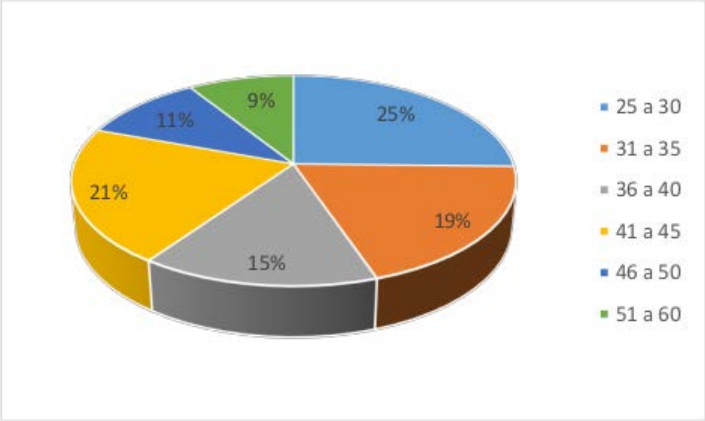

Figure 5. Age of responding managers

Source: Elaborated by the authors based on research data

Considering experience, Figure 6 shows the management time of the institution's managers. It can be seen that even with 59% of the managers being under 41 years of age, 42% of the managers have more than five years of management experience. With less than one year of management time, it can be seen that 7% are in this scenario. It is also noteworthy in this case that, despite the existence of the Campus Colorado do Oeste for more than 25 years, the performance of IFRO in the state as Federal Institute is only ten years.

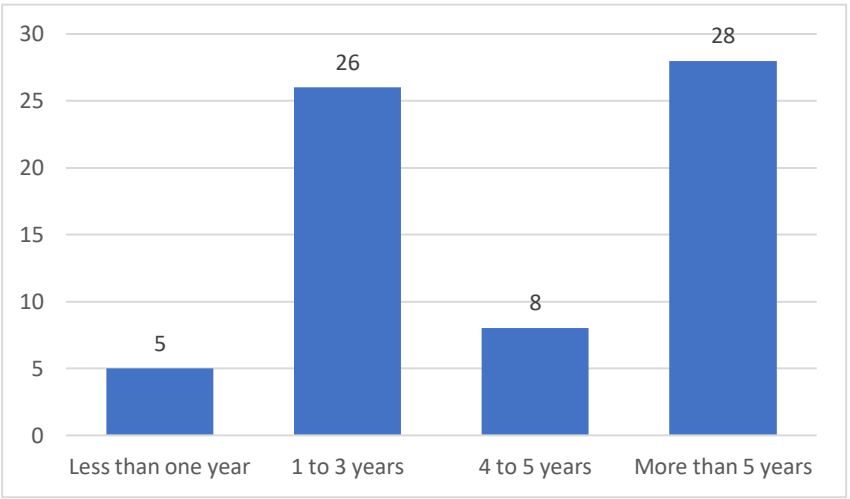

Figure 6. Management time of responding managers

Source: Elaborated by the authors based on research data

Considering the time of management according to gender identity, Figure 7 shows that there are, as well as in the case of men, a higher number of female managers with more than five years of management. It can also be verified that the proportion of management time between women and men is similar, considering the percentage of respondents.

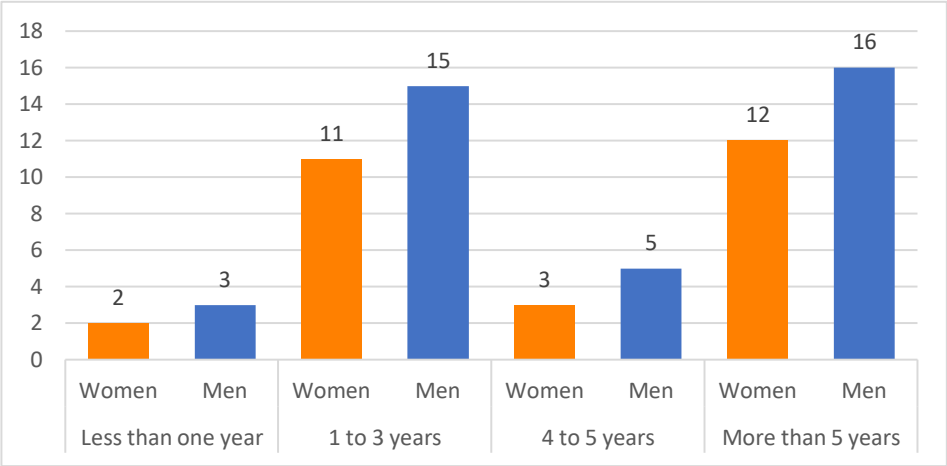

Figure 7. Management time of the respondent managers by gender identity

Source: Elaborated by the authors based on research data

In the Effort Expectation factor, the first item analyzed was "The system is useful for my work". It can be seen that there is a high agreement on the usefulness of the work for managers with a very high average ranking. In further detailing the analysis, it is noted that in the gender comparison, the agreement was higher for males on the usefulness of DSS for work, with 97.4 of degree of agreement of the proposition and 4.72 of average ranking for male respondents. The result can be seen in Table 3.

Table 3. Consideration of the usefulness of the system for the work of managers

Proposition [The system is useful for my work.]	**Semantic Differential**					**Total**	**Average Ranking**	**Disagreement with the proposition**	**Consistent with the proposition**	**Degree of agreement of the proposition**	**Degree of disagreement with the proposition**
	I totally disagree	**I Partially Disagree**	**Indifferent**	**Partially agree**	**Totally agree**						
Both sexes	0	0	6	10	51	67	4.67	3.0	64.0	95.5	4.5
Masculine	0	0	2	7	30	39	4.72	1.0	38.0	97.4	2.6
Feminine	0	0	4	3	21	28	4.61	2.0	26.0	92.9	7.1

Source: Elaborated by the authors based on research data

Another item analyzed that deserves highlighting in the Effort Expectation Factor was "My interaction with the system is clear and understandable". There is a "substantial agreement" concerning to clarity and understanding of the system use, both for the female and male public (Table 4). It can suggest that managers

agree that the system is useful for their work. However, the first problem of the Effort Expectation Factor is the clear and understandable interaction with the system, allowing us to infer that despite the importance of the decision support system, the interaction with the system does not occur satisfactorily. This statement is more evident for female managers from 1 to 3 years of management with a moderate agreement and managers of the sixth male from 4 to 5 years of management.

Table 4. Clarity and understanding of interaction with the system by management time

GENDER	**Proposition** [My interaction with the system is clear and understandable]	**Semantic Differential**					**Total**	**Average Ranking**	**Disagreement with the proposition**	**Consistent with the proposition**	**Degree of agreement of the proposition**	**Degree of disagreement with the proposition**
		I totally disagree	**I Partially Disagree**	**Indifferent**	**Partially agree**	**Totally agree**						
BOTH	Less than one year	0	0	0	3	2	5	4.40	0.0	5.0	100.0	0.0
	1 to 3 years	0	2	3	18	3	26	3.85	3.5	22.5	86.5	13.5
	4 to 5 years	1	0	0	5	2	8	3.88	1.0	7.0	87.5	12.5
	More than 5 years	1	0	6	15	6	28	3.89	4.0	24.0	85.7	14.3
MASCULINE	Less than one year	0	0	0	1	2	3	4.67	00	3.0	100.0	0.0
	1 to 3 years	0	0	1	11	3	15	4.13	0.5	14.5	96.7	3.3
	4 to 5 years	1	0	0	3	1	5	3.60	1.0	4.0	80.0	20.0
	More than 5 years	1	0	3	10	2	16	3.75	2.5	13.5	84.4	15.6
FEMININE	Less than one year	0	0	0	2	0	2	4.00	0.0	2.0	100.0	0.0
	1 to 3 years	0	2	2	7	0	11	3.45	3.0	8.0	72.7	27.3
	4 to 5 years	0	0	0	2	1	3	4.33	0.0	3.0	100.0	0.0
	More than 5 years	0	0	3	5	4	12	4.08	1.5	10.5	87.5	12.5

Source: Elaborated by the authors based on research data

The next item analyzed was “I find the system easy to use”, in which the gender identity and management time were compared, as can be seen in Table 5. It can be seen that the degree of disagreement for women is lower regarding not finding the system easy to use. One the other hand, for men, besides the

presentation of high disagreement with the item, there is a low agreement among managers who have 4 to 5 years of management, and this is a very relevant indicator of disagreement. It is also assumed by the other items that male managers have greater difficulty in using the system.

Table 5. Ease of use of the system

GENDER	Proposition [I find the system easy to use]	Semantic Differential					Total	Average Ranking	Disagreement with the proposition	Consistent with the proposition	Degree of agreement of the proposition	Degree of disagreement with the proposition
		I totally disagree	I Partially Disagree	Indifferent	Partially agree	Totally agree						
BOTH	Less than one year	0	0	1	2	2	5	4.20	0.5	4.5	90.0	10.0
	1 to 3 years	0	0	3	15	8	26	4.19	1.5	24.5	94.2	5.8
	4 to 5 years	1	1	0	2	4	8	3.88	2.0	6.0	75.0	25.0
	More than 5 years	1	0	5	6	16	28	4.29	3.5	24.5	87.5	12.5
MASCULINE	Less than one year	0	0	1	0	2	3	4.33	0.5	2.5	83.3	16.7
	1 to 3 years	0	0	1	8	6	15	4.33	0.5	14.5	96.7	3.3
	4 to 5 years	1	1	0	1	2	5	3.40	2.0	3.0	60.0	40.0
	More than 5 years	1	0	1	4	10	16	4.38	1.5	14.5	90.6	9.4
FEMININE	Less than one year	0	0	0	2	0	2	4.00	0.0	2.0	100.0	0.0
	1 to 3 years	0	0	2	7	2	11	4.00	1.0	10.0	90.9	9.1
	4 to 5 years	0	0	0	1	2	3	4.67	0.0	3.0	100.0	0.0
	More than 5 years	0	0	4	2	6	12	4.17	2.0	10.0	83.3	16.7

Source: Elaborated by the authors based on research data

Still in the Effort Expectation Factor was checked the item “Learning to use the system is easy for me”. It can be observed that managers partially or totally agree with this statement, with 88% of notes, which suggests the interest in learning how to use the decision support tool.

In the case of the Performance Expectation Factor, there are two items to analyze. This factor has aggregated propositions that relate to how the use of DSS affects the performance of the respondent. The first is "Using the system increases my productivity". It was verified that the percentage of total and partial agreement is practically the same. Yet, for 19% of the managers, it is indifferent to consider the increase in productivity from the use of the decision support system.

The second item of the analyzed Performance Expectation Factor was "Using the system allows me to perform tasks more quickly". In this case, the partial agreement was greater than the total agreement, which suggests that there are doubts if the system allows performing tasks more quickly. Female managers over five years of age were the most disagreed, however, because they also differed on ease of use and willingness to learn, it is understood that they cannot know that the system can make tasks faster because of the above. Male managers with less than one year of management presented a low agreement concerning the proposition, which allows us to suppose that their own inexperience with the system increases the time of learning and use of the tool. The results can be seen in Table 6.

Table 6. Using the system to perform tasks more quickly

GENDER	Proposition [Using the system allows me to perform tasks more quickly]	Semantic Differential					Total	Average Ranking	Disagreement with the proposition	Consistent with the proposition	Degree of agreement of the proposition	Degree of disagreement with the proposition
		I totally disagree	I Partially Disagree	Indifferent	Partially agree	Totally agree						
BOTH	Less than one year	0	1	0	1	3	5	4.20	1.0	4.0	80.0	20.0
	1 to 3 years	0	0	4	12	10	26	4.23	2.0	24.0	92.3	7.7
	4 to 5 years	0	0	1	3	4	8	4.38	0.5	7.5	93.8	6.3
	More than 5 years	1	1	5	12	9	28	3.96	4.5	23.5	83.9	16.1
MASCULINE	Less than one year	0	1	0	0	2	3	4.00	1.0	2.0	66.7	33.3
	1 to 3 years	0	0	0	9	6	15	4.40	0.0	15.0	100.0	0.0
	4 to 5 years	0	0	1	3	1	5	4.00	0.5	4.5	90.0	10.0
	More than 5 years	1	0	2	7	6	16	4.06	2.0	14.0	87.5	12.5

FEMININE	Less than one year	0	0	0	1	1	2	4.50	0.0	2.0	100.0	0.0
	1 to 3 years	0	0	4	3	4	11	4.00	2.0	9.0	81.8	18.2
	4 to 5 years	0	0	0	0	3	3	5.00	0.0	3.0	100.0	0.0
	More than 5 years	0	1	3	5	3	12	3.83	2.5	9.5	79.2	20.8

Source: Elaborated by the authors based on research data

Finally, we have the Social Influence Factor that was grouped to evaluate the items that demonstrate managers' perception of the use of DSS about other people. The first item analyzed was "The people I relate to think I should use the system". According to Table 7, the Average Ranking points to an indifference on the part of managers to the statement.

Table 7. Use of the system concerning people with whom managers relate

[The people I relate to think I should use the system]	**Semantic Differential**					**Total**	**Average Ranking**	**Disagreement with the proposition**	**Consistent with the proposition**	**Degree of agreement of the proposition**	**Degree of disagreement with the proposition**
	I totally disagree	**I Partially Disagree**	**Indifferent**	**Partially agree**	**Totally agree**						
Masculine	1	0	23	13	2	39	3.38	12.5	26.5	67.9	32.1
Feminine	0	0	19	7	2	28	3.39	9.5	18.5	66.1	33.9

Source: Elaborated by the authors based on research data

The next proposition analyzed was "People who are important to me think I should use the system", (Table 8). Again, a significant value of respondents, most of whom consider the statement to be indifferent, suggesting that even people who managers consider important are indifferent if they think they should use the system.

Table 8. Relationship between system use and the people who are important to the manager

Proposition [People who are important to me think I should use the system]	**Semantic Differential**					**Total**	**Average Ranking**	**Disagreement with the proposition**	**Consistent with the proposition**	**Degree of agreement of the pronosition**	**Degree of disagreement with the pronosition**
	I totally disagree	**I Partially Disagree**	**Indifferent**	**Partially agree**	**Totally agree**						
Both sexes	1	0	36	19	11	67	3.58	19.0	48.0	71.6	28.4
Masculine	1	0	20	11	7	39	3.59	11.0	28.0	71.8	28.2
Feminine	0	0	16	8	4	28	3.57	8.0	20.0	71.4	28.6

Source: Elaborated by the authors based on research data

In this item, the analysis by gender showed that in the woman's case, the difference is minimal, i.e., both managers tend to consider indifferent the perception of the system used by other people that they consider important.

Finally, the last item of the Social Influence Factor is "Managers show that using the system is important for their reputation". However, this research aims to evaluate the use and acceptance of the DSS by the managers of the institution. Therefore, this proposition despite presenting agreement, was not considered in the analysis since all are managers and presupposed to use the system. The results are presented in Table 9.

Table 9. Perception of managers about using the system being important for their reputation

Proposition [Managers show that using the system is important for their reputation]	**Semantic Differential**					**Total**	**Average Ranking**	**Disagreement with the proposition**	**Consistent with the proposition**	**Degree of agreement of the pronosition**	**Degree of disagreement with the pronosition**
	I totally disagree	**I Partially Disagree**	**Indifferent**	**Partially agree**	**Totally agree**						

Both sexes	1	6	22	25	13	67	3.64	18.0	49.0	73.1	26.9
Masculine	1	6	13	11	8	39	3.49	13.5	25.5	65.4	34.6
Feminine	0	0	9	14	5	28	3.86	4.5	23.5	83.9	16.1

Source: Elaborated by the authors based on research data

In order to enrich the analyses carried out, a correlation check between moderators (age, gender and management time) and the factors of acceptance and use of the Indicator Panel was performed in parallel using the SPSS (Statistical Package for the Social Sciences) software, version 24, from the calculation of the Pearson correlation where significant correlations at levels 0.01 and 0.05 were identified. Table 10 shows the analysis performed with the aggregate profile of men and women.

Table 10. Correlation between user profile and usage and acceptance factors

Proposition	**Age**	**Management time**	**Gender**
The system is useful for my work	-0.084	-0.090	-0.086
Using the system allows me to perform tasks more quickly	**-0.212**	-0.144	-0.061
Using the system increases my productivity	-0.137	-0.150	-0.007
My interaction with the system is clear and understandable	0.005	-0.065	-0.054
It will be easy to become a skilled system user	-0.084	-0.130	-0.112
I find the system easy to use	0.034	0.042	-0.046
Learning how to use the system is easy for me	-0.020	0.058	-0.021
The people I relate to think I should use the system	**-0.207**	-0.011	0.006
People who are important to me think I should use the system	-0.021	0.057	-0.011
Managers show that using the system is important to their reputation	0.158	-0.111	0.194
**. The correlation is significant at level 0.01 (bilateral).			
*. Correlation is significant at the 0,05 level (bilateral).			

Source: Elaborated by the authors based on research data

By analyzing the variables relating to the user profile, you can see that there are very few correlations. As can be observed in Table 8, there are few significant correlations, and the ones that are present a reduced

significance degree (equal or inferior to 0.05). We can also see that the intensity of the correlation is also reduced. As there is a weak negative correlation between age and the use of the system to perform tasks more quickly, it can assume that managers do not consider that using the system allows performing tasks more quickly.

In the same way, there is a weak negative correlation between age and the fact that managers perceive that the people with whom they relate think that they should use the system. It suggests that there is not total agreement with the preposition, corroborating with the presented graphics that there was partial agreement about the statement.

From the initial observations, it was separated the analyses by gender, to allow a more adequate understanding between the existing correlations of age and management time about the propositions of the UTAUT Model of use and acceptance of the Indicator Panel. Table 11 presents the result of the analysis separately from the correlation between men and women and the propositions.

Table 11. Correlation between user profile by gender and system use and acceptance propositions

Proposition	**Age**		**Management Time**	
	Masculine	**Feminine**	**Masculine**	**Feminine**
The system is useful for my work	-,003	,034	-,031	,220
Using the system allows me to perform tasks more quickly	**-,280***	-,151	-,141	-,150
Using the system increases my productivity	-,207	-,112	-,176	-,146
My interaction with the system is clear and understandable	,068	,117	**-,294***	-,222
It will be easy to become a skilled system user	,085	-,074	-,086	**,284**
I find the system easy to use	,130	-,235	,009	-,174
Learning how to use the system is easy for me	,109	-,131	,024	,112
The people I relate to think I should use the system	**-,376****	-,221	-,167	,115
People who are important to me think I should use the system	-,193	,044	-,071	,231
Managers show that using the system is important to their reputation	,147	,256	-,214	,268
**. The correlation is significant at level 0.01 (bilateral).				
*. Correlation is significant at the 0,05 level (bilateral).				

Source: Elaborated by the authors based on research data

Thus, it can be observed in Table 11 regarding the perception of the men, that there is a correlation between age and the manager's perception that the system allows them to perform tasks more quickly. There is a weak correlation between age and the use of the system to perform activities more quickly. It suggests what male managers with lower age do not understand that the system allows them to perform tasks more quickly.

Another point is that the correlation between management time and the interaction with the system is clear and understandable. In this case, especially for male managers, there is a negative correlation when the proposition suggested that the less time spent in management, the less the manager perceives when the interaction with the system is clear and understandable. This fact may demonstrate that there should be better training for those who are starting in management since they may present more difficulties in operating the Indicator Panel and how to use it for their decision-making process.

A prominent point in the comparison between male and female managers is that male managers perceive that they can become a skilled user of the Indicator Panel. One the other hand, female managers presented a positive correlation concerning the proposition, demonstrating that female managers have a better perception that they can become skilled users in the handling of the tool, different from male managers who presented insignificant correlation value.

Finally, corroborating with the graphs already presented, there is a significant negative correlation between men's age and the perception that the people with whom they relate think they should use the system. In this situation, it can be analyzed that male managers with minor age do not consider the evaluations of the people with whom they relate regarding the use of the system.

5. Conclusion

This research aimed to analyze the perception of managers regarding the use and acceptance of Decision Support Systems (DSS) at the Federal Institute of Education, Science, and Technology in Rondônia. The DMS used by the institution is called the Panel of Indicators and aggregates several elements that allow the user to have access to information that can contribute to the decision-making process.

Based on the application of the UTAUT Model, the Exploratory Factor Analysis (EFA) was performed, and the results of the first tests allowed simplifying the model, generating three preponderant factors for the use and acceptance of the Indicator Panel: Effort Expectation, Performance Expectation, and Social Influence factors. It is worth mentioning that the "Facilitating Conditions" construction was removed for not reaching the adequate reliability level.

The reduction demonstrated that the factors pointed out here explain 77.33% of the acceptance and intention of use, similar to the result found by Venkatesh et al. (2003), where the UTAUT Model explained 70% of the intention of use variation.

Besides, the results showed that managers understand the system is useful for their work, with 76% affirmation, and that it is important for the institution. However, although 80% of them use a decision support system, only 50% use the Indicators Panel. It suggests that managers agree that the system is useful

for their work, but the effort expectation, which is clear and understandable interaction with the system, presented contradictions. It allows the inference that despite the importance of the system in supporting decision making and managers' perception of contributions to the decision-making process, interaction with the system does not occur clearly and understandably.

It is noteworthy that the results presented do not change from the experience, gender, and age for the use of the system and is consistent with the studies of Zaragoza and Domingues (2013), in which the variables also did not affect the intention of use. Thus, it can be inferred that both female and male managers have the same understanding of the Panel of Indicators for the institution.

After analyzing the propositions of the Effort Expectation Factor, it was possible to verify that the interaction with the system is not clear and understandable enough for managers. However, most managers consider that it is easy to become a skilled user, learn how to use the system, and use the system. It suggests that if there is adequate training and/or disclosure by the institution about the importance of the tool, updating data and new features could improve the use of the decision-making process.

Related to the UTAUT model, it is perceived that being a public institution may suggest that the use of the system and the expectation of performance is linked to easing of use and improvement in the execution of activities and increased productivity than other propositions. Concerning social influence, it is perceived that the systems´ acceptance and use are related to the support of the institution and that the relationship with people does not have high adherence to agreement for use and acceptance of the system.

The non-significance of the "Social Influence" construct may be the fact of the voluntary use of the system for decision making. According to Venkatesh et al. (2003), Social Influence is more significant in environments where the use of a system is mandatory, so such a construct may not show importance.

Finally, the importance of a tool such as the IFRO Indicator Panel as a Decision Support System can be proven, and it is evident that in today's world, the faster information is available and more visible to the user tends to be more productive.

The present study sought contributions to the research of the subject under investigation. As a theoretical contribution, this research relates to the application of the UTAUT Model in a Decision Support System, specifically the IFRO Indicator Panel. From a practical point of view, the study will help the institution to understand the aspects that influence the adoption and use of the Panel of Indicators as a Decision Support System and thus plan actions and discussions for its adoption.

In the field of methodology, the contribution of this study was made through the use of paraconsistent logic associated with factor analysis and the average ranking differing from studies that usually use structural equation modeling.

Concerning the limitations of this study, there is a possible bias of the managers, since the Indicator Panel is an institutional instrument.

Thus, it is suggested that for future researches, a direct approach to participants in a qualitative way be carried out in order to seek a more detailed clarification on the use and acceptance of decision support systems, as well as to investigate the influence of other constructs.

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Monitoring of technological horizons for patents on chronic kidney disease

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Abstract

Worldwide, the lack of resolution of the current pharmaceutical arsenal to heal some diseases, including chronic kidney disease, opens space for further research in the field of health. Technological horizons monitoring actions are highlighted in the tracking of relevant technologies to solve certain health issues that are still considered incurable. In this perspective, it is proposed in this study to monitor technological horizons on chronic kidney disease to investigate whether any of the technologies found is incorporated into SUS, with effective use and social impact. For this purpose, a survey was conducted on the International Platform for Clinical Trials Records (ICTRP) of WHO, National Institute of Industrial Property (INPI) and patent database linked to the ORBIT intelligence system. The searches allowed the identification of 32 clinical trials and 375 patents filed worldwide, 33 in Brazil. However, no new technology has been incorporated or is being analyzed for incorporation by the Brazilian Unified Health System (SUS).

Keywords: Monitoring of technological horizons, chronic kidney disease, patents.

1. Introduction

To achieve economic development with equity, academia, government and society understand that this growth depends on the strengthening, expansion and consolidation of science, technology and innovation

(CT&I) activities. The economic development of countries is ensured in innovation based on scientific and technological development. It is no coincidence that several countries, such as the United States and China, have placed innovation as the central line of their strategies for resuming growth after the 2008 crisis (BRAZIL, 2016).

Associated with the scenario of needs of strategic solutions to program innovation in the context of health, Brazil, through the Brazilian Unified Health System (SUS), created in 2006 the commission for the incorporation of technologies (CONITEC) in the scope of the SUS and Supplementary Health (SS), by means of decree No. 3,323 of December 27, 2006 (BRAZIL, 2006). In 2008, he created the Brazilian Network for the Evaluation of Health Technologies (REBRATS) and a Working Group (WG) was established for the development of a Monitoring Technological Horizon (MTH) system. In summary, it can be inferred that the gradual implementation of the WGMTH together with health technology assessment (HTA) actions is considered as an important aspect to establish priorities and provide innovations relevant to the health system, still in the initial phase of the life cycle of health technologies (BRAZIL, 2011).

However, according to the World Health Organization (WHO, 2011), despite the important achievements recorded in the health area in recent decades, there are still several uncured diseases that surround the world population, such as chronic kidney disease (CKD).

CKD is characterized by decreased glomerular filtration rate (GFR) function or presence of kidney injury markers, or both, for duration longer than one trimester, regardless of etiology. In which in its most advanced phase the kidneys can no longer maintain the normality of the patient's internal environment. The cause of CKD is complex and uncertain and progression is multivariate, which leads to different prognoses (WANG et al., 2019).

According to the Brazilian Society of Nephrology (SBN, 2017), approximately 13 million Brazilians have some degree of kidney problems. Of this total, 126,583,000 are in a serious condition with hemodialysis dependence or transplant dependence. In Brazil, cases increase at a rate of 10% per year and kidney disease already kills more than breast cancer. Of these deaths, 70% occur before diagnosis, according to data from the Ministry of Health (BRAZIL, 2015).

In this perspective, it is proposed in this study to perform the MTH on CKD to investigate whether any of the technologies found are incorporated into the SUS, with effective use and social impact. Thus, it can be emphasized the fundamental role of technological innovation as an important instrument for the evolution of disease treatment and driving a healthy and stable quality of life with reduced suffering in the population. In addition, the social role of the use of knowledge is featured, being able to provide preventive aspects that privilege public health.

2. Chronic kidney disease

The kidneys are organs that have the function of eliminating toxic substances from the body through urine. In addition, they participate in the excretion of water and mineral salts and in controlling the pH of the blood. When the individual is affected by a chronic disease that leads to the loss of their functions, they say that there is CKD (RUDNICKI, 2014, p. 107).

The kidneys are fundamental organs for the maintenance of homeostasis of the human body. Thus, it is not

surprising to find that, progressive decrease in renal function, implies in the impairment of essentially all other organs. Renal function is assessed by glomerular filtration (FG) and its decrease is seen in CKD, associated with loss of kidney regulatory, excretory and endocrine functions. When FG reaches very low values, below 15 mL/min/1.73 m^2, what is called renal functional failure (FFR) is established, that is, the most advanced stage of progressive functional loss observed in CKD (BASTOS; BREGMAN; KIRSZTAJN, 2010, p. 250).

CKD is currently defined as the presence of abnormalities in the structure or function of the kidneys, present for more than three months, with health implications. The new Improving Global Outcomes Guidelines (KDIGO) recommend to classify CKD based on the cause, on the category of glomerular filtration rate (GFR) and on albuminuria, which makes it possible to identify the risk of adverse outcomes, such as progressive CKD , end-stage kidney disease, acute kidney disease, all-cause mortality and cardiovascular mortality (PORTO et al., 2015).

CKD is increasingly recognized as a global public health problem. According to the WHO, kidney and urinary tract diseases are the most common cause of death and the twelfth most common cause of disability. In Brazil, available statistics are alarming, as they emphasize that approximately 100,000 people are undergoing dialysis in Brazil. The cost of the dialysis and kidney transplantation program in Brazil is around R $ 1.4 billion per year (MENEZES et al., 2017, p. 1060).

The increase in the number of cases has been reported in the last decade in different contexts, associated with aging and the demographic transition of the population, as a result of the improvement in life expectancy and the fast urbanization process. Arterial hypertension and diabetes are the main causes, while socioeconomic, racial and gender disparities are also determining factors (MARINHO et al., 2017, p. 381).

CKD does not contemplate an expectation of cure, but the maintenance of a chronic state by subjecting the patient to renal replacement therapy modalities. The treatments available for terminal kidney diseases are: hemodialysis, peritoneal dialysis and kidney transplantation, which are complex, varied modalities and represent a health problem of wide magnitude and relevance, especially when its complexity, risks, diversity of operations and cost are recognized (CASTRO; GROSS, 2013).

It is known that hemodialysis as a treatment for CKD replaces the main functions of the kidney, but is not able to fully replace the organ. It is a high-cost/complex procedure that involves highly specialized assistance, advanced technology, highly complex actions and requires coordination between the secondary and tertiary levels of assistance. In addition, over the past few years, there has been a growing demand, which has resulted in considerable consumption of financial resources (COSTA; VASCONCELOS; TASSITANO, 2010, p. 463).

SUS expenses with renal replacement therapy (RRT) are very high, such information can be observed in the study by Silva et al. (2016), in which they highlight that in 2012, SUS financed 84% of patients undergoing treatment in some type of RRT, spending 2 billion reais.

The federal government stated in 2017 that over the years, expenditure on these procedures has evolved in percentage terms more than the amount realized. Between 2014 and 2015, federal spending on TRS increased by 3.84%, from R $ 2.6 billion to R $ 2.7 billion, while the number of procedures grew 3.7% in the period, ranging from 13.5 million to 14 million (BRAZIL, 2017).

As with kidney transplantation, for Silva et al. (2016), innovations related to dialysis can also bring

favorable changes in the costs of this intervention.

3. Monitoring of technological horizons

MTH is not about making predictions, but about conducting a methodical investigation of evidence that ensures adequate and resilient preparation for future opportunities and threats. This tool emerged in the early 20th century with the British Defense Committee of England. Since then, it has been used in several other areas, especially in the business area since the 1960s, with increasing application in supporting political decisions (BRAZIL, 2017).

Still in the 1990s, discussions started on the importance of developing a network for collaboration and exchange of experiences on the theme, which was intensified at the conference organized by the Danish Hospital Institute in 1995, with the participation of representatives of the Denmark, Finland, France, Luxembourg, the Netherlands, Sweden and the United Kingdom. From these discussions, the first international MTH network called European Information Network on New and Emerging Health Technologies (EuroScan) was established in 1999, initially composed of agencies from countries participating in the Danish Hospital Institute conference and one agency from Canada. In 2006, with the growing interest and participation of agencies from other continents, the network was renamed EuroScan International Network (PACKER; SIMPSON, 2005).

In 2017, members of the EuroScan international network founded the legal scientific association of the EuroScan International Network in Cologne, Germany. The knowledge provided must support the areas of evaluation and decision-making at the local, regional, national and international levels (EUROSCAN, 2017).

In Brazil, one of the first activities for the development of MTH was the realization, in 2010, of the MTH workshop. In the initial proposal, issues related to the stages of the MTH were defined, such as the definition of the customer, the type of technology to be explored and the time horizon of the technology life cycle. Thus, the body responsible for the incorporation of health technologies in the SUS was identified as the main customer for information generated by the MTH (BRAZIL, 2011).

Due to the importance of MTH in the elaboration of policies and in the decision-making process, its application can be thought of in order to subsidize the actions of the main actors involved in the management of technology in the health system. Thus, MTH in the health system can support decision-making processes throughout the technology's life cycle (BRAZIL, 2017).

These processes are part of the National Policy on Health Technology Management (PNGTS), approved in 2009 and whose objective is to maximize the health benefits to be obtained in view of the available resources, ensuring the population's access to effective and safe technologies, under conditions of equality. In Brazil, SUS is a major incorporator of technologies. The Ministry of Health alone purchases approximately R $ 8 billion in medicines, equipment and health products per year. At the same time, managers of all SUS instances are constantly under pressure to incorporate new and emerging technologies (SILVA; PETRAMALE; ELIAS, 2012).

As a result, there was a need to develop guidelines to program MTH within agencies and institutions. The development of an MTH guideline was motivated by the fact that the agencies present a wide variety of

ways to carry out MTH activities. Thus, the guideline proposed by the network aims to systematize these experiences in the form of a general structure that allows other agencies to develop their MTH systems, adapting this guideline to their realities.

The process of monitoring new and emerging technologies will anticipate for the manager the priority technologies for the health system, which will allow the planning of the incorporation agenda, as well as the direction of health technology research and evaluations, making the time and resources for investment in research. In addition, the planning of the incorporation agenda will result in a better allocation of health system resources (VIDAL et al., 2013).

4. Methodology

This is a quantitative, exploratory and cross-sectional research, conducted on the International Platform for Clinical Trials Records (ICTRP) of WHO, National Institute of Industrial Property (INPI) and patent database linked to the ORBIT intelligence system.

The research universe included technological products related to CKD deposited in Brazil and in the world in the last 20 years.

Data collection was carried out from February 2018 to February 2019 using patentometry techniques. Initially, the keywords were defined from the consultation with Health Sciences Descriptors (DeCS): Chronic Kidney Disease; Kidney Disease and Kidney. In the INPI database, the advanced search strategy was used with the Boolean operator "and" combined with the descriptors, to maximize the possibilities of finding patent documents about CKD.

In the ORBIT intelligence system, the search expression was created, which was formed from Boolean operators "and" and "or", in addition to the logical connectives of ORBIT and International Patent Classification (IPC): "TI" title; "AB" summary; "OBJ" objective of the invention; "ICLM" independent claims; "IC" international patent classification; "EC" European classification; "CPC" cooperative patent classification. These operators were used combined with the established keywords. Equation (1) refers to the search term for patents about CKD.

Table 1. Equation used for search

Equation (1)	(+ KIDNEY DISEASE + *OR* + CHRONIC RENAL DISEASE + *OR* + NEPHROPATHY CHRONIC +) / TI / AB / OBJ / ICLM *AND* (A61K *OR* A61P *OR* A61M *OR* A61N *OR* A61B) / IC / EC / CPC).

The table contains the equation used to perform the searches in ORBIT intelligence.

The ICTRP was used to verify the number of potential ongoing clinical trials for developing patents. For this purpose, it was used the advanced search combined with the conditions or problems studied and the time frame of 20 years. After the selection of technological products, the MTH was carried out. At this stage, the technologies were tracked in the databases of the National Health Surveillance Agency (ANVISA) based on the search for the International Classification of Disease (ICD) N180, which refers to CKD.

To analyse the collected data, descriptive statistics techniques were used, using the Microsoft Office Excel

2016 for Windows® program.

5. Results

5.1 Clinical trials registered in ICTRP/WO related to CKD

According to the search strategy associated with the keywords, the results reported in the ICTRP were 32 clinical trials related to CKD in the last 20 years. In Figure 1, there is a prevalence of more recent trials having the highest number of records in 2018.

According to Camacho (2013, p. 5), in a scenario of innovation in a certain field, clinical trials are indispensable, because they constitute an essential prerequisite for the licensing of drugs and immunobiologicals by the regulatory agencies of several countries.

Berwanger (2009) emphasize the importance of clinical trials in its study, stating that they became a process of choice for evaluating interventions, aiming to protect against ineffective or harmful procedures to human health.

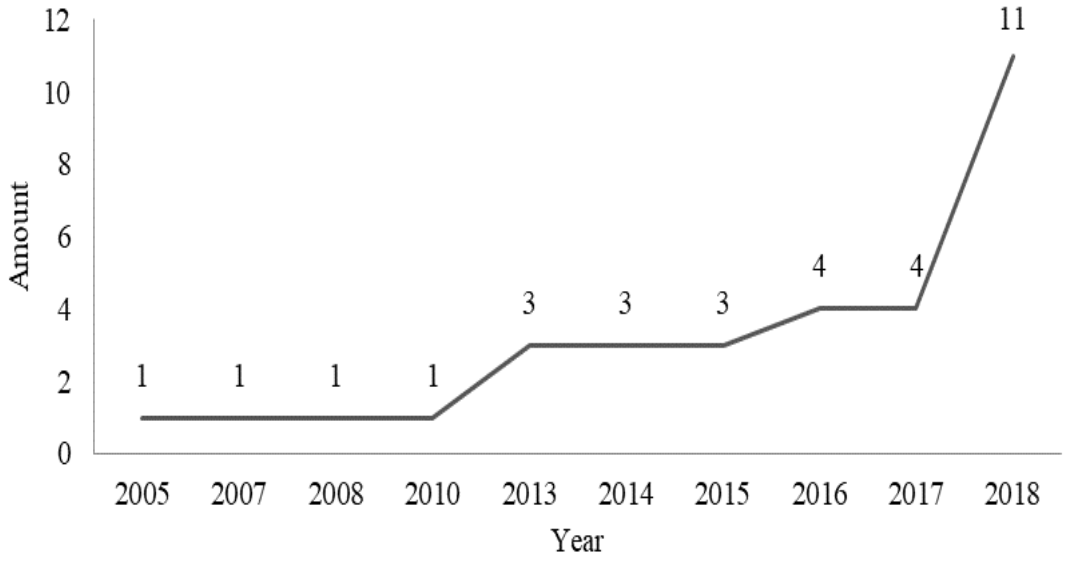

Figure 1. Year of registration of clinical trials on CKD.
Self elaboration (2019).

One of the challenges in the CKD area is to increase the availability of medications and therapeutic procedures that can enable patients to live longer with less suffering, providing a better quality of life for these people. This leads to the search for resources, the professional training of researchers and the conduct of research in the country that generates consistent scientific evidence and contributes to the process of incorporating technologies by SUS.

ANVISA (2017) describes that clinical trials are studies conducted with humans to measure the parameters of safety and efficacy of new drugs, being essential for the arrival of new therapeutic alternatives on the market. These trials are divided into phases I (the first studies to be conducted in humans, usually in a small number of healthy volunteers), II (through these trials, it is confirmed if the new drug has a therapeutic effect and toxicity is assessed allowing the selection of the therapeutic regimen (the dose and frequency of

administration of the new drug) for the Phase III trials), III (comparative studies, usually multicentric) and IV (studies carried out after obtaining the marketing authorization and related to the approved indication), Figure 2 shows the clinical trials under analysis, separated by year and phase. In percentage terms, it can be observed that clinical studies that are in phase I comprise 6.24%, those in phase II represent 3.12%, in phase III there is 9.36% of clinical studies, phase IV represents 6, 24% of these studies. It is noted that 75.04% of the tests were not precisely identified, as they are represented by the category N / A (not applicable). Here it is also showed that 15.6% of the tests are in an advanced stage, comprising the junction of the categories of phases III and IV.

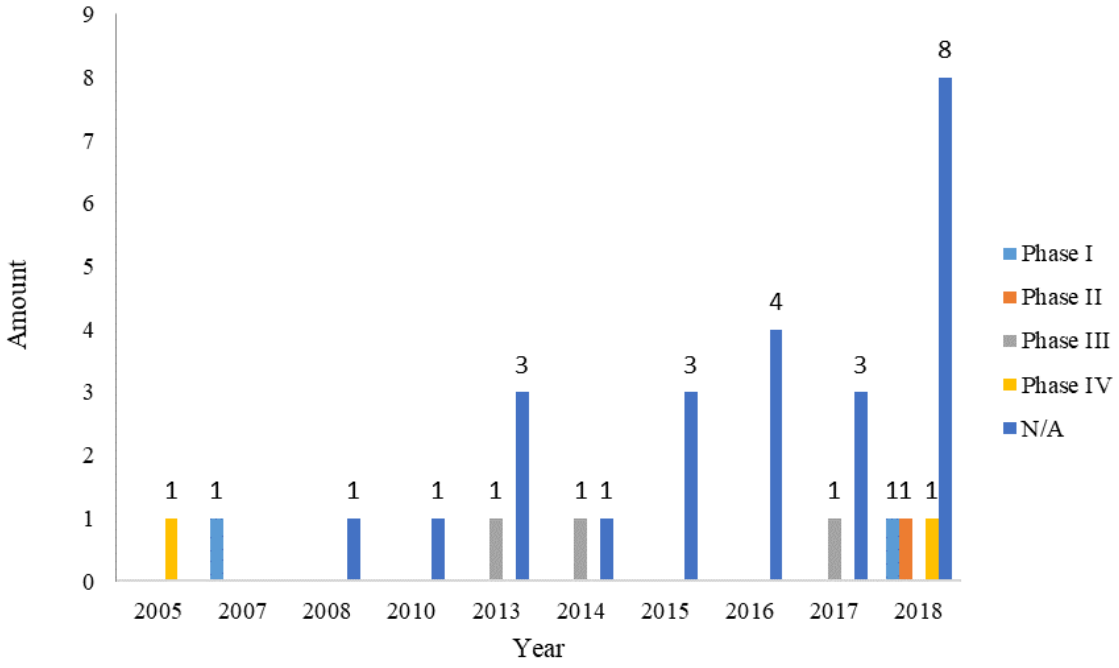

Figure 2. Phases of clinical trials registered for the CKD field of study.
Self elaboration (2019).

Figure 3 shows the countries that register clinical trials about CKD, with emphasis on Australia, which in the studied scenario, had 29% of the trials, followed by China with 16%, the United Kingdom with 13%, Canada with 10% and Brazil occupying the 5th position with 7%. The number of clinical trials in Brazil showed a growth rate of 26% in the period 2001 to 2011. However, according to information from the Center for Innovation and Pre-Clinical Trials (CGE, 2017) it is below the average shown in the other BRICS countries that is 39%. Official companies and laboratories are responsible for the smallest part, approximately 27% (in 2010) and about 50% of these tests are concentrated in phase III, in which there is less density and technological risk.

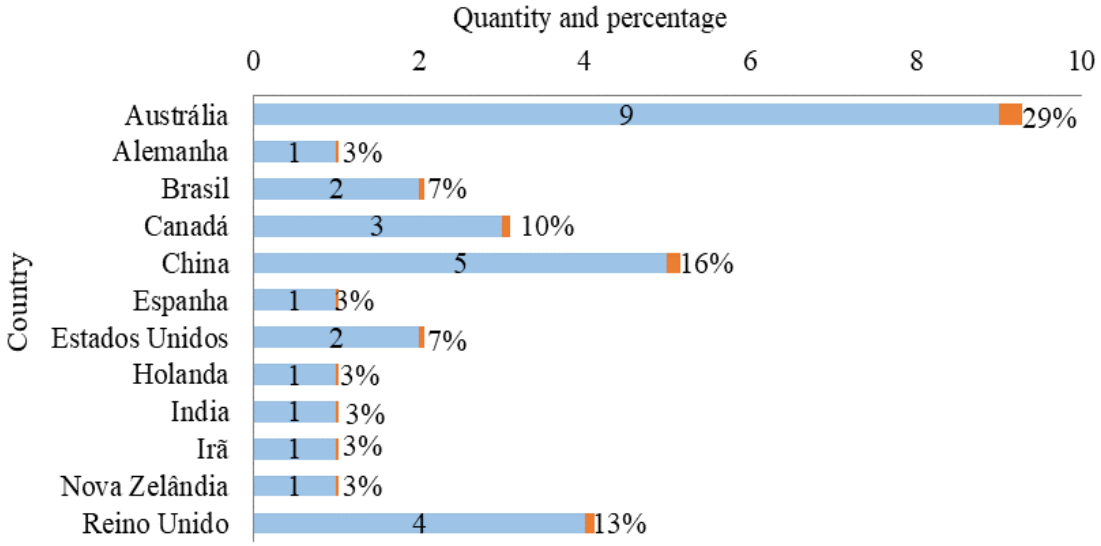

Figure 3. Countries that have registered clinical trials on CKD.
Self elaboration (2019).

Brazil does not have a large volume of private sector investments in RD&I, but despite that, according to Moraes (2016), the country had 0.55% of the Gross Domestic Product (GDP) applied by private companies, even so, remaining distant countries like South Korea (2.68%) and China (1.22%). Also according to the author, comparing the GDP of investment in RD&I in Brazil with the numbers of nations of the Organization for Economic Cooperation and Development (OECD), with other countries in Latin America and the BRICS, Brazil only appears above Mexico, Argentina, Chile, South Africa and Russia being very distant from China and South Korea, nations that started the leap in industrial development very recently. In 2011, China became the world's second largest investor in RD&I.

What stands out is the large private investment in innovation in the world's major economies. In Brazil, this investment is still hesitant. The government should look for strategies to encourage these investments, simplifying the processes, providing attractive tax benefits to investment in RD&I for companies, valuing the companies that make this investment.

5.2 Patents filed with the PTO and ORBIT intelligence related to CKD

The analysis of patents on the world stage is made to monitor the countries where protection was used for purposes of market reserve or as an incentive strategy for international trade. From a technological perspective, this information about the trends of technologies in world markets can bring scenarios of the current relevance of a given area (FERREIRA; FERREIRA; HASNER, 2016, p. 4).

In Figure 4, it can be seen that in the world there are 375 patents related to CKD, while in Brazil only 33. Current patents have been protected in several national offices. What can be seen is a consolidated scenario in China (CN), followed by Japan (JP) and the patents of the European Patent Organization (EPO). Another expressive scenario that stands out is the USA. China is a great power when it comes to innovation, according to which WIPO (2018) shows in its report that China in 2017 filed 1.38 million patent applications, which is more than double the number received by States United. Furthemore, the report

shows China's fast rise in patent issues over the past 15 years.

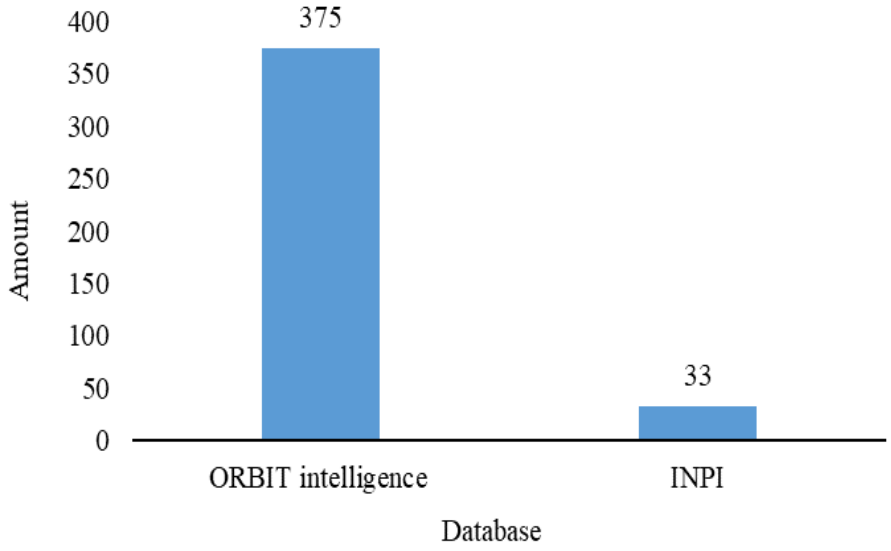

Figure 4. Number of patents on CKD.
Self elaboration (2019).

The top 30 DRC patent depositors were pharmaceutical companies and universities. In the first five positions, pharmaceutical companies lead the ranking of patent deposits in the world. The pharmaceutical industry and new drug development process is largely linked to the patent system. This is also a relevant sector characterized by great dynamism and constant need for innovation, requiring high investments in RD&I (OLIVEIRA et al., 2018).

In Brazil, the INPI (2018) released its yearbook for depositing technological products, the ranking of patent deposits, in this case, the top position occupied by universities stands out, with eight of the top ten positions occupied by federal and state universities. As occoured in 2016, only one company appears among the ten largest depositors.

The reason why Brazil is not among the best is that, unlike the economies that aim to achieve prominence on the world stage, Brazil does not yet have public policies and does not make the necessary investments to leverage innovation in the country. In addition, as revealed by Akkari et al. (2016) the development of new drugs and pharmaceutical formulations for other countries are seen as the focus of economic progress and innovation, which makes them stand out worldwide.

5.3 The MTH in the CKD scenario

After collecting the patent information, we tried to identify whether these technologies are being analyzed by the agencies for their market introduction. In the ANVISA database, the search for CID N180 regarding DRC did not return any records.

Analyzing the patents found with the clinical trials found in the ICTRP, no relationship was found between the technologies selected in the study for CKD, stating the results that more than 75% of the trials were registered in the category does not apply. In this category, the studies do not aim to analyze the efficacy of drugs, but rather some alternative therapy, such as music therapy.

From this, it was observed that there are no emerging technologies that can bring effective results and that

are different from those currently applied. The predominance of drugs for factors related to CKD was noted, but not technologies related to better substitute therapies.

Thus, it is emphasized that investments must be made in order to finance research that has quality and can be effectively used, considering that the investment is large so that research does not leave the paper to benefit society.

It is important that the Brazilian MTH system seeks to conduct studies at specific diseases such as CKD, in addition, it is important that HTA activities consider intelligent data systems and international collaboration to improve the efficiency of the MTH system. In this way, the institutions will also be able to measure the quality of the patents produced within their scope.

6. Conclusion

In view of the objectives outlined in the study, the use of the MTH methodology for the analysis of emerging technologies is emphasized. The main point of emphasis in the application of the methodology is the importance of using collaborative work for the effectiveness of the system. In addition, the need to strategically bring together several actors is highlighted so that there is a real success in HTA activities.

The reason is that world patent scenario reveals that the area of CKD still has little research, despite the fact that the disease is currently considered a public health problem. 375 patents have been filed worldwide, 33 of them in Brazil. Within this scenario, China stands out as one of the main countries to develop research in the area, with the pharmaceutical industry being the one that most deposits patents on CKD.

When is about clinical trials, the main reason for studying them is the possibility of identifying other emerging technologies that are already under analysis. In the context of CKD, 32 trials were found in the last 20 years, however, 75% of them seek to analyze alternative therapies for patients with the disease, not applying the category of new products or processes.

The MTH revealed that in the scenario in study, none of the technologies found is in the maturity stage to be incorporated into SUS, considering that their incorporation depends on the analysis of several factors, among them being a new and effective therapy and results.

However, pioneering research in Brazil uses stem cells to allow the return of kidney function. Although Brazilian law prohibits the protection of patents on this type of material, research is at an advanced stage, it is an emerging technology with the possibility of effective use. Thus, its processes must be widely monitored by the HTA teams in order to accelerate the research process, seeking mainly to implement it in SUS. This research can promote a better quality of life for patients with CKD, as well as reducing the costs of treatment with hemodialysis.

The MTH methodology proved to be effective in the application for analyzing the quality of the technologies produced and identifying those technologies. ATS systems need to be attentive to act effectively in the use of emerging technologies, monitoring, fostering for faster development and seeking more quickly to implement novelties that promote improvements for patients and health systems.

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Influence of Gender Stereotyping Dynamics on Appointment of Female Teachers as Secondary School Principals in Makueni Sub-county, Makueni County, Kenya

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Abstract

Female teachers play an important role in school management. However, their number in positions of school headship is low. The purpose of this study was to assess the influence of gender dynamics on the appointment of female teachers as secondary school principals in Makueni Sub-county, Makueni County, Kenya. The objectives were: to assess the influence of female teachers' gender roles, self-perception, stereotyping and management training on appointment as secondary school Principals. The study was guided by The Pearson's Theory of Gender Relations and Feminism Theory. Mixed methodology was applied and thus concurrent triangulation design was adopted. Qualitative data were analyzed thematically along the objectives and presented narrative forms. Quantitative data were analyzed descriptively using frequencies and percentages and inferentially using linear regression analysis with the help of Statistical Packages for Social Science (SPSS Version 23) and presented using tables. The study established that gender stereotyping is a major hindrance to female teachers' desire to seek to positions of headship. The study recommends that educational policy-makers to come up with policies that create positions for women to eliminate gender imbalance in education administration. Policy makers to come up with a curriculum that include gender issues for purpose of sensitizing the community on the social/cultural barriers which cause gender imbalance in education administration. The Ministry of Education should come up with a policy where attendance of workshops and seminars is a compulsory requirement for all teachers in order to build skills and knowledge on their careers and give women chances to compete favorably with men.

Keywords: Gender stereotyping, appointment of female teachers as principals

Introduction

Female teachers play an important role in school management. Cognizant of this assertion, Fidler and Atton (2012) posit that, in England and Wales, gender representation of the secondary school heads in the country reflects, to a degree, this crucial difference in the composition and ensuing degree of autonomy of the

governing bodies. Fidler and Atton (2012) further assert that, in these countries where the local education authority monitors and moderates the decision, the representation of both men and female teachers is more proportional. In New Zealand, boards have total control over their choice of school Principals, male teachers are disproportionately represented. In secondary schools, female teachers represent 82% of the workforce, but are disproportionately underrepresented in leadership, occupying only 40% of managerial positions.

Seen from another perspective, 60% of school principals are appointed from the 18% male pool of the workforce (Court, 2012). Men are six times more likely to win a school manager's position disregarding experience or qualifications, than female teachers. In addition, 80% of senior management positions in secondary schools (assistant and deputy principals) are held by female teachers (Court, 2012), indicating that there is a very large pool of well-qualified and experienced female teachers who may be hitting a glass ceiling (Livingstone, 2014). The reforms gave new roles, powers and functions to New Zealand boards of trustees, which in the case of recruitment of the school principals were more unregulated than in any other country with similar policies (Wylie, 2012). The high degree of autonomy that boards have in the school manager's appointment means that this function is localized and not subject to any form of central control. In addition to appointing whoever they like, there is no accountability required at any level by central government in the appointment process.

Explanations have been given for gender imbalance in education administration based on the socialization and sex-role stereotypes. Organizational socialization is the process by which new leaders become integrated in formal and informal norms as well as unspoken assumptions of a school. Cognizant of these views, Johnson (2003), in a longitudinal study conducted in Columbia, noted that since traditional stereotypes label women as socially incongruent as leaders, they face greater challenges to be integrated into an organization. Johnson (2003) noted that socialization and sex-role stereotypes act as obstacles to gender balance attainment of management positions in schools. Women have failed to advance to high level leadership positions in schools because they are oversaturated with a cultural message of female inferiority complex (Johnson, 2003). This results to women being judged on how "womanly" they are when they behave inferior and shy away from top positions. Such views lend credence to the findings of a study conducted in Venezuela in which Eagley and Johnson (2008) asserted that negative stereotypes of women by superintendents and school board members have negatively affected gender balance in education administration. Eagley and Johnson (2008) indicated that there is perceived women inability to discipline students, supervise other adults, criticize constructively, and manage finances. The school board members lack confidence in female superintendents' ability to oversee the construction of a new building and when she completes the task the board is surprised (Eagley & Johnson, 2008). These findings corroborate the fact that school principals and board members believe that women are easy to direct simply because they are female. If they turn out not to be malleable the reaction is negative because they seem to be violating the expected norms when they act like men. These expectations of feminine behavior result in negative perception of assertive actions of women.

In France, a female style of leadership like assertiveness and being direct is unacceptable and colleagues will view the man as firm but a female as stubborn (Bynum, 2008). Bynum (2008) noted that another form of sex stereotype is related to societal perceptions that women are emotional and work at emotional level.

In the same vein, Cubillo and Brown (2003), in a study conducted in Lesotho, indicated that, due to such perception, it is assumed that women cannot be natural and logical decision makers. Aemero (2005) also supported these findings and pointed out that women are too emotional and cannot see things rationally and this affects their decision making. Aemero (2005) indicated that few women plan to enter administrative positions upon college completion. This is in consistent with the findings of a study carried out in KwaZulu Natal Province in South Africa in which Chisolm (2013) observed that not a single female teacher had planned to enter school management when they joined teaching as a career. These findings lend credence to the fact that women have their career aspirations limited due to gender socialization. The belief that the image of leadership is associated with masculine traits has caused gender imbalance in education administration (Chisolm, 2013). The popular traits are masculine by nature and are male and female accepted.

In Kenya, gender is constructed within institutions and cultural contexts that produce multiple forms of masculinity (Chelimo & Wasyanju, 2007). Schools play a major role in formation and maintenance of masculine traits, that is, program division, sports and discipline systems. Chelimo and Wasyanju (2007) asserted that the popular masculine traits accepted by all are decisiveness, appearing tough, less talking and putting a social distance between themselves and staff. In other words, female leaders without these traits are viewed negatively. In Kenya, the turn of the new millennium has witnessed invigorated female teachers' participation in secondary school educational leadership (Republic of Kenya, 2015). Their pronounced representation and participation have brought with it challenges they have to grapple with in positions of authority like secondary school leadership. In Makueni Sub-county, appointment of male and female teachers in school management positions is pegged on a variety of factors which include; leadership skills, training and competency, service delivery and experience of service though the number of female principals is still below expectations (Republic of Kenya, 2015). In Makueni Sub-county, the female teachers are at lower levels of appointment despite the constitutional threshold of 2/3.

A report by Muchungu (2013) shows that out of the 47 public secondary schools in Makueni Sub-county, female Principals constitute a paltry 8.5% (4 out of 47) In Makueni Sub-county, the shift of masculine model has not changed (Muchungu, 2013). Socialized roles have become so familiar and become unquestioned norms. Since socialization tends to be invisible, it is easy to fall into the trap of believing that women choose these roles. Despite this woman have made it to the top. Having a vision and well-planned career path with a goal to move up is crucial. In an assessment study conducted in Lower Yatta District and Makueni County, David (2013) asserted that the factor that explains the most about the resistance to women in positions of power in schools is the devaluation of women. While equity gains have been made, different expectations of and attitudes to women and men still exist (David, 2013). However, David (2013) have not indicated how different aspects of stereotypes against female teachers by those who hire constitute the major barrier to female teachers' advancement in school management.

Statement of the problem

Appointment of female teachers as secondary school principals has not been fully achieved as per the expectations of the education stakeholders. As stated in the background, the future of gender parity in the

appointment of school principals is not optimistic where school boards have total control over their choice of managers and female are disproportionately represented.

In public secondary schools in Kenya, female teachers represent 82% of the workforce, but are disproportionately underrepresented in leadership, occupying only 40% of top managerial positions. As noted in the background, in Makueni Sub-county, the scenario is the same with most female teachers being at lower levels of appointment despite the constitutional threshold of 2/3.

Muchungu (2013) indicates that out of the 47 public secondary schools in Makueni Sub-county, female Principals constitute a paltry 8.5% (4 out of 47). This is contrary to the fact that there is recognition in education of both the importance of equal opportunity and the strengths that women bring to management. Despite these observations, little has been done to interrogate how gender stereotyping influences appointment of female teachers as secondary schools.

Theoretical Framework

The study was guided by Management Practices Theory which as postulated by Kuo (2009). This theory addresses how managers and supervisors relate to their organizations in the knowledge of its goals, the implementation of effective means to get the goals accomplished and how to motivate employees to perform to the highest standard. The central focus of this study is that although school managers in different parts of the world could have achieved managerial success without having basic theoretical knowledge in management, it has to be unequivocally emphasized that those managers who have mixed management theory in their day-to-day practice, have had better chances of managing their organizations more efficiently and effectively to realize appointment of female teachers in positions of school management. Thus, the rationale of using this theory in this study is that to enhance appointment of female teachers as school principals, education managers ought to appreciate the important role they play in their respective organizations. Education managers need to adopt practices geared towards increasing the number of female teachers in positions of school management.

This study also adopted Ruth Pearson's Framework on gender relations. According to Pearson's (2005) theory, society views all activities that are carried out to be based on social roles and interactions of men and women. In this context, the framework views the notion of gender roles and activities as having a strong ideological content. Because of these biases, the performance of women and men is affected on nearly all spheres of life such as education, leadership and general development. The rationale of using this theory in this study is that it recognizes the fact that career mobility to positions of school management involves female teachers who happen to be actively involved in education administration aspiring to be administrators and play their practical gender roles as well. That is, women have been socialized over time to be submissive and therefore when one becomes a leader and portrays traits of assertiveness, decisiveness and directness, it becomes socially unacceptable and one is viewed as stubborn. This study also adopted a theoretical lens informed by feminist theory which was postulated by Janet Price and Margrit Shildrick (2002) which views gender as a social, historical, and cultural construct.

Janet and Margrit (2002) hold the view that femininities, like masculinities, are not a product of biology or some manifestation of inner essence; rather they are socially constructed configurations of gender practice

created through historical and social processes, situated in patriarchal relations of power, and interact with other social justice factors such as race, social class, bodily ability, and sexuality. Feminist theorists argue that the most valued jobs are reserved for the men of the dominant racial ethnic group. Feminist histories, as feminist theories and politics, focus on domination, marginalization, appropriation, and the 'othering' of any social group. In so doing, feminism imparts numerous deconstructive possibilities of dominant storylines by challenging dominant categories and unpacking concepts such as leadership. Additionally, research drawing upon feminist theory can also be reconstructive, as it provides space for voices of the less advantaged and offers alternative representations of leadership through the narratives of marginalized leaders.

Delimitations of the Study

This study was carried out in public secondary schools in Makueni Sub-county. The study focused on the influence of gender stereotyping dynamics on appointment of female teachers as principals in public secondary schools. Mixed methodology was used and thus, concurrent triangulation research design was applied. In this study, questionnaires were used to collect quantitative data from teachers whereas interview guides were used to collect qualitative data from principals, staffing officer and sub-county director of education.

Research Methodology

Mixed methodology was applied and thus concurrent triangulation design was adopted. Target population comprised 44 principals, 836 teachers, the staffing officer and the sub-county director of education totaling to 838 respondents from which a sample of 272 respondents was determined using Yamane's Formula. Stratified sampling was used to create five strata based on the number of zones in Makueni Sub-county. From each zone, three principals and 51 teachers were selected using purposive sampling. The staffing officer and sub-county director of education were also selected for the study. This procedure enabled the researcher to sample 15 principals, 255 teachers, the staffing officer and the sub-county director of education. Data analysis began by identifying common themes. Qualitative data were analyzed thematically along the objectives and presented narrative forms. Quantitative data were analyzed descriptively using frequencies and percentages and inferentially using linear regression analysis with the help of Statistical Packages for Social Science (SPSS Version 23) and presented using tables.

Results and Discussions

The study sought to:

i. To establish the influence of gender stereotyping dynamics on appointment of female teachers as secondary school principals in Makueni Sub-county.

Response Rate

In this study, 255 questionnaires were administered to teachers out of which 249 questionnaires were filled and returned. At the same time, the researcher also interviewed principals, Staffing Officer and Sub-county Director of Education. This yielded response rates shown in Table 1;

Table 1: Response Rates

Respondents	Sampled Respondents	Those Who Participated	Achieved Return Rate (%)
Principals	15	13	86.7
Teachers	255	249	97.6
Staffing Officer	1	1	100.0
Sub-county Director of Education	1	1	100.0
Total	**272**	**264**	**97.1**

Source: Field Data (2020)

Table 1 shows that principals and teachers registered a response rate of 97.1%. This confirmed the findings of Creswell (2014) that a response rate above 75.0% is adequate and of suitable levels to allow for generalization of the outcomes to the target population.

Stereotyping Dynamics and Appointment of Female Teachers as School Principals

The study sought to find out how stereotyping influences appointment of female teachers as school principals. Data were collected from teachers and results are shown in Table 2;

Table 2: Teachers' Views of Influence of Stereotyping on Appointment of Female Teachers as Principals

Summary of Test Items	SA %	A %	U %	D %	SD %
Societal norms about women influence appoint of female teachers as secondary school principals	58.8	21.6	4.1	10.4	5.1
Societal norms about women influence promotion of female teachers	61.6	17.7	3.9	10.5	6.3
Societal beliefs about women influence appoint of female teachers as secondary school principals	59.9	19.8	2.5	12.2	5.6
Societal beliefs about women influence promotion of female teachers	65.9	13.4	3.7	10.3	6.7

Source: Field Data (2020

Table 2 reveals that slightly more than half 146(58.8%) of the teachers strongly agreed with the view that societal norms about women influence appoint of female teachers as secondary school principals.

54(21.6%) agreed. 10(4.1%) were undecided, 26(10.4%) disagreed whereas 13(5.1%) strongly disagreed. The study also revealed that a fair majority 153(61.6%) of the teachers strongly agreed with the view that societal norms about women influence promotion of female teachers as did 44(17.7%) who agreed. 10(3.9%) were undecided, 26(10.5%) disagreed whereas 16(6.3%) strongly disagreed. These findings corroborate the findings of a study conducted in Colombia in which Johnson (2003) noted that since traditional stereotypes label women as socially incongruent as leaders, they face greater challenges to be integrated into an organization. Johnson (2003) noted that socialization and sex-role stereotypes act as obstacles to gender balance attainment of management positions in schools.

In other words, Johnson (2003) further posits that women have failed to advance to high level leadership positions in schools because they are oversaturated with a cultural message of female inferiority complex. These findings attest to the fact that formal and informal norms as well as unspoken assumptions of a school hinder female teachers from seeking positions of school leadership and thus impede their career mobility. Similarly, slightly more than half 148(59.9%) of the teachers strongly agreed that societal beliefs about women influence appointment of female teachers as secondary school principals as did 49(19.8%) who agreed. 6(2.5%) were undecided, 30(12.2%) disagreed whereas 14(5.6%) strongly disagreed. 164(65.9%) of the teachers strongly agreed with the view that societal beliefs about women influence promotion of female teachers as did 33(13.4%) who agreed. 9(3.7%) were undecided, 10.3% disagreed whereas 17(6.7%) strongly disagreed.

These findings are consistent with the assertions of Chisolm (2013) that the belief that the image of leadership is associated with masculine traits has caused gender imbalance in education administration. In the same vein, these findings lend credence to the assertions of Eagley and Johnson (2008) who indicated that there is perceived women inability to discipline students, supervise other adults, criticize constructively, and manage finances. These findings point to the fact that socialized roles have become so familiar and become unquestioned norms and hinder female teachers from seeking positions of headship in most schools.

Inferential Findings on the Influence of Stereotyping on Appointment of Female Teachers as Secondary School Principals

To verify the relationship between stereotyping and appointment of female teachers as secondary school principals, data were further collected on the extent to which societal norms influence appointment of female teachers as secondary school principals (great extent = 3, low extent = 2 and not sure = 1) and the number of female teachers in leadership positions in secondary schools. The results are shown in Table 3:

Table 3: Results of the Extent to which Societal Norms Influence Appointment of Female Teachers as Principals and the Number of Female Teachers in Leadership Positions in Secondary Schools

Extent of the Influence of Societal Norms	Number of Female Teachers in Leadership Positions in Public Secondary Schools
3	5
3	4

3	4
3	4
2	3
2	3
2	3
2	3
1	2
1	2
1	1
1	1
1	1

Source: Field Data (2020)

Table 3 shows that stereotypes which are held either by society or schools influence the appointment or promotion of more female teachers to positions of secondary school headships. These findings further lend credence to the assertions of Chisolm (2013) that the belief that the image of leadership is associated with masculine traits has caused gender imbalance in education administration. In the same vein, these findings lend credence to the assertions of Eagley and Johnson (2008) who indicated that there is perceived women inability to discipline students, supervise other adults, criticize constructively and manage finances. These findings further affirm the fact that socialized roles have become so familiar and become unquestioned norms and hinder female teachers from seeking positions of headship in most schools. These results were subjected to linear regression analysis and the results are shown in Table 4:

Table 4: Linear Regression Analysis Showing Relationship Between the Extent of the Influence of Societal Norms on Appointment of Female Teachers as Principals and the Number of Female Teachers in Secondary School Management

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.017	.301		.057	.955
	Extent of the Influence of Societal Norms on Appointment of Female Teachers as Principals	1.431	.144	.949	9.940	.000

a. Dependent Variable: Number of Female Teachers in Leadership Positions in Secondary Schools

Source: SPSS Generated (2020)

Table 4 shows linear regression analysis which generated a linear model of the form; Number of Female Teachers in Leadership Positions = 0.017 + 1.431Extent of the Influence of Societal Norms on Appointment of Female Teachers as Principals. These results from the linear regression equation indicates

that the coefficient for the extent of influence of societal norms on appointment of female teachers as principals is 1.431. This indicates that, the greater the extent of influence of societal norms, the higher the number of female teachers appointed into leadership positions in secondary schools and is expected to increase by a factor of 1.431. This implies that stereotyping has a significant influence on appointment of female teachers into leadership positions in public secondary schools. In the same token, the value 0.017 indicates that the number of female teachers appointed as school leaders is not only dependent on stereotyping, but also on a set of other factors like their level of training on management skills.

Table 4 also shows that the p-value, 0.000 is less than 0.05, that is, a low p-value (0.000< 0.05). This indicates that there is significant relationship between stereotyping and number of female principals appointed as secondary school principals and those promoted to other positions of school leadership. These results are consistent with the findings of a study conducted in Lower Yatta District and Tharaka Nithi County by David (2013) which generated a p-value of 0.046<0.05. It is thus evident that formal and informal norms as well as unspoken assumptions of a school hinder female teachers from seeking positions of school leadership and thus impede their career mobility. Besides, the belief that the image of leadership is associated with masculine traits has caused gender imbalance in education administration. That is, the perceived women inability to discipline students, supervise other adults, criticize constructively, and manage finances have become so familiar and unquestioned norms which hinder female teachers from seeking positions of headship in most schools.

Thematic Analysis of Qualitative Findings on the Influence of Stereotyping on Appointment of Female Teachers as Secondary School Principals

The principals, Staffing Officer of Education and Sub-County Director of Education were also interviewed. They also indicated that societal norms about women influence appointment of female teachers as secondary school principals and their promotion to other leadership positions. These views lend credence affirms that traditional stereotypes label women as socially incongruent as leaders and thus face greater challenges to be integrated into an organization. That is, socialization and sex-role stereotypes act as obstacles to gender balance attainment of management positions in schools. In other words, the interviewees also observed that women have failed to advance to high level leadership positions in schools because they are oversaturated with a cultural message of female inferiority complex.

These views further attest to the fact that formal and informal norms as well as unspoken assumptions of a school hinder female teachers from seeking positions of school leadership and thus impede their career mobility. The belief that the image of leadership is associated with masculine traits has caused gender imbalance in education administration. This points to the fact that there is perceived women inability to discipline students, supervise other adults, criticize constructively, and manage finances. These views indicate that socialized roles have become so familiar and become unquestioned norms and hinder female teachers from seeking positions of headship in most schools

SUMMARY OF FINDINGS AND CONCLUSIONS

The study established that gender stereotyping dynamics influence appointment of female teachers as secondary school principals. Societal norms about women and beliefs influence appoint of female teachers as secondary school principals and promotion. Besides, women face numerous challenges since traditional stereotypes label women as socially incongruent as leaders and thus find it difficult to be integrated into an organization. Therefore, women have failed to advance to high level leadership positions in schools because they are oversaturated with a cultural message of female inferiority complex. Formal and informal norms as well as unspoken assumptions of a school hinder female teachers from seeking positions of school leadership and thus impede their career mobility.

RECOMMENDATIONS

The study established that there is a lot of negative beliefs and norms which hinder women from seeking management positions in schools. The study thus, recommends that policy makers to come up with a curriculum that include gender issues for purpose of sensitizing the community on the social/cultural barriers which cause gender imbalance in education administration. This may enable women change their self-perception and view themselves as managers just like their male counter-parts.

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Evaluation of reading comprehension questions in Moroccan ELT textbooks

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Abstract

It has been well-documented that traditional teaching that emphasizes rote memorization is unable to meet the 21st-century challenges. Learners of today need to learn how to think for themselves and voice out their opinions. This can be achieved only by providing learners with teaching materials that promote skills of analysis, syntheses, and evaluation. The objective of this paper is to evaluate reading comprehension questions of Moroccan ELT textbooks, entitled Ticket to English 2 and Gateway to English 2. This paper seeks to examine the extent to which higher-order questions that stimulate thinking are infused in reading comprehension texts. The study adopted the descriptive quantitative method using a checklist. The checklist is used as an instrument to collect the data using Bloom's taxonomy to investigate the frequency of questions. The results obtained show that 77% of the questions in the first textbook and 84.12% of the questions in the second textbook are classified as being low-order questions. The questions that emphasize high cognitive skills are 23% and 14.78 respectively. Hence, it has been deduced that the two textbooks failed to promote skills of higher-order thinking skills through reading comprehension questions.

Key words: Bloom' taxonomy, Morocco, questions, Reading comprehension

Introduction

The present paper aims at evaluating the reading comprehension questions of Moroccan ELT textbooks titled *Ticket to English 2 and Gateway to English2*. More precisely, it seeks to examine the extent to which higher-order thinking skills (HOTS) are integrated by means of reading questions and activities. According to Bloom's taxonomy, the theoretical framework of this paper, the cognitive domain is divided into six levels namely knowledge, comprehension, application, analysis, synthesis and evaluation (Bloom et al, 1956). Questions at the first three levels are classified as being low-cognitive questions. Students here are required to recall facts and knowledge or to easily locate answers in the text. However, questions of analysis, synthesis, and evaluation are meant to enhance students' higher thinking skills. The high cognitive thinking skills enable learners to think beyond the rote memorization of knowledge. In this

respect, high order questions or activities help students to deeply read the text and evaluate ideas critically. Put differently, higher-order questions require learners not only to understand the printed words but also to be able to apply the information acquired/learned in a new context and hence make connections between ideas.

The rationale behind the focus on Bloom's Taxonomy to assess the textbook originates from the ongoing discussion about the education reform in Morocco. The latest version of this reform is what is termed the 2015-2030 Strategic Vision. The Strategic Vision has emphasized the shift from learning that focuses on recalling facts to learning that promotes students' critical thinking. The objective is to make learners be active participants in the learning process. Accordingly, there should be a "…switch from a logic of linear transmission of knowledge and memorization to that of learning and developing critical thinking, engaging in personal growth and development, the acquisition of languages, knowledge, civic values and digital technologies skills" (The Strategic Vision for the Reform 2015-2030). Ibrouk (2016) shows that teaching methods need to move away from the one-sided transmission of knowledge towards the self-construction of knowledge. To explain, the transmission of knowledge alone is not enough to create a citizen who can cope with challenges at different domains be it economic, social or technological to name but a few. To achieve this, a change of curricula and teaching methods needs to be adopted if the objective is to create a better educated and skillful citizen (Llorent-Bedmar 2014).

Bloom' s taxonomy of cognitive domains

Benjamin Bloom with the collaboration of a group of educational psychologists classified the cognitive processes into six levels (Bloom,1965). These levels are meant to be sequential; the objectives of each level need to be attained before moving to the following. Through observation, Bloom et al. found that 95% of questions posed require learners to recall facts and already-acquired knowledge. Put differently, much emphasis is allotted to the levels of knowledge and comprehension. (Nappi, 2017)

Bloom's taxonomy is represented as a pyramid with higher cognitive levels at the top (analysis, synthesis and evaluation) and low cognitive levels at the bottom (knowledge, comprehension, and application). This taxonomy is meant to ask questions progressively; starting with simple questions (knowledge, comprehension) to more challenging ones (high level questions). The latter are the ones that can make of learners to be autonomous thinkers (Nappi, 2017). Cooper and Simonds (1999) gave a succinct explanation of the levels, which include:

Knowledge: questions which seeks to recall already-known information.

Comprehension: questions which require students to restate or paraphrase material literally to show understanding.

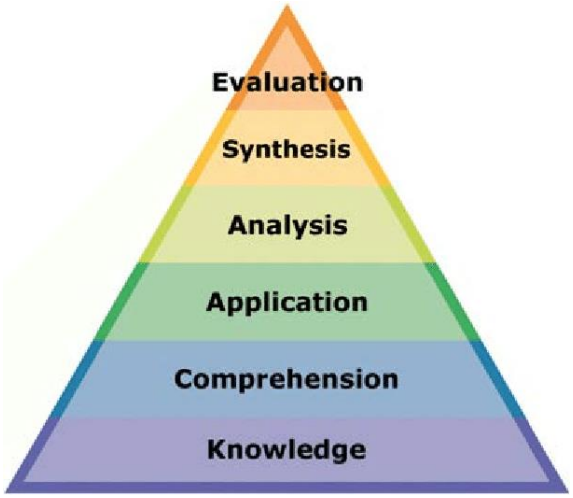
Application: questions which require learners to use already-known knowledge to solve problems.

Analysis: questions that seeks to break down ideas into its component parts for analysis.

Synthesis: questions that require learners to combine ideas into a statement, plan…etc that is new for them

Evaluation: questions that require learners to judge and evaluate ideas based on some criteria.

Cooper and Simonds (1999).



Bloom et al.(1956) Taxonomy

Low and high order questions

Tienken, Goldberg, and DiRocco (2009) made a distinction between questions that require learners to recall and memorize facts and questions that necessitate students to engage in higher process of analyzing, synthesizing, and evaluating. It has been stated by many researchers (Redfield and Roussou ,1981; Long and Sato ,1983; Wilen ,1991) that higher order questions are advantageous to students' learning and achievements. Lewis (2015) showed that asking high order questions give teachers a clear image about students' deep understanding.

Reading comprehension

Reading comprehension is defined as "the construction of the meaning of a written or spoken communication through a reciprocal, holistic interchange of ideas between the interpreter and the message in a particular communicative context" (Harris & Hodges, 1995, p. 39). The most important word in this definition is "construction". The word implies the active participation of the reader. That is, Reading Comprehension is not simply to memorize words or locate an answer to a simple question. It is the active involvement of the reader in constructing the meaning of the printed words. Smith (1994) stated that reading is not a passive mechanical activity, but it is a "purposeful and rational dependent on the prior knowledge and expectation of the reader (a learner). Reading is a matter of making sense of written language rather than decoding print to sound**"** (Smith 1994, 2)

According to *schema theory* (Anderson & Pearson, 1984) reading comprehension is not only a bottom-up process where readers are supposed to understand synonyms, answer multiple choice questions, etc, but it is also a top-down process in which the reader brings about his background knowledge and problem-solving skills to give a meaning to the text. (Brown, 2000).

Davies (1995) classified reading activities into two kinds: passive and active. Passive reading incorporates silent reading to answer multiple questions, true-false statements, gap-filling exercises, and vocabulary exercises to name but a few. These tasks do not require students to deeply understand, analyse and evaluate ideas. Learners can easily locate the answers. Hence, these kinds of reading activities do not encourage deep learning. Active reading, on the other hand, requires students to use skills of analysis, synthesis, and evaluation. Students at this level work in pairs or groups to negotiate answers and pose questions about the ideas discussed in the text (Davies 1995). Active reading enhances student-student interaction and therefore more communication is generated. Most importantly, the role of the teacher is minimized. He/she is no longer the all-knowing figure who imposes their ideas. The instructor's role is to facilitate learning.

Brown (2000) suggested three phases of teaching reading. The first phase is the pre-reading discussion. This is a warm-up activity to prepare students for the text. At this level, students are encouraged to ask questions that the text can answer. Tomitch (1991) called this technique ReQuest which stands for the reciprocal questioning. Learners write their questions on a piece of paper that is called and reproduced on the board. This is motivating to students who actively participate in providing questions to the text. The second phase is "the while reading". At this stage, students are offered a quick instruction that explains their purpose of reading. Students read to find answers to the questions they asked before. It is an opportunity to see the extent to which students' prophecies were valid. The last phase is "the post reading" activity. Along with posing low order questions to check understanding, there should be a set of questions that stimulate critical thinking such as questions of analysis, synthesis, and evaluation. The objective is to foster a student-centered approach, which emphasizes the dynamic participation of students in the learning process. (Drown, 2000).

Review of literature

Research has documented that most textbooks are not designed in a way to promote students' deep learning. Mrah (2017) evaluated two Moroccan EFL textbooks. The results revealed that the textbooks do not foster skills of critical thinking as they focus too much on low-order thinking skills. Karns, Burton, and Martin (1983) studied the type of questions used in six textbooks of economics. The results showed that low-order questions such as questions of knowledge, comprehension, and application are much-emphasized skills in the textbooks. On the other hand, high-order questions that improve students' critical thinking and develop their oral communication are not given much importance. Similarly, Riazi and Mosalanejad, (2010) investigated the exercises and activities of high school and pre-university textbooks and found that there was much focus on low-cognitive skills. The results showed that about 75.3% of the exercises and the activities are low-order skills and only 24.7% are classified as being high-cognitive skills. Ighbria (2013) analyzed six units of 9th-grade textbooks. Her objective was to examine the extent to which textbooks help in developing students' thinking. The result showed that out of 381 questions in the textbook about 244 questions occur at the levels of knowledge, comprehension, and application. However, comparing these studies with the previous ones we can notice that questions at the analysis level are much more frequent in the reading comprehension texts. About 89 out of 381 are at the level of analysis. Kurnia

et al (2019) conducted a study on the use of high-order skills in the reading comprehension questions of English textbooks of year X of high school in Indonesia and found that about 73.3% and 6.32 of the reading comprehension questions belong to knowledge and comprehension cognitive domains respectively. That explains that about 80.62% of the questions are low-cognitive questions. Only 19.38% are ranked as high order questions. The aforementioned studies have revealed that there was too much focus on the low-order skills.

Objective of the study

The purpose of this study was to evaluate reading comprehension questions of the EFL textbook in Morocco namely *Ticket to English2*. This textbook was selected because it is widely used in Morocco and is highly recommended by education inspectors. We used Bloom's taxonomy of learning objectives to assess the types of questions. The study sought to investigate which levels of Bloom's taxonomy were much frequent in the reading comprehension texts. Hence, this study aimed to answer the following research questions.

1- Which types of questions are more prevalent in the reading comprehension?
2- To what extent do these two textbooks help in developing students' thinking through reading comprehension questions?

Method

This study adopts a descriptive quantitative research design. We opted for this method to evaluate reading comprehension questions and investigate the frequency of high order questions using Bloom's taxonomy.

We used reading comprehension pre-and post-reading questions of *Ticket to English 2* textbook as a source of data. The textbook is divided into 10 units dealing with different themes. In each unit, there exists a text whose topic is related to the theme.

Instrument, procedures and data analysis

Based on bloom's taxonomy of learning objectives, a checklist was used to evaluate the cognitive domains of the reading comprehension questions. Moreover, to analyze the data collected, all reading comprehension in the textbook were classified, analyzed and codified using the Bloom's taxonomy. The reading questions were first calculated and then classified in a table containing the six levels of bloom's taxonomy. The coding categories are knowledge, comprehension, application, analysis, synthesis and evaluation.

Findings and interpretations

Table 1 shows the frequency distribution of reading comprehension questions in the textbook.

	Levels of bloom's taxonomy	**Frequency of questions (Ticket To English 2**	**Percentage**	**Frequency of questions (Gateway to English 2**	**Percentage**
Low order thinking skills (LOTS)	Remembering	10	11.76 %	15	20.27%
	Understanding	55	64.70%	42	56.75%
	Applying	0	0%	6	8.10%
High order thinking skills (HOTS)	Analyzing	5	5.88%	6	8.10%
	Synthesizing	5	5.88%	0	00%
	Evaluating	10	11.76%	5	6.75%
	Total	85	100%	74	100%

The examination of the reading comprehension questions displays that low order thinking skills (LOTS) are more frequent than high order thinking skills (HOTS). The total number of questions that were categorized according to Bloom's taxonomy was 85 in *Ticket to English* 2 textbook and 74 in *Gateway to English 2*. Approximately, 77% and 84.12% of the questions occur at the level of knowledge and comprehension. It seemed that the first textbook utilized less low-order skills than the second. However, the difference is not that huge to make us assume that the first is better than the other. High cognitive skills (Analysis, synthesis and evaluation) received the lowest percentages in the two textbooks. Only 23% and 14.78% of questions are found to emphasize higher order thinking skills.

While investigating the type of questions in the reading comprehension, it was found that most activities incorporate true/false tasks, multiple-choice questions, filling the gap/chart activities and vocabulary exercises. Most of these tasks are easily located in the texts and hence are unable to promote students' deep learning. Besides, pre-reading questions that are supposed to arouse curiosity and encourage learners to discover the ideas in the text are also classified as being low cognitive questions. while comparing the two textbooks, we could notice that *Ticket to English 2* received higher percentage of high cognitive skills than *Gateway to English 2*. However, this does not lead us to give preference for one textbook over another. Put in a nutshell, the findings reveal that there is a disbalance in the use of low and high cognitive skills.

Discussion

It has been well-documented that certain types of questioning behavior have dominated the classroom discourse for many years. Research shows that questions that require students to give factual information and answers are frequent. However, high order questions that engage students to reflect on their knowledge are barely used (Nunan, 1991). The above results depict that preponderance of reading comprehension questions seek to check students' understanding. These types of questions are important for teachers to assess students' comprehension. However, they fail to foster deep learning. Deep learning is achieved when learners are challenged to sort out problems through questions of interpretation, analysis, and reasoning. This kind of learning encourages more interaction and increases students' talk in the classroom. Deep learning also promotes student-centered models in the classroom. In other words, students are held responsible for their learning. According to Ouakrime (1991), developing student-centered approach is meant "to produce … independent learners, with AIR in their lungs to successfully sail through their language learning journey". When students are given more opportunities to express themselves, the teacher's role is minimized to being a facilitator. For students to have a good understanding of what they read, they need to be able to make inferences and use information that goes beyond the written text (Resnick,1987)

The findings of this study are in accordance with similar studies conducted in Morocco. Elboubakri (2013) and Mrah (2017) Es-salhi and El-fatih (2019) found that Moroccan EFL coursebooks failed to foster skills of critical thinking. Jabbour (2016), contrary to our findings, claimed that *Ticket to English 2* textbook contains important elements that can promote skills of critical thinking. Jabbour gave examples of (case study and project work units) which are overlooked by majority of teachers because of different reasons; time constraint is at the top. 86% of teachers who participated in this study said that they generally skip these units.

The overuse of low-cognitive skills may be attributed to students' low proficiency level. Textbook designers probably opted for lower skills to meet a large ratio of students. In other words, their choice is probably based on the assumption that students are not equipped with enough knowledge to use the language at a high thinking level. Hence, further research is required to get views from textbook designers and practitioners about the motives behind the emphasis on literal comprehension more than critical comprehension.

Conclusion and suggestion

In conclusion, reading comprehension of *Ticket to English 2* and *Gateway to English 2* textbooks emphasized more low order questions that correspond to the lowest levels of Bloom's taxonomy. The results obtained from the coursebooks showed that about 77% in the first and 84.12 % of the questions in the second occur at the levels of knowledge and comprehension. Only 23% and 14.78% of the questions in the textbooks target the high levels of thinking. Put in a nutshell, the textbooks failed to vary the cognitive levels of the reading comprehension questions. This leads us to conclude that reading comprehension questions do not help in stimulating students' high order thinking and hence teachers shouldn't rely too much on them. They can provide students with other more interesting and

motivating reading comprehension texts, which incorporate a variety of thinking skills. Texts that involve a variety of cognitive skills are more likely to increase students' motivation and engagement.

Limitation

The main limitation of this study is its reliance on one research methodology to evaluate the textbooks. Therefore, an open-ended questionnaire or a semi-structured interview should have been administered to investigate Moroccan teachers' perspectives and attitudes towards the emphasis on low-order skills in the two textbooks.

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The effectiveness of the Internal Control System as a regulatory element in Public Pension Expenses for Accountabilty

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Abstract

This article used theorists to reinforce data on the effectiveness of the Internal Control System as an instrument that regulates public pension expenditure for Accountabilty. This topic allows the understanding of the importance of internal control as a practice that helps in the quality and results of an organization, because Accountability represents the obligation of accountability for the performance of a work from the responsibility of a delegated authority. How much and how the Internal Control System can assist the manager in decisions? The general objective is to analyze the effectiveness of the internal control system in order to serve pension institutions more effectively. The methodology was bibliographic, exploring magazines and websites, besides the Brazilian legislation; the data collection was carried out at the Public Servants Welfare Institute of the State of Rondônia (IPERON). It was possible to conclude that it is necessary for IPERON's Internal Control Sector to develop its activities according to its mission and vision so that qualitative results have priorities.

Keywords: *Internal Control. Public Expenses. Accountabilty.*

1. Introduction

The main objective of this study is to present the Internal Control System as an instrument of regulation in the application of public pension expenses for Accountability in public institutions. To this end, the importance, effectiveness and support that this system gives to management for the good use of public resources will be discussed, allowing accountability to the citizen and user of information, with clarity, ethics and respect for legislation.

The epistemological definitions address the importance of control in public administration to enable the organization in the methods and measures adopted to safeguard its resources to ensure effectiveness and operationalization.

Regarding legislative aspects, the Rondônia State Court of Auditors instituted Normative Decision no. 002/2016/TCE-RO, in which it establishes the guidelines on the implementation and operation of the internal control system, where it lists five principles inherent to internal control activities: Principle of segregation of functions; Principle of cost/benefit relation; Principle of adherence to guidelines and norms; Principle of adequate qualification and Principle of technical-functional independence, being all these elements that guide the professional's activities [1].

A highlight is the fact that all determinations guide the public and private spheres, not excluding any body, because there is an understanding that the manager of the private initiative can do everything that the law does not prohibit, but it is up to the public manager to do only what the law allows, creating a problem in

this conception of ideas, since society demands results and often, due to lack of knowledge of the legislation, is held responsible for the involuntary involvement of possible irregularities.

Moreover, the various findings are often scored by the internal control sector of the institution and as a consequence some convictions are issued under Brazilian law. For this, the choice of this subject occurred due to the need to make explicit to the taxpayer and to the interested party the social security information that the public power, especially a social security institution, must value for the good use of the resources of public servants.

In this sense, the biggest aspect of this survey is defined by the concern about the use of the social security public resources, the means and the reasons why the manager will effectively manage the taxpayer's money and, consequently, the contribution of the intentional control system to Accountability.

Thus, this study will show the contributions of the internal control system, duly organized, directed by committed and qualified servants, fact provides the manager of a welfare institution, the efficient mechanisms for decisions involving the application of resources and the accountability of organizational activities.

In this sense, the general objective is to analyze the effectiveness in the internal control system to effectively serve the welfare institutions. The specific objectives are: to describe the concept of internal control; identify the challenges and obstacles of the researched object; evidence the applicability of an organized system in the social security institutions; contextualize the new vision of the Internal Control System by the manager through the resources provided.

In view of the above, the article was structured in five sections arranged in a logical sequence giving priority to the understanding of the object of study. The first section delimited the introduction; the second section presents the epistemological field of internal control conceptualization, the systematic organization of norms and guidelines. The third section discusses the methodological aspects of the research. The fourth section consists of the analysis and discussion of the results and finally the final considerations that suggest future research in this area for the dissemination of this knowledge to accounting professionals in contemporary times.

2. Knowing about Internal Control

2.1 Definition of the term Control

Conceives control is defined as a "subject of public administration, faculty of surveillance, guidance and correction that one Power, organ or authority exercises over the functional conduct of another [2].

Its origin derives from the French term control and, for this reason, it has always encountered resistance among vernacular language cultivators, but because it is untranslatable and irreplaceable in its vulgar or technical meaning, it has been definitively incorporated into some languages, including dictionaries of the Portuguese language, and it has also become popular when the systematics of something or something that needs to be followed with greater vigor is triggered.

In the mini contemporary dictionary of the Portuguese language its conception allows the understanding of the control as being the "supervision or monitoring exercised over certain activities, or the power to exercise them" [3]. Control is a theme applied in actions in which it needs organization to direct something or focus

on an activity in which a result needs to be presented.

2.2 Meaning of the term Control

In other viwe "internal control in the public administration is the verification of the compliance of its actions with a standard, enabling the controlling agent to adopt a measure or proposal as a result of the judgment formed" [4].

In this epistemological dialogue, internal control is defined by the American Institute of Certified Public Accountants as the "organization plan and all methods and measures adopted in the company to safeguard its assets, verify the accuracy and fidelity of accounting data, develop efficiency in operations and encourage the monitoring of prescribed administrative policies [5].

From now on, the concept formulated by the French Institute of Accounting Experts highlights that internal control is “formed by the organization plan and all the methods and procedures adopted internally by the company to protect its assets, control the validity of the data provided by Accounting, increase efficiency and ensure the proper application of management instructions” [6].

Internal control represents in the organization the "set of procedures, methods or routines with the objectives of protecting assets, producing reliable accounting data and helping management in the orderly conduct of the company's business [7].

In this context, two types of controls are exemplified: accounting and administrative. As for accounting controls, it is clarified that these are the systems of checking, approval and authorization; segregation of functions; physical control of assets and internal audit. As for administrative controls, the procedures consist of reporting statistical analyses of profitability, quality control, staff training, time and movement studies, analysis of variations between budgeted and incurred amounts, and controls of commitments made, however, unpaid.

However, [5] this is the main means of control available to the management of an organization, from the financial point of view, is accounting. From this perspective, the better and more efficient internal controls are, the greater the security for the manager, since, when fragility is verified, the professional increases the number of tests, however, when he notices that the controls are strong, the number of tests decreases, therefore, the smaller the better. Then, “Internal control comprises the organization plan and the coordinated set of methods and measures adopted by the company to protect its assets, verify the accuracy and reliability of its accounting data, promote operational efficiency and encourage adherence to the policy outlined by management [8].

In terms of documents instituted, the Federal Accounting Council, through the exercise of its legal and regimental attributions, enacted [9], in which it approved the Brazilian Accounting Standards (NBC) T16.8 which deals specifically with Internal Control, defining it from this accounting perspective “it comprises the set of resources, methods, procedures and processes adopted by the public sector entity, for the purpose of (a) to safeguard the assets and ensure the veracity of the equity components; (b) to comply with the accounting record in relation to the corresponding act; (c) to provide timely and adequate information; (d) to encourage adherence to the norms and directives established; (e) to contribute to the promotion of the operational efficiency of the entity; (f) to help prevent inefficient and uneconomical practices, errors, fraud, misappropriation, abuses, deviations and other inadequacies” [10].

Within this context, the existence of various ways of evaluating internal control in an organization is highlighted, and its realization can be carried out in two stages called: The first concerns adequacy and the second consistency.

In the case of adequacy occurs when divergent points are identified with regard to existing or inadequate controls, and these results can be obtained through the answers to questionnaires applied in which the survey allows to verify what the existing control system is and if it is consistent with the organization's needs.

As far as consistency is concerned, its application to internal controls is verified with regard to the result of their evaluation. It is emphasized that for the controls that are being practiced, a work program is effectively made that will assess the levels of adherence of all areas of the institution, their inconsistencies and the reasons for not accepting the application of some controls.

2.3 Internal Control System in Brazil legislation

With regard to the legal aspects promulgated in Brazil with regard to the practice of internal control in organizations, one finds the doctrinal scope in the 1988 Federal Constitution emphasized in arts. 31, 70 and 74 “article 31 deals specifically with the internal control system concerning municipalities when it states that "the inspection of the municipality will be exercised by the Municipal Legislative Branch, through external control, and by the internal control systems of the Municipal Executive Branch, in accordance with the law” [11]. Over and above that, article 70 deals with it in a broader way “the accounting, financial, budgetary, operational and patrimonial inspection of the Union and of the direct and indirect administration entities, as to legality, legitimacy, economy, application of the subsidies and renunciation of revenues, will be exercised by the National Congress, through external control, and by the internal control system of each Power" [11]. However, article 74 stipulates that the Legislative, Executive and Judiciary branches have the duty to maintain an integrated system of internal control" [11].

2.4 Macro objectives, Types and Forms of Internal Control

The macro objectives of Internal Control allow to ensure the legitimacy of liabilities, safeguard assets against theft, losses or waste, promote operational efficiency and encourage adherence to internal policies of the institution.

For this purpose, there are two types of Control, internal and external. Internal Control occurs when activities are carried out within the institution itself. However, External Control occurs by agents from outside the institution.

As for internal control [4] "external control is carried out by a body external to the public administration responsible for the controlled act (e.g. City Hall with the assistance of the Court of Auditors)". Besides that internal control is carried out by the executing agency itself within the scope of its own management, exercised in an appropriate manner, capable of providing a reasonable margin of assurance that the objectives and goals will be achieved effectively, efficiently and with the necessary economy (e.g. Internal Control System, Internal Control Committee, Municipal Control) [4].

2.5 Internal Control Principles

The principles of internal control are fundamental [4], therefore, essential to the activity of internal control because they are defined by: 1) The responsibility must be determined; 2) Accounting and operations shall be segregated; 3) Independent evidence must be used to prove that the operations and accounting are accurately recorded; 4) There must be rotation between servers in charge for each job; 5) Vacation must be mandatory for people who occupy important positions: 6) All instructions and norms must be made in writing; 7) The segregation of functions should be avoided [4].

Thus, it is also discussed that "the principles of Legality, Impersonality, Morality, Advertising and Efficiency, contemplated by art. 37 of the Federal Constitution, are general rules in the performance of the public administrator.

In view of the new reality of public administration, there are new principles that should be considered in the performance of internal control, which are: the principle of public interest, economy, speed, reasonability, proportionality, isonomy, administrative probity and broad defense" [4].

2.6 Effectiveness of the Internal Control System

In other view "effectiveness is the ability to produce the results previously defined, through its objectives and performance targets, within the established deadlines" [12].

In this sense effectiveness is the ability of the manager to deal with the resources available to achieve the greatest number of results than had been planned. And efficiency deals with the degree to which resources are planned and are being used by the organization in a beneficial manner.

The FC brings in art. 37 the constitutional principles regarding the direct and indirect public administration of any of the Powers of the Union, the States, the Federal District and the Municipalities will obey the principles of legality, impersonality, morality, publicity and efficiency [11].

It is understood that efficiency in dealing with public resources is the concern of the legislator, and must be understood in a unison for its application.

Thus, the combination of efficiency and effectiveness is essential for the system and the internal control sector to assess the credibility of the management, since they allow for vigilance and asset protection, offering profitability and economy.

For this effectiveness to occur, it becomes consubstantial that the Internal Control System of the institution is the junction of all sectors involved in an articulated manner and, demonstrated through its organization chart, regardless of whether it is of public or private order.

It should be noted that, as previously mentioned, the Federal Constitution-88 does not leave legitimate in its articles 31 and 70 regarding the Internal Control Sector, but deals with the Internal Control System. Moreover, it enacts in § 1 of art. 74 some salutary attributions when those responsible for Internal Control, upon becoming aware of any irregularity or illegality, shall inform the Federal Audit Court, under penalty of joint and several liability [11].

2.7 The Head of the Internal Control Sector

In some agencies each sector has a respective leader or person in charge who provides the manager with reliable information in real time for his effective decision making, which may depend on the administrator

to institute a specific sector of Internal Control, or depending on the organizational structure to create the Internal Audit, or for greater security to have both in the institution.

It is the responsibility of the manager of a welfare institution to delimit the creation of the Internal Control Sector, in which he must exercise the attributions of analysis of expenses in terms of their regularity, manifesting himself/herself or positioning through administrative opinions.

It may even institute the Internal Audit Sector, which may be considered allied to the Internal Control Sector, since its objective is to supervise, normalize, recommend, inspect, and evaluate the degree of reliability of the institution's procedures.

Furthermore, when this institution is of public order, its perspective is limited in the control in measuring results, based on the analysis of deviations and generation of reports. Its applicability is effective to provide a strategic awareness focused on the principle of continuous improvement.

The approaches of the most renowned treatmentists constitute requirements to be met by public expenditure, such as usefulness, adequacy, opportunity, publicity, legitimacy [12].

In this context, for an expenditure to be characterized as public, it must meet these requirements. That public expenditure is the set of "financial expenditures made by the public administration for the payment of obligations aimed at the operation of public services or for the return of amounts not belonging to the State [13].

2.8 Accountability

It defines the concept of Accountability, when it says it is “the set of personal attributes and expected behaviors of individuals who exercise parts of the public power granted to the state, i.e., by external expectations, users and institutions of society, either as a result of internal rules established by institutions. In its strict sense, the term designates the obligation to be accountable for the safekeeping and/or use of public resources, property, and the decision-making authority conferred on a public office or government program [12].

In this epistemological context [14] mentions that Accountability is the obligation to account for the performance of work arising from an assumed responsibility derived from a delegated authority. Henceforth states that "Public Accountability presupposes the awareness of the obligation to be accountable by those who use public resources outlining a greater degree of awareness in society makes the need for accountability more evident" [15].

Clarifies [2], that the duty to be accountable reaches not only administrators of public entities and bodies, but also parastatal entities and even private individuals who receive state subsidies for determined application. Moreover, it is a natural consequence of the administration as a charge of management of property and interests of others, since administration corresponds to the performance of a mandate of zeal and conservation of property and interests of others, it is clear that who exercises accountability to the owner.

3. Methodology

A descriptive study of a basic nature was carried out with a quantitative approach with technical procedures

in bibliographical research to substantiate the epistemological field, use of legislative documentation applied to the subject, research in journals and electronic sites.

In other view "descriptive research has as its main practice the characteristics of a certain population or phenomenon, or the establishment of relations between variables" [16].

The collection of data was based on a Welfare Institution through the application of a semi-structured questionnaire, with closed questions in order to identify and analyze the understanding of the servants who are in the front line to know the effectiveness of the internal control system as a regulatory element in public welfare expenses for accountability through their contributions. The questionnaire is a data collection instrument consisting of an ordered series of questions that must be answered in writing by the informant, without the presence of the researcher. They must be clear and limited in length and be accompanied by notes explaining the nature of the research and stressing the importance and need for answers in order to motivate the informant [17].

In this sense, it was intended to establish the duality of opinions, or repetitions that do not contribute conceptually on the subject, but can recommend a new approach, so that we can build the mission and vision in a solid way proposing constructive conclusions and discussion of the results achieved.

The listed research respected the limits regarding the theme, objectives and procedures accomplished. This type of research is "a deep and exhaustive study of one or a few objects, in order to allow broad and detailed knowledge of them [16].

4. Results

In order to achieve the proposed objective, a questionnaire with 10 (ten) questions was applied to the employees who work at the Institute of Social Security for Public Servants of the State of Rondônia - IPERON, located at Avenida 7 de Setembro nº 2557 - Bairro Nossa Senhora das Graças, in Porto Velho, Rondônia, Brazil

As it is a quantitative study, it clarifies in percentage the specificities of the place under analysis. In the sense of the objectives, it was a descriptive research, because its objective was to show to the society the performance of the Internal Control System can contribute to the management regulating the public expenses in a social security institution, in the particular case of IPERON.

The data was collected in August of 2019, when the questionnaire was applied to the collaborators of the following areas: Administrative and Financial Direction, Welfare Direction, Technical Direction, Registration Management, Administrative and Human Resources Management, Welfare Management, Psychosocial Management, Accounting Management, and Team Leadership.

In view of the above, the analysis and discussion is contextualized by means of the questions asked.

The first question was to point out the fragility in some sector participating in the Internal Control System, since it contemplates all the sectors involved in the management of the organization, and presupposes that each one must do their role well.

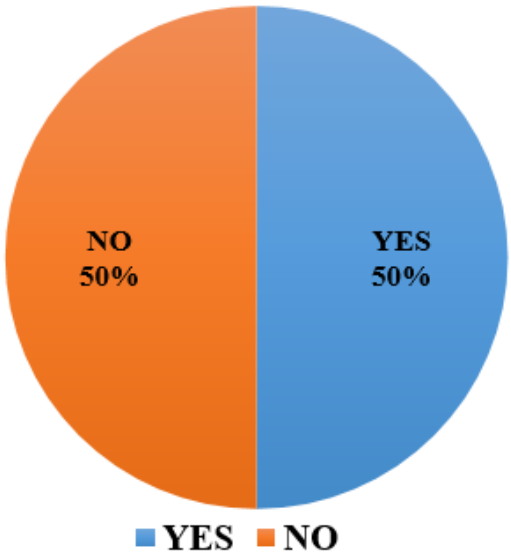

Figure 1: Are there weaknesses in any sector?. By the author (2020).

For the questions yes and no the percentage of 50% each was obtained, the result of this index is worrying because it means that the management needs to make urgent improvements in the process structure.
The second question had in its scope the possibility of knowing which components could be optimized or modified for an improvement in the internal control system.

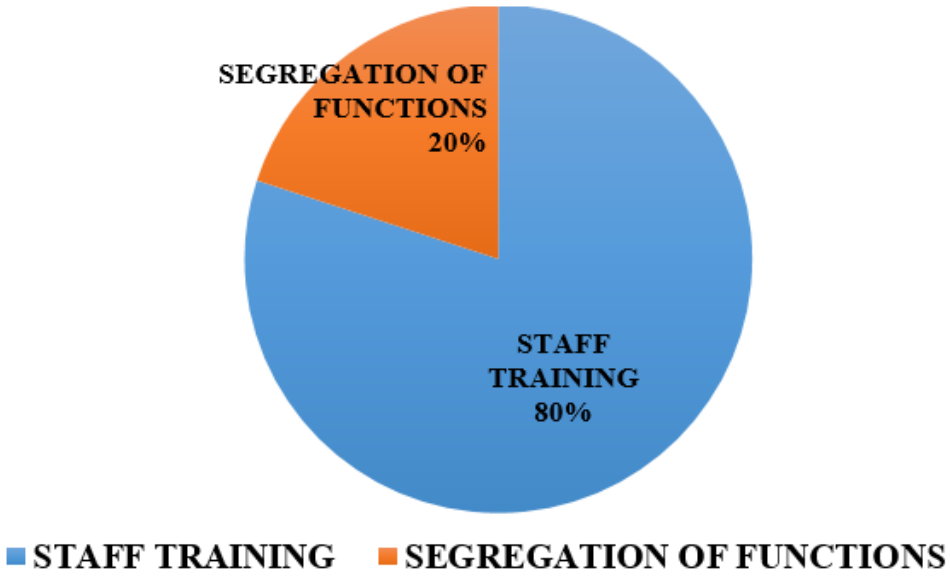

Figure 2. Components that can optimize or modify for improvement. By the author (2020).

The response was 80% for staff training and 20% for job segregation. The result reflects a lack of knowledge of segregating functions, and enabling the occurrence of fraud, and therefore malice, because the same agent who makes acquisitions should not make payments, for example.
The questionnaire when formulating the third question asked what could be wrong with the operations that are performed in the internal control system.

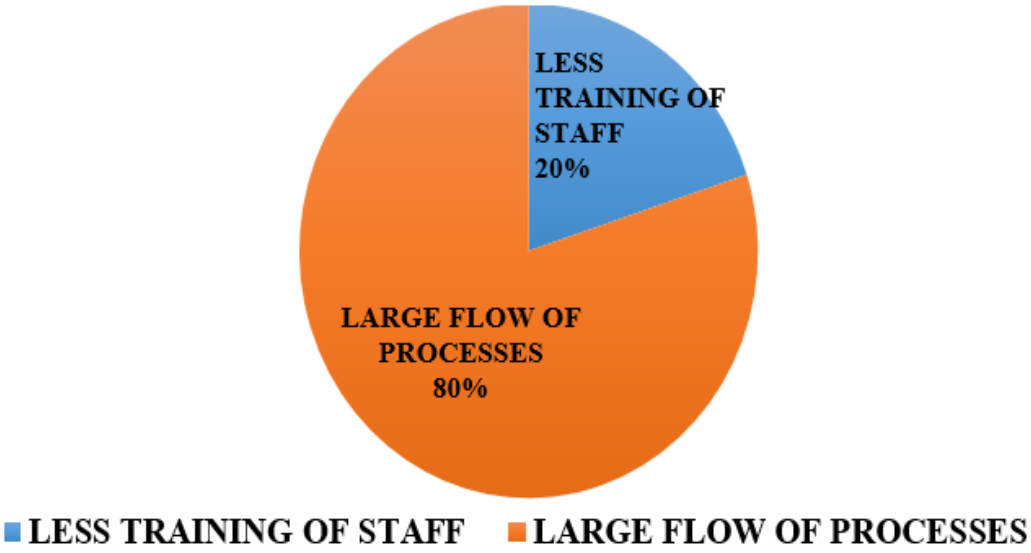

Figure 3. Errors made in the operation. By the author (2020).

As a response, 80% of the surveyed population informed that the flow of processes is very large, while 20% of the surveyed population expressed the opinion that the flow of processes in the institution under survey urgently needs to be improved.

In the fourth question, the researcher wanted to know which sectors represent an obstacle to the increase in productivity of the internal control sector, and which components could be optimized or modified for an improvement in the internal control system.

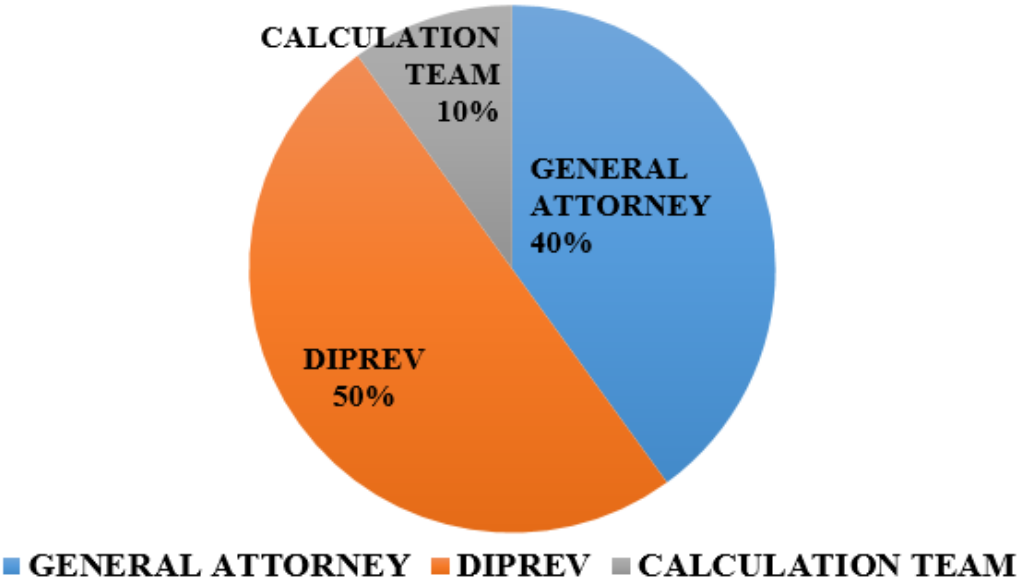

Figure 4. Sectors for Improvements. By the author (2020).

The results show that 50% responded that DIPREV represents the greatest obstacle, while the Prosecutor's Office represents 40% and therefore the Calculation Team with 10%. This means that the two sectors, together DIPREV and PROGER, need to re-evaluate their strategies.

The fifth question was more emphatic and questioned the interviewee if he understands that there is a need to give more celerity to the retirement processes at the Institute of Welfare of Public Servants of the State of Rondônia (IPERON).

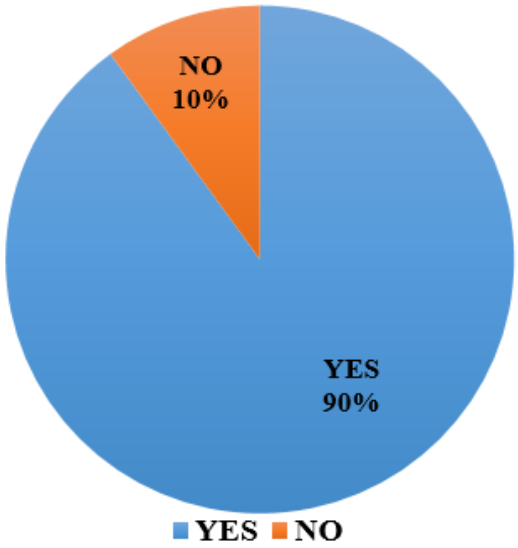

Figure 5. Celerity. By the author (2020).

The answers point out that 90% of the interviewees believe that the procedural process should be speeded up, but 10% believe that it is good, i.e. the vast majority are in favor of the process as a whole being improved.

The sixth question sought to know if there was any record of discontent in the Institute of Welfare of Public Servants of the State of Rondônia (IPERON), motivated by the delay in granting retirement by some servant.

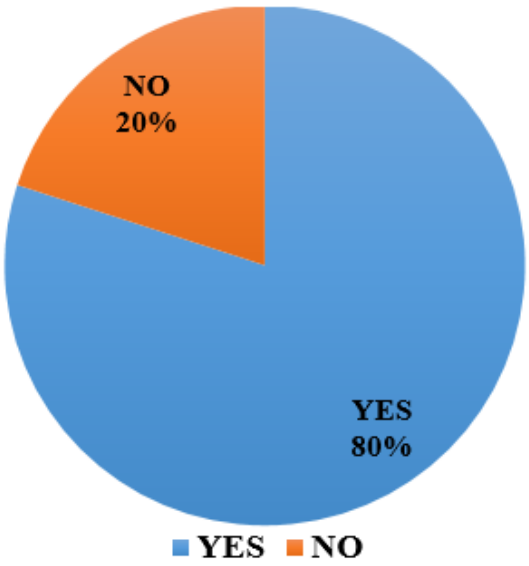

Figure 6. Record of discontent. By the author (2020).

For 80% of those interviewed, there were records, and only 20% emphasize that there were not. This demonstrates the need for the Internal Control Sector to be more active, it needs that in the institution under study a flow of processes be elaborated that allows more agility, so that the server that has the right to retire is not vilified at the moment it most needs, after a life of working service.

The seventh question brings in its bulge the opinion of the public servants of the Institute of Welfare of the State of Rondônia (IPERON), if the public servants of the State of Rondônia, are satisfied with the services performed by the institute.

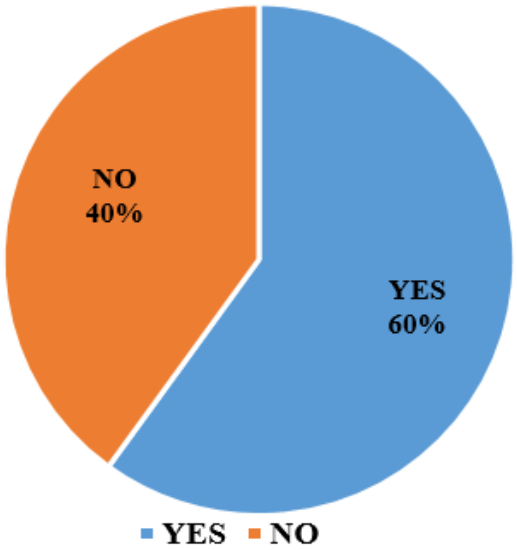

Figure 7. Level of Satisfaction. By the author (2020).

Regarding the level of satisfaction of the participating subjects, 60% of the servants of the State of Rondônia said that the services performed by IPERON have been pleasing, but this is the opinion of the servants of the entity studied, however 40% believe that there is no satisfaction for the services performed by the institution.

The eighth question brings an interesting question in which it was asked if the interviewee would be willing to contribute with suggestions to speed up the process.

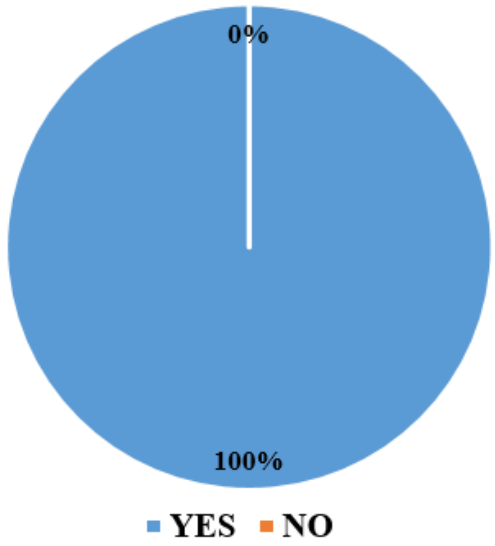

Figure 8. Suggested Procedure. By the author (2020).

The answers show that 100% of the respondents were positive, demonstrating that they want to participate in the decision-making process, suggesting or recommending the necessary improvements, thus speeding up the process in the institution under study. The ninth question was made in a way that could clear any doubts regarding the performance of the internal control sector, and whether it is acting in compliance with the legislation.

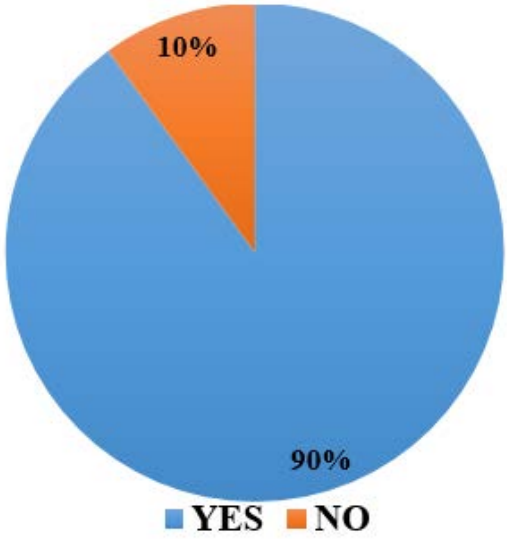

Figure 9. Performance of the Internal Control Sector. By the author (2020).

In this question the answer was unanimous for 90% who responded positively, and only 10% do not think so. The tenth question was formulated in order to know from the interviewee if IPERON usually knows his opinion through internal research about the services it is offering.

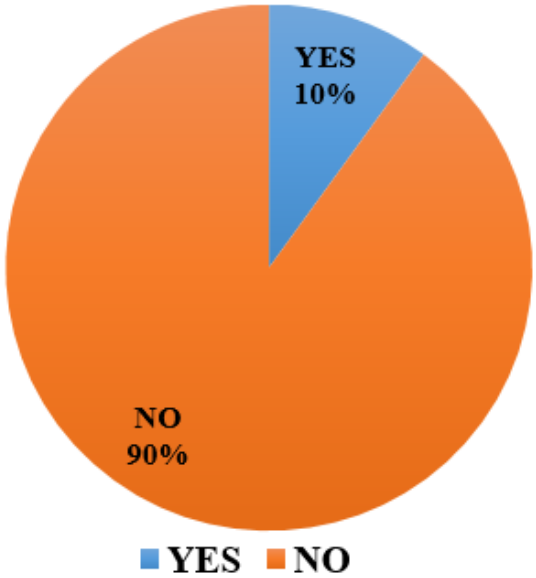

Figure 10. Receipt of Opinions. By the author (2020).

Again the result was overwhelming, in which 90% responded negatively, that is, that the institution studied does not usually establish a close relationship with the server, and only 10% responded positively.

5. Conclusion

As detailed in this study, the junction of efficiency with the effectiveness of the internal control system, as an element that performs the follow-up, and recommends in a clear, objective and concise way, checking whether all control procedures are being performed effectively.

Public expenses need to be incurred to meet the needs of society as a whole, however, it is necessary that those who carry them out, meet the basic principles of the public administration, which guide their effective payment.

The application of the questionnaire in the studied institution demonstrated that it is essential to segregate functions, improve the elements that make up the internal control system, with personnel training, improve the flow of processes in order to manifest themselves in a high way, reassessing their strategies in each sector participating in the system, give more speed to the processes, because the vast majority of the sectors researched are in favor of the process as a whole being improved. The discontent proved to be small and demonstrates the need for the Internal Control Sector to be acting on the compliance for which it was created, excelling for its mission and vision.

In this context, it was perceived that it is necessary to make greater improvements in the functional structure, with priority to learning, in the sense that there is an understanding that is close to unanimity regarding the satisfaction for the services performed by the entity, but the manager or administrator has the responsibility and humility to know the opinion of its employees, to establish a relationship and proximity with the employee, considering that they are the ones in the front line, and they reflect greatly the image of the institution.

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Perspectives and uncertainties: Challenges and achievements of the *Lato sensu* distance learning program at a University in the Brazilian Amazon

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ABSTRACT

Distance-learning graduate programs go beyond the limits of academic training, restricted to obtaining a degree. Challenges and overcoming occur, not only in the search for qualification, for a career plan and following the company's' remuneration policy, but also due to the physical distance from major teaching centers. The great proposal is to supplant the frontiers of knowledge, in places where there is immense biodiversity, in contrast to geographical isolation. The objective of the study is to present the challenges and perspectives of the lato sensu graduate program at a University of the Brazilian Amazon, in the Municipal Public Management course in the state of Rondônia. The methodology used was that of review, as it seeks to describe, analyze and discuss scientific and technological knowledge already published. The review is basic and, it is expected that it will serve as support for scientific research and also, as support for theoretical reference. The course presented as a result works aimed at the better performance of the Management of the Municipalities of Rondônia. The research work developed by the students represents a local reality diagnosed with the search for managerially planned solutions.

Keywords: Post-Graduation. University Management. Municipal Public Management. Qualification. Amazon.

1. INTRODUCTION

Despite the colossal physical distances between cities in the Amazon Region, the vigorous developmental process brought with it the necessary changes to bring these spaces together, albeit virtually. Distance Education (EaD) has currently become a viable tool for public policies aimed at offering courses, seeking to reach people who live in remote regions of the Amazon, and have difficult access to education.

Thus, the EaD, presents itself as the institutional tool to enable the offerings of undergraduate courses and specialization *lato sensu*. This option often represents the only opportunity for students from these remote locations to join a free and quality higher education course.

Due to the geographic isolation of most municipalities in the Amazon Region, whose access is often restricted, and which have enormous barriers to be overcome, such as economic and social, they often prevent the population from enjoying citizens' rights, such as education. In this context, the Federal University of Rondônia (UNIR), through the Directorate of Distance Education (DIRED), offers eight

municipalities in the state, centers for undergraduate courses and *lato sensu* specialization in the distance modality.

In this sense, the article proposes to describe, the challenges and perspectives of the distance education program at the level of specialization *lato sensu*, in a University of the Brazilian Amazon. The study was carried out at the Federal University of Rondônia, through the experience of implementing the Municipal Public Administration course.

Therefore, the purpose of this article is to present the challenges and perspectives of the *lato sensu* graduate program at a University of the Brazilian Amazon. To achieve this objective, it is necessary to: (1) Analyze the difficulties encountered in carrying out the *lato sensu* specialization course; (2) Understand the difficulties and solutions most encountered by students enrolled in the course; (3) Know the results obtained by the course object of study.

1.1 Contextualization

Distance learning courses in the National Public Administration Training Program (PNAP) were approved by the Superior Council of the Federal University of Rondônia (UNIR, 2010). Through the selection process, the Municipal Public Management course was initiated, covering, among others, in the capital and municipalities, in order to meet a repressed demand, even in regions of more difficult access, where the population craves for qualification opportunities.

The Municipal Public Management course has the following training in its structure: a course coordinator, tutoring coordinator, distance tutors and classroom tutors. To promote the administrative and didactic-pedagogical part of the course, DIRED/UNIR has the figure of the general director and postgraduate coordinator, whose main function is to manage and provide resources that enable the development of distance courses.

The course under study was implemented in eight municipalities in Rondônia, including the capital, Porto Velho, which, even though the public university offering on-site courses is available, also chose to offer the course, providing opportunities for improvement in this area.

1.2 Course structure

The postgraduate course in Municipal Public Management was created through Resolution no. 246/CONSEA (UNIR, 2010), with single entry, which started in 2012 in some centers and 2013 in others. Due to the lack of resources, it was forced to stop his activities in 2013, resuming in mid-2014. The course was divided into 14 modules with a proposed duration of fifteen months. To be approved, the student needed a minimum of 70%.

In order to reduce dropouts and increase the success rate, it was suggested to encourage student rescue activities. In these new activities, under the title of Repercurso, the student could recover up to two subjects. These disciplines were offered based on new activities, new assessments and special monitoring by tutors and coordinators. Thus, there was a higher rate of success in the course.

The curricular structure of the course consisted of 420 hours. 80% of this workload was carried out on a virtual basis and 20% with face-to-face classes. There were 210 hours of the so-called Basic Core and 210 hours of the Macro Management System for Public Systems, whose initial proposal would not exceed

15 months from the beginning. In order to develop the content, printed support texts, a Virtual Learning Environment (VLE), face-to-face meetings and a tutoring system were used.

The virtual classes took place through the Online Learning System (MOODLE). The face-to-face classes took place at the hubs on Friday (evening) and Saturday (evening and morning). At the centers there was a technical and pedagogical infrastructure, a computer lab, a library for face-to-face activities and as a support base for studies.

The objective of the Basic Module was to provide the student with an awareness of the current government policy, placing it in the transition that has been taking, over the past few years, from a Managerial State to a Necessary State. This framework allowed students to better understand. Throughout the Specific Module, the different actions and programs implemented by the current public administration were studied.

1.3 Poles

The project of the course on screen, foreseen for each pole of the interior and capital, 50 vacancies, offered to society in general. The municipalities covered were Ariquemes, Buritis, Chupinguaia, Nova Mamoré, Porto Velho, Ji-Paraná and Rolim de Moura. Table 1 provides information on the distance between them and the capital, in addition to the demographic density of each municipality.

The poles were chosen, in principle, in the same municipalities where there are campuses at the Federal University of Rondônia, and where there was a partnership with the municipal governments. As can be seen, many of the centers have extremely low demographic density, which makes access to higher education and even more specialization courses more difficult, such as the municipalities of Buritis and Chupinguaia. Figure 1 shows the poles and their distribution in the state.

Figure 1- DIRED's poles of action in the State of Rondônia

Source: DIRED (2020)

Owing to the distance and pole access, teachers' visits were periodic, but not constant. The locomotion difficulties of the Amazonian population, in general, present precarious means of inter-municipal transport, in addition to a shortage of specialized professionals in these small localities in the Amazon. In this way, the course proposal, contributes to reduce the limitation of the educational sector and to reduce the deficit in the intellectual development of the population with technological distance from such municipalities with the large centers.

Table 1. Poles of the Municipal Public Management course

POLES	Distance from Capital	Population (estimated in 2019)	Demographic density (hab / km²)
Ariquemes	203 km	107,863	24.4
Buritis	319 km	39,654	12.1
Chupinguaia	660 km	11,182	2.1
Jí-Paraná	378 km	128,969	16.9
Nova Mamoré	280 km	22,546	2.2
Porto Velho	-	529,544	15.5
Rolim de Moura	480 km	55,058	37.6

Source: IBGE (2019)

Thus, for a good development of the course, it was necessary to guarantee access to computers connected to the internet, with a minimally satisfactory link that would allow the upload and download of files. This has become one of the main challenges to be overcome. With this kit it is possible to access the internet at a nominal speed of 512kbps. However, due to climatic factors characteristic of the region, such as large amounts of clouds and frequent rains, the actual speed achieved is around 100kbps (LUCENA, 2012).

2. Theoretical Reference

Lato sensu postgraduate courses, or *lato sensu* specialization courses, are no longer considered free, that is, independent of authorization to operate by the Ministry of Education and Sport (MEC). With Opinion no. 908/98 (Brazil, 1998) and Resolution no. 3 (Brazil, 1999) of the Higher Education Chamber of the National Education Council, the conditions for the validity of certificates for on-site specialization courses were established, and made the regulation of such courses in the distance modality is necessary.

2.1 Distance mode

The flexibilization of teaching with the insertion of the distance modality presents an increasing demand, considering the educational challenges, which is reflected in initiatives and incentives on the part of the public administration, especially in the Amazon Region, since there is difficulty in displacement, in

the face of great distances to be covered. Despite the availability of appropriate technological resources, this modality has been meeting the demand for undergraduate and specialization courses.

As proposed by Moore and Kearsley (2007), it is in Distance Education that the relationships between students and teachers are analyzed, as it is not limited to the barrier imposed by space and time, since both, teacher and student, are, as a rule, in different places, during the teaching-learning process, generating benefits that bring greater flexibility to the student in terms of time and place of study.

Lima (2000) corroborates this thought and adds that Distance Education is the trend that is unfolding on the horizon and demonstrates that distance education will consolidate itself as the most viable alternative for the democratization of knowledge. In turn, Reis (2003) understands that more than technology in distance education is needed so that it can develop an educational environment. For the author, it is important that there is interaction, since technological advances provide better possibilities in the educational context, however, access to information is not a sufficient cause for the acquisition of knowledge.

Therefore, with the proposal to serve the significant portion of the local population, the distance modality seeks to promote inclusion through democratization of opportunities and sequence of studies, meeting public policies to provide quality training to work in the public sector, whose investment has been implemented through the Open University of Brazil (UaB) (CAPES Foundation, 2020), which is a program to support public higher education institutions, together with the Coordination for the Improvement of Higher Education Personnel (CAPES), which is a foundation linked to the MEC, in addition to the Federal University of Rondônia (UNIR).

Knowledge is social and its creation and distribution are part of the creation activities of particular groups of people. The group thus formed provides the instruments so that the knowledge generated can be disseminated through socially created ways, adopted and used in specific social contexts (LIBÂNEO, 2002).

In turn, Ivanoff (2010) points out the difficulties inherent in the students' first contacts with the new teaching modality, and how its use in an educational process represents a real challenge in the construction of knowledge. However, the assimilation of this new approach happens naturally and students gradually get used to it and take advantage of the opportunity to enhance their abilities. (LITTO; FORMIGA, 2009).

2.2. Higher Education in the Brazilian Amazon

At the beginning of the 60s of the 20th century, Higher Education in Brazil was limited exclusively to capitals and very few inland cities. Thus, access to higher education for people from the countryside was restricted (ESTRADA, 2000). This development model, concentrated the thinking populations in the capitals and metropolises, accentuating the rural exodus and the social problems arising from them.

However, the activities of university institutions need to analyze the context in which they operate and consider regional interests, challenges and particularities. The needs to respond to the recognition process of the Amazon Region, in a way that occupies the various regional gaps, go through the constant growth of the social and quality demands of higher education in terms of professional, intellectual, technical and political training opportunities (VACA et al., 2007).

In turn, the cities of the interior, according to the authors, far from these poles of knowledge, were until recently, at the mercy of knowledge, which was destined for the privileged few. The International Conference on Higher Education in the Amazon, at the beginning of the 21st century, found that in the Amazon region there was still a significant brain drain both abroad and to more developed regions of the countries.

It is observed that the Federal Universities of the Amazon Region have about 30 years of creation, with the exception of the Federal University of Amazonas, whose conception is from 1909 (UFAM, 2020) and UFPA founded in 1957 (UFPA, 2020), being the oldest in the Region, as shown in Table 2.

Table 2 - Federal Universities in the Amazon Region

Federative Unit	Name	Acronym	Year of creation
Acre	Federal University of Acre	UFAC	1974
Amapá	Federal University of Amapá	UNIFAP	1990
Amazonas	Federal University of Amazonas	UFAM	1909
Pará	Federal Rural University of Amazônia	UFRA	2002
	Federal University of Pará	UFPA	1957
	Federal University of Oeste do Pará	UFOPA	2009
	Federal University of Southeast Pará	UNIFESSPA	2013
Rondônia	Federal University of Rondônia	UNIR	1982
Roraima	Federal University of Roraima	UFRR	1989
Tocantins	Federal University of Tocantins	UFT	1990
	Federal University of Northern Tocantins	UFNT	2019

Source: Brasil (2020)

The Brazilian Amazon Region has only 11 Federal Universities, in contrast to other regions. In brief comparison, only the state of Minas Gerais has the same number of institutions as the entire Brazilian Northern Region, followed by the state of Rio Grande do Sul, with 7 institutions and Bahia with six. This shows how much it is necessary to internalize higher education in Brazil.

2.3 The Federal University of Rondônia

'The Federal University of Rondônia Foundation (UNIR) is a university in the west of the Brazilian Amazon Region. was created in 1982 by Law No. 7011 (BRASIL, 1982). It has eight *campi*, located in the municipalities of Ariquemes, Cacoal, Guajará-Mirim, Ji-Paraná, Porto Velho, Presidente Médici, Rolim de

Moura and Vilhena. Its administrative headquarters are located in the capital, in Porto Velho, where the Rectory and pro-rectories are established (UNIR, 2020).

Currently, it has 56 undergraduate courses, 18 masters and three doctorate courses, all in person. 8874 students are enrolled in the undergraduate program and 581 in the *lato sensu* graduate program.

2.4 About the Distance Education Directorate

The Directorate of Distance Education (DIRED) is a supplementary department of UNIR, therefore being, the body that makes University Management, whose objective is to offer initial and continued training in undergraduate and graduate courses for municipalities where there are hubs in the State from Rondônia. These courses are promoted in the distance mode and have the support of a trained and well-structured team.

To reduce the difficulties inherent to the Amazon region, DIRED adapted traditional pedagogical models that, according to Behar (2009, p. 2), represent a teaching/learning relationship. This structure unites didactic-pedagogical support and students; technological and logistical solutions to make the offer of courses and support for distance learning students viable.

For distance courses to be viable, support from the local city hall is required. The centers have a secretary, a computer lab, with computers and a library. To accompany the student, there is the coordinator of on-site tutors. Support for remote activities is carried out through AVA, where a virtual classroom was created for each discipline, containing didactic material, fixation and assessment activities, file repository and space for viewing notes.

3 Methodology

The methodology used was that of review, as it seeks to describe, analyze and discuss scientific and technological knowledge already published. The review is basic, it is expected that it will serve as support for scientific research and, also, as a theoretical reference support for future works.

The methodological procedures adopted in this research were bibliographic review and the research is classified as qualitative, which according to Strauss and Corbin (2008), is used in a non-mathematical process of interpretation: data (from sources such as interviews, observations and documents), procedures (which include data reduction, elaboration of categories and definition of the relationship between these categories) and reports (verbal or written).

The characteristics of a research, according to Prodanov and Freitas (2013), vary according to the nature, approach, purposes, technical procedures, sample and data collection instruments. Thus, this research fits into the typologies mentioned in Chart 1, with emphasis on the data collection instruments, which are concerned with controlling the quality of the data and the process used to obtain it.

Chart 1 - Research typology

Feature Type Description	Feature Type Description	Feature Type Description
Kind	Basic	Basic research seeks to generate knowledge for practical application and aimed at solving problems that contain previously defined objectives. These goals can be medium or short term in scope.
Approach	Qualitative	Qualitative research considers that everything can be quantified, which means translating into numbers, opinions and information to classify and analyze them
Purposes	Exploratory	It is exploratory, since it used the use of bibliographic and documentary tools in order to analyze the perspectives and uncertainties of Distance Education in the Amazon Region.
Technical procedures	Bibliographic research	The bibliographic research supported the data collection to satisfy the proposed objectives.
Data collection instruments	Observation	It is concerned with controlling the quality of the data and the process used to obtain it.

Source: Adapted from Prodanov and Freitas (2013), Vergara (2004), Gil (2002), Marconi (2003) and Malhotra (2001).

4. DATA ANALYSIS AND INTERPRETATION

The construction of new knowledge, capable of transforming society with trained managers, is only one of the goals of those who choose this modality. According to Gil (2002), “analysis aims to organize and summarize the data in a way that allows the provision of an answer to the proposed problem”. The interpretation, on the other hand, aims to search for the broader meaning of the answers, which is done through its connection with others previously obtained.

In spite of all the adversities found for the implantation and continuity of the course, having as a direct consequence the students' permanence in the classes, bringing many dropouts along the way, caused sometimes by the paralyzes of the course, sometimes by the distance, the course presented in its final stretch, a rate of achievement in the different centers, considered regular, by DIRED, since it was the first time that there was a distance course, the deadline for its completion was several times postponed.

Such difficulties resulted in a significant percentage of dropouts, as shown in Chart 2, which shows the number of students enrolled by pole. The number of students who completed all 14 subjects of the course is listed below.

In the next column, the number of students who presented the Course Completion Work, and finally the achievement rate by pole.

Chart 2 - Utilization rate by pole

POLOS	Enrolled Students	Concluding Repercurso	Graduating Students	Utilization rate
Porto Velho	48	9	22	46%
Ariquemes	49	5	25	51%
Nova Mamoré	50	1	18	36%
Jí-Paraná	52	7	28	54%
Buritis	17	0	01	6%
Rolim de Moura	49	5	17	35%
Chupinguaia	10	1	02	20%
TOTAL	**275**	**28**	**113**	**47%**

Source: Prepared by the authors based on DIRED data (2019)

It is possible to observe that there was an average of 41% of students who were successful in completing the course. 350 places were offered, and only 113 managed to complete the course. With a keen look, it can be seen that the municipalities of Buritis and Chupinguaia were the ones with the lowest number of graduating students. These two cities are outside of BR 364, a highway that connects the state of Rondônia with the rest of the country, and that in these cities, there are more problems related to the continuous supply of energy and internet connection.

Of the enrolled students, 28 made use of the institutional tool called **Repercurso**, and were included in the list of graduates. Having overcome these barriers, it was then possible to conclude the specialization of the lato sensu course in Municipal Public Management. On the other hand, the course presented as results scientific articles aimed at the better performance of the Management of the Municipalities of Rondônia, works that can easily be implemented, since the researches developed by the students with teaching guidance represent a local reality diagnosed with the search for solutions managerially planned.

5. Final Considerations

The *lato sensu* course in Municipal Public Management was offered in seven municipalities in the state of Rondônia, through DIRED, with face-to-face support, including the capital Porto Velho. 350 vacancies were offered in the distance modality, preferably for civil servants, also counting on vacancies for the

community. Poles municipalities had partnerships with local city halls, and attracted students from adjacent locations.

Initially the students had difficulty and had to adapt to the new modality, and for that, there was a period of adaptation. However, the difficulties encountered throughout the course did not mischaracterized from the pioneering nature of this proposal for the integration of distance learning, and provided the great diversity of the target audience, which, in their majority, are students from distant locations.

From the perspective based on the social, political and economic reality of the society in which they live and operate, a picture of dropouts was presented, which affected the desired levels of success. Allied to this, the failures compromised the permanence of the target audience in the virtual classrooms. To reverse this situation, preventive measures were adopted, aiming to stop evasion, in order to motivate students to rethink their role in the society to which it is inserted. The pedagogical decisions made were to make the student aware of his role as an active subject and an opinion maker. And the conclusion of the course research was worked together with them, which were aligned with their professional profile.

Another difficulty was the lack of continuous internet at the poles. This point is still being analyzed by management, for the next courses, with quality virtual access. Thus, specific objective 1 was successfully achieved, since the difficulties encountered in carrying out the *lato sensu* specialization course were analyzed. From then on, it was possible to verify the rate of success of the course. One hundred and thirteen students completed and defended the Course Conclusion Papers, making up an index of 41% of the total enrolled students. Despite the fact that the result is below expectations, the strategic role played by UNIR, in the municipalities and adjacent region, increased its institutional commitment with regard to raising the levels of success of these courses, together with the Higher Education Systems.

In summary, it is possible to see that the scenario has been transformed, with the innovation of this teaching modality, bringing education closer to the more distant regions and with low demographic density. Therefore, specific objective 2, Verifying if there was a change in the initial scenario with the implementation of the studied course, was positive.

To meet the specific objective 3 to know the results obtained by the course object of study, it was through studies carried out for the elaboration of the Course Conclusion Works, that the proposals for solutions for the involved municipalities were observed bringing change to the initial environment.

Knowing the latent problems and difficulties is important, since from then on, it is possible to see an evolution and improvements in the situation. With updated data, it becomes possible to seek from the Federal and Municipal Government and the private initiative, programs that encourage the change in the realities of these locations, removing obstacles and fostering trends in order to reduce challenges and prospect prospects from postgraduate courses *lato sensu* graduation in the state of Rondônia.

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Analysis of Nursing Team Knowledge About Phlebitis and Its Related Factors

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Abstract

Phlebitis is one of the local complications related to intravenous therapy, which must be managed by the nursing team. This study analyzed the knowledge of the nursing team about phlebitis and its main risk factors, prevention, and control measures. This is a cross-sectional study with a quantitative design carried out with 124 nursing professionals from a Brazilian university hospital. The data collection was carried out between the period of August 2018 to July 2019 for that, the researchers applied a multiple-choice questionnaire. The results showed the equivalence of the three nursing categories in terms of knowledge about phlebitis, however, there was a discrepancy concerning the phlebitis visualization scale, use of warm compresses, dressings, chemical properties of the solutions and factors intrinsic to the patient. The need to implement permanent education among professionals became evident.

Keywords: Intravenous therapy; Nurses' knowledge; risk factors; phlebitis;

1. Introduction

Phlebitis is a local complication of peripheral intravenous (IV) therapy, a technical-scientific process performed by the nursing team, which consists of the insertion of a peripheral venous catheter (PIVIC). Its classification is mostly ordered by visual scales, with Visual Infusion Phlebitis (VIP) being the most commonly used (MILUTINOVIC et al., 2015; GOULART et al., 2020).

There are several risk factors associated with the appearance of phlebitis, such as the duration of PIVIC, gender, the intrinsic characteristics of the patient, as well as the chemical properties of the drugs. According to the main cause, phlebitis can be classified as mechanical, biological, chemical, or post-infusional phlebitis (URBANETTO et al., 2017).

For the Infusion Nurses Society, the phlebitis rate for a given population must be less than or equal to 5% to guarantee harm reduction. Nevertheless, this rate is very variable between countries, and this scenario is also seen among studies of Brazilian institutions with rates of 5%, 25.8%, 31.6%, and 55.6%, showing values much higher than what is considered safe (URBANETTO et al., 2017; YING et al., 2019)

Considering that the nursing team is responsible for the care of peripheral intravenous (IV) therapy, from insertion to maintenance of the PIVIC, it is essential that professionals know and put into practice the

appropriate care, to prevent and reduce adverse events related to the use of peripheral devices and consequently ensure patient safety (HOSSAIN et al., 2016).

Adherence to strategies that enable the reduction of errors during the medication process and the management of peripheral accesses are attitudes that must be considered by those in management positions (WELYCZKO, 2020), such as offering opportunities for continuing education, adequate dimensioning, the purchase of devices that follow the recommended guidelines and even the installation of time protocols for changing the device and choosing the insertion location (MILUTINOVIC et al., 2015).

Knowledge about the appropriate techniques and the early identification of risk factors for the development of phlebitis can considerably reduce hospital stay, expenses with materials and, mainly, reduce the incidence of phlebitis and other complications in the same proportion as it increases patient safety (MILUTINOVIC et al., 2015).

For this reason, this study analyzed the knowledge of the nursing staff of a Brazilian university hospital, using a multiple-choice questionnaire on phlebitis and its main risk factors, prevention, and control measures.

2. Method

A unicentric, quantitative and cross-sectional study was carried out with nursing professionals from three clinics (pneumology, medical clinic, and infectious-parasitic diseases) of a Brazilian University Hospital linked to the Unified Health System (SUS) in Belém-Pará, Brazil, among the period from August 2018 to July 2019.

The sample was chosen by the probabilistic method, the population of 178 nursing professionals from the three clinics was used for the sample calculation, 95% confidence level, and 5% margin of error were considered. Inclusion criteria were (i) age over 18, regardless of gender; (ii) to be an effective civil servant or Consolidated Labor Laws (CLT) employer, and (iii) accept to participate in the study. The exclusion criteria included: professionals on leave or vacation or not working in the three mentioned clinics.

A total of 124 nursing professionals were included in the study, among them 21 nurses, 75 nursing technicians, 14 nursing assistants and 14 did not inform the professional category. The rate of refusal to study was 30%.

Data collection was performed according to the availability of each participant in the three work shifts. The applied questionnaire was adapted from Lanbeck et al., (2004), it contains 13 questions allocated in two domains: characterization of the participants and variables related to phlebitis, its average time of completion was 15 minutes by the participants. The questionnaire was adapted with the inclusion of three questions related to the knowledge of the VIP scale, the correlation of the degree of phlebitis to the manifested signs and symptoms, and the adoption of management measures when phlebitis was identified.

The Epi Info™ software, version 7.2.2.6, was used for descriptive analysis. The descriptive statistics methods used in this study were: measures of central tendency (arithmetic mean) and measures of variability (standard deviation) for numerical variables. To assess the association between epidemiological characteristics and the team's knowledge about phlebitis concerning the professional category, Fisher's exact tests, and the G test were used, according to the specific criteria of each test. The significance level of 5% was used for all work. Statistical analyzes were performed on Bioestat 5.3.

The study met the legal ethical requirements in force in Resolution No. 466/2012 of the National Health Council and was approved by the research ethics committee of the Research Center for Oncology at the Federal University of Pará, under protocol 2.730.246.

3. Results

3.1 Sample characterization

The sample consisted of 124 participants, 21 (16.9%) of whom were nurses, 75 (60.5%) technicians, 14 (11.3%) assistants and 14 (11.3%) did not inform their professional category. The hospital unit that had the largest number of patients was the clinic for infectious and parasitic diseases holding 40.3% of the total sample. Table 1 below shows the main characteristics related to professionals.

Table 1. Sample characterization

Variables	Frequency (n=124)	%
Category		
Nurse	21	16.9
Technician	75	60.5
Assistant	14	11.3
Not reported	14	11.3
Sector		
Medical clinic	44	35.5
Infectious and parasitic diseases	50	40.3
Pneumology	27	21.8
Not reported	3	2.4
Genre		
Feminine	85	68.5
Male	27	21.8
Not reported	12	9.7
Age		
23 to 29	4	3.2
30 to 39	27	21.8
40 to 49	35	28.2
50 to 59	15	12.1

> = 60	2	1.6
Not reported	41	33.1
Years of work experience		
< 1 year	8	6.5
1 to 5	6	4.8
6 to 10	13	10.5
11 to 20	33	26.6
> 20 years	16	12.9
Not reported	48	38.7
Employment bond		
CTL employer	59	47.6
Civil servant	49	39.5
Others	5	4.0
Not reported	11	8.9

Source: collection data, 2018-2019.

Among the professionals, the majority had a formal contract 59 (47.6%), with a predominance of the female gender 85 (68.5), whose ages ranged from 23 to 60 years, with an average mean age of 42.7 years (±8, 43).

The education of the participants was shown in table 2, and revealed that more than 50% of the technicians and assistants answered that they had a college degree; the percentage of specializations (p = 0.0219), master's and doctorate degrees was higher in the nurses' class.

Table 2. Education level by professional category

	Nurse n (%)	Technician n (%)	Auxiliary n (%)	Not reported n (%)	P Value
University graduate					
Yes	20 (95.2)	36 (48)	7 (50)	5 (35.7)	-
Not informed	1 (4.8)	39 (52)	7 (50)	9 (64.3)	
Residency/specialization					
Yes	12 (57.1)	9 (12)	1 (7.1)	0 (0.0)	0.0219*
No	8 (38.1)	26 (34.7)	6 (42.9)	5 (35.7)	
Not informed	1 (4.8)	40 (53.3)	7 (50)	9 (64.3)	
Master					
Yes	5 (23.8)	3 (4.0)	0 (0.0)	1 (7.1)	0.1304
No	15 (71.4)	31 (41.3)	7 (50)	4 (28.6)	
Not informed	1 (4.8)	41 (54.7)	7 (50)	9 (64.3)	
Doctorate					
Yes	1 (4.8)	0 (0.0)	0 (0.0)	0 (0.0)	0.5751
No	19 (90.5)	34 (45.3)	7 (50)	5 (35.7)	

Not informed	1 (4.8)	41 (54.7)	7 (50)	9 (64.3)
Total	**21 (100)**	**75 (100)**	**14 (100)**	**14 (100)**

Source: collection data, 2018-2019. * Statistical significance.

3.2 Knowledge of phlebitis prevention and control measures by professional category

Table 3 related the professional categories to the knowledge of phlebitis prevention and management, practices commonly used by the category in daily work and crucial to mastering this theme.

Table 3. Knowledge of the nursing team in relation to phlebitis prevention and control measures.

	Nurse n (%)	**Technician n (%)**	**Auxiliary n (%)**	**Not informed n (%)**	**P Value**
Knowledge about the VIP Scale					
Yes	4 (19.0)	18 (24)	2 (14.3)	1 (7.1)	0.6101
No	13 (61.9)	37 (49.3)	8 (57.1)	6 (42.9)	
Not informed	4 (19)	20 (26.7)	4 (28.6)	7 (50)	
Correlation of the degree of phlebitis with its signs and symptoms (correct answers)					
0	0(0.0)	4(5.3)	0(0.0)	1(7.1)	1.000
1	1(4.8)	6(8.0)	0(0.0)	0(0.0)	
2	3(14.3)	5(6.7)	2(14.3)	0(0.0)	
3	3(14.3)	9(12.0)	3(21.4)	1(7.1)	
4	0(0.0)	0(0.0)	0(0.0)	1(7.1)	
5	12(57.1)	15(20)	1(7.1)	3(21.4)	
Not informed	1(4.8)	2(2.7)	1(7.1)	0(0.0)	
Not applicable	1(4.8)	34(45.3)	7(50.0)	8(57.1)	
Type of infusion that reduces the risk of phlebitis					
Bolus	5 (23.8)	17 (22.7)	1 (7.1)	1 (7.1)	0.5164
Short term	14 (66.7)	43 (57.3)	8 (57.1)	10 (71.4)	
Not report	0 (0.0)	2 (2.7)	3 (21.4)	1 (7.1)	
Do not know	2 (9.5)	13 (17.3)	2 (14.3)	2 (14.3)	
Infusion speed that reduces the risk of phlebitis					
10 to 15 min	3 (14.3)	9 (12)	1 (7.1)	2 (14.3)	0.3773
16 to 30 min	1 (4.8)	10 (13.3)	2 (14.3)	0 (0.0)	
31 to 60 min	4 (19.0)	18 (24.0)	7 (50)	6 (42.9)	
Greater than 60 min	11 (52.4)	29 (38.7)	3 (21.4)	4 (28.6)	
Not informed	2 (9.5)	9 (12)	1 (7.1)	2 (14.3)	
Dilution of irritating drug to reduce phlebitis risk					
Sterile water					
Yes	7(33.3)	26(34.7)	7(50.0)	9(64.3)	0.5523
No	11(52.4)	35(46.7)	5(35.7)	4(28.6)	
Unwritten	3(14.3)	12(16.0)	2(14.3)	1(7.1)	

Do not know	0(0.0)	2(2.7)	0(0.0)	0(0.0)	
Saline solution					
Yes	6(28.6)	20(26.7)	3(21.4)	1(7.1)	0.8604
No	12(57.1)	41(54.7)	9(64.3)	12(85.7)	
Unwritten	3(14.3)	12(16.0)	2(14.3)	1(7.1)	
Do not know	0(0.0)	2(2.7)	0(0.0)	0(0.0)	
5% glucose					
Yes	3(14.3)	11(14.7)	2(14.3)	2(14.3)	0.9879
No	15(71.4)	50(66.7)	10(71.4)	11(78.6)	
Unwritten	3(14.3)	12(16)	2(14.3)	1(7.1)	
Do not know	0(0.0)	2(2.7)	0(0.0)	0(0.0)	
Conduits					
Warm compress					
Yes	13 (61.9)	45 (60)	13 (92.9)	8 (57.1)	0.0042*
No	7 (33.3)	28 (37.3)	0 (0.0)	4 (28.6)	
Not informed	1 (4.8)	2 (2.7)	1 (7.1)	2 (14.3)	
Cold compress					
Yes	16 (76.2)	53 (70.7)	13 (92.9)	11 (78.6)	0.8651
No	1 (4.8)	2 (2.7)	1 (7.1)	2 (14.3)	
Not informed	4 (19)	20 (26.7)	0 (0.0)	1 (7.1)	
Medicines prescribed for the management of phlebitis					
Yes	6 (28.6)	7 (9.3)	0 (0.0)	2 (14.3)	0.0219*
No	14 (66.7)	66 (88.0)	13 (92.9)	10 (71.4)	
Not informed	1 (4.8)	2 (2.7)	1 (7.1)	2 (14.3)	

Source: collection data, 2018-2019. * Statistical significance.

Limited knowledge was noted regarding the VIP scale and its gradation to phlebitis. An imbalance of knowledge was identified between the categories related to daily practices to reduce the risk of phlebitis, the type of infusion of short duration, and the speed of infusion.

Regarding the conduct, the professionals indicated having some attitude towards phlebitis, with non-pharmacological measures being the most expressive as a warm compress among all classes ($p = 0.0042$). Nevertheless, medication management was disregarded by most professionals ($p = 0.0219$).

3.3 Knowledge of the nursing team regarding the main risk factors for phlebitis

The professionals were asked about the main risk factors related to the patient, the type of material used for infusion, as well as the characteristics of the drugs administered. Table 4 shows these results considering the participant's correct or incorrect.

Table 4. Knowledge of the nursing team regarding risk factors for phlebitis

	Nurse n (%)	Technician n (%)	Auxiliary n (%)	Not informed n (%)	P Value
Duration of catheter stay					
Correct	1(4.8)	1(1.3)	0(0.0)	0(0.0)	0.6466
Incorrect	19(90.5)	70(93.3)	14(100)	14(100)	
Not informed*	1(4.8)	4(5.3)	0(0.0)	0(0.0)	
Skillful vein					
Correct	18(85.7)	59(78.7)	12(85.7)	13(92.9)	0.6642
Incorrect	1(4.8)	8(10.7)	1(7.1)	0(0.0)	
Not informed*	1(4.8)	4(5.3)	0(0.0)	1(7.1)	
Do not know	1(4.8)	4(5.3)	1(7.1)	0(0.0)	
Risk factor (dressing)					
Correct	18(85.7)	33(44.0)	6(42.9)	5(35.7)	0.0042*
Incorrect	2(9.5)	33(44.0)	5(35.7)	8(57.1)	
Not informed	0(0.0)	2(2.7)	1(7.1)	0(0.0)	
Do not know	1(4.8)	7(9.3)	2(14.3)	1(7.1)	
Risk factor for phlebitis performed on the catheter					
Short cateter					
Correct	16(76.2)	59(78.7)	12(85.7)	13(92.9)	0.7817
Incorrect	5(23.8)	16(21.3)	2(14.3)	1(7.1)	
Long cateter					
Correct	3(14.3)	13(17.3)	3(21.4)	2(14.3)	0.8692
Incorrect	18(85.7)	62(82.7)	11(78.6)	12(85.7)	
Large gauge					
Correct	18(85.7)	68(90.7)	14(100)	13(92.9)	0.2307
Incorrect	3(14.3)	7(9.3)	0(0.0)	1(7.1)	
Small gauge					
Correct	6(28.6)	16(21.3)	2(14.3)	5(35.7)	0.6066
Incorrect	15(71.4)	59(78.7)	12(85.7)	9(64.3)	
Plastic cateter					
Correct	6(28.6)	33(44)	6(42.9)	8(57.1)	0.4394
Incorrect	15(71.4)	42(56)	8(57.1)	6(42.9)	
Metal cateter					
Correct	19(90.5)	73(97.3)	14(100)	14(100)	0.3472
Incorrect	2(9.5)	2(2.7)	0(0.0)	0(0.0)	
Risk factor for phlebitis performed at catheter location					
Forearm					
Correct	18(85.7)	58(77.3)	10(71.4)	11(78.6)	0.5777
Incorrect	3(14.3)	17(22.7)	4(28.6)	3(21.4)	

Hand						
	Correct	17(81.0)	64(85.3)	10(71.4)	12(85.7)	0.4919
	Incorrect	4(19.0)	11(14.7)	4(28.6)	2(14.3)	
Wrist						
	Correct	21(100)	73(97.3)	13(92.9)	14(100)	0.5053
	Incorrect	0(0.0)	2(2.7)	1(7.1)	0(0.0)	
Antecubital fossa						
	Correct	21(100)	72(96)	14(100)	13(92.9)	0.428
	Incorrect	0(0.0)	3(4.0)	0(0.0)	1(7.1)	
Factor that increases the risk of phlebitis related to patients						
Male gender						
	Correct	21(100)	74(98.7)	13(92.9)	13(92.9)	0.5006
	Incorrect	0(0.0)	1(1.3)	1(7.1)	1(7.1)	
Female gender						
	Correct	13(61.9)	29(38.7)	5(35.7)	6(42.9)	0.1502
	Incorrect	8(38.1)	46(61.3)	9(64.3)	8(57.1)	
Advanced age						
	Correct	16(76.2)	36(48.0)	8(57.1)	8(57.1)	0.0676
	Incorrect	5(23.8)	39(52.0)	6(42.9)	6(42.9)	
Children						
	Correct	15(71.4)	67(89.3)	11(78.6)	13(92.9)	0.1458
	Incorrect	6(28.6)	8(10.7)	3(21.4)	1(7.1)	
Obesity						
	Correct	15(71.4)	57(76)	10(71.4)	11(78.6)	0.8832
	Incorrect	6(28.6)	18(24)	4(28.6)	3(21.4)	
Malignity						
	Correct	1(4.8)	7(9.3)	2(14.3)	2(14.3)	0.6474
	Incorrect	20(95.2)	68(90.7)	12(85.7)	12(85.7)	
Cachexia						
	Correct	9(42.9)	65(86.7)	11(78.6)	11(78.6)	0.0005*
	Incorrect	12(57.1)	10(13.3)	3(21.4)	3(21.4)	
Rheumatic disease						
	Correct	19(90.5)	73(97.3)	13(92.9)	12(85.7)	0.4757
	Incorrect	2(9.5)	2(2.7)	1(7.1)	2(14.3)	
Alcoholism						
	Correct	18(85.7)	70(93.3)	13(92.9)	13(92.9)	0.6051
	Incorrect	3(14.3)	5(6.7)	1(7.1)	1(7.1)	
Respiratory insufficiency						
	Correct	11(52.4)	32(42.7)	4(28.6)	2(14.3)	0.0885
	Incorrect	10(47.6)	43(57.3)	10(71.4)	12(85.7)	

Immobilization						
	Correct	7(33.3)	9(12.0)	2(14.3)	2(14.3)	0.1056
	Incorrect	14(66.7)	66(88.0)	12(85.7)	12(85.7)	
Arterial failure						
	Correct	19(90.5)	61(81.3)	9(64.3)	12(85.7)	0.1821
	Incorrect	2(9.5)	14(18.7)	5(35.7)	2(14.3)	
Thromboembolism						
	Correct	5(23.8)	41(54.7)	6(42.9)	3(21.4)	0.0393*
	Incorrect	16(76.2)	34(45.3)	8(57.1)	11(78.6)	
Diabete mellitus						
	Correct	8(38.1)	28(37.3)	4(28.6)	9(64.3)	0.809
	Incorrect	13(61.9)	47(62.7)	10(71.4)	5(35.7)	
Infectious disease						
	Correct	14(66.7)	58(77.3)	11(78.6)	14100)	0.6085
	Incorrect	7(33.3)	17(22.7)	3(21.4)	0(0.0)	
Risk factor (drugs)						
High pH						
	Correct	16(76.2)	54(72.0)	10(71.4)	11(78.6)	0.925
	Incorrect	5(23.8)	21(28.0)	4(28.6)	3(21.4)	
Low pH						
	Correct	7(33.3)	1(1.3)	1(7.1)	1(7.1)	0.0004*
	Incorrect	14(66.7)	74(98.7)	13(92.9)	13(92.9)	
High concentration						
	Correct	15(71.4)	55(73.3)	9(64.3)	12(85.7)	0.8009
	Incorrect	6(28.6)	20(26.7)	5(35.7)	2(14.3)	
Low concentration						
	Correct	21(100)	73(97.3)	13(92.9)	14(100)	0.5053
	Incorrect	0(0.0)	2(2.7)	1(7.1)	0(0.0)	
Low osmolarity						
	Correct	1(4.8)	6(8.0)	1(7.1)	0(0.0)	0.8849
	Incorrect	20(95.2)	69(92)	13(92.9)	14(100)	
High osmolarity						
	Correct	13(61.9)	65(86.7)	12(85.7)	12(85.7)	0.584
	Incorrect	8(38.1)	10(13.3)	2(14.3)	2(14.3)	
Warm fluid						
	Correct	21(100)	70(93.3)	13(92.9)	13(92.9)	0.3313
	Incorrect	0(0.0)	5(6.7)	1(7.1)	1(7.1)	
Cold fluid						
	Correct	20(95.2)	73(97.3)	14(100)	14(100)	0.6844
	Incorrect	1(4.8)	2(2.7)	0(0.0)	0(0.0)	

Documentation routine for PIVIC insertion					
Correct	20(95.2)	67(89.3)	12(85.7)	13(92.9)	0.8726
Incorrect	1(4.8)	6(8.0)	1(7.1)	0(0.0)	
Do not know	0(0.0)	2(2.7)	1(7.1)	1(7.1)	

Source: collection data, 2018-2019. * Statistical significance.

Responses regarding the duration of PIVIC's stay were wrong in all categories (> 90%), although they considered using their coverage as a risk factor (p = 0.0042). There was a divergence in the recognition of cachexia as a risk factor between categories (p = 0.0005). Also, it was found that thromboembolism (p = 0.0393) and low pH were not listed by most professionals in the categories as an important risk factor (p = 0.0004) for phlebitis.

4. Discussion

In this study, there was a predominance of females among professionals, which corroborates the profile found in previous studies (SANTOS et al., 2020; BUGS et al., 2017; FURUKAWA et al., 2017; PAULA et al., 2017; MACHADO et al., 2016; SOUZA and TEIXEIRA, 2015). The largest of the participants were nursing technicians, followed by nurses and last nursing assistants, data similar to previous study (SANTOS et al., 2020; MACHADO et al., 2016).

The majority age group was between 40 and 49 years old, it is noteworthy that professionals aged 36 to 50 years are in the full development of their cognitive abilities (MACHADO et al., 2016). The age group above 50 years stands out here, which corresponds to 13.7%, in agreement with the profile of professionals from all over Brazil, which indicates that 14.4% of nursing professionals are over 50 years old (MACHADO et al., 2016).

It was evident that, although more than 50% of nursing technicians and assistants have degrees, most have no specialization, unlike the scenario among nurses. It is worth noting that professional qualification directly influences the level of knowledge about intravenous therapy (LAMSAL et al., 2019), and this perspective is also observed in the studies by Milutinovic et al., (2015).

As for non-pharmacological management, the warm compress was the most cited by the participants (p = 0.0042), and the cold compress also had a high rate of indication. These data demonstrate that there is a divergence in conduct among professionals. Welyczk (2020) argues that warm compress associated with elevation of the limb and administration of medications is effective in pain management, application of heat contributes to the vasodilation of the vessels, reducing symptoms of discomfort and friction of the device in the endothelium (ANNISA et al. , 2017; BARBOSA et al., 2016; WELYCZKO, 2020). While Gauttam and Vati (2016) report similar results between warm or cold compresses, however, cold compresses had immediate effects in reducing signs and symptoms.

Therefore, there is a divergence in the literature and scarcity on the subject so commonly used in clinical practice by nursing. Although effective, the compresses are insufficient to treat phlebitis alone, requiring their association with herbal medicines or other therapeutic modalities, to reduce the risk of progression to thromboembolism (BARBOSA et al., 2016; WELYCZKO, 2020; GOULART et al., 2020; ZHENG et al., 2014).

Even in the absence of statistical significance, it is worth noting the alarming fact that most participants do not know the VIP scale, results similar to the study by Alves et al., (2019). This knowledge is imperative in nursing, as it seeks the early identification of risk factors, classification of phlebitis for proper management, and reduction of complications (INOCÊNCIO et al., 2017).

In Brazil, national recommendations indicate that PIVIC should not be routinely changed in less than 96 hours (BRASIL, 2017). However, the results of this research indicated that professionals follow routine substitutions similar to the results of other studies (LI et al., 2016; YING et al., 2019). Current evidence indicates that the indication for replacement should be supported by clinical evaluation (palpation and inspection) and patient complaints (VENDRAMIM et al., 2019; OH et al., 2020). In this sense, there must be constant updating of professionals in the face of new studies.

Interestingly, the assessment of the dressing as a risk factor for phlebitis was highly considered among professionals ($p = 0.0042$) similar to the studies by Li et al., (2016) and Milutinovic et al., (2015). Recognition of this practice is of paramount importance, as non-sterile and non-transparent coverings favor mechanical and/or infectious phlebitis (SALGUEIRO-OLIVEIRA et al., 2019), although the insertion of the recommended technologies depends on available institutional resources (CORLEY et al., 2019).

The conditions intrinsic to the patient must be previously known by the nursing team for the best handling of the catheter (BITENCOURT et al., 2018). Here, thromboembolism and cachexia were not recognized as a risk factor by most participants, it is believed that these results are linked to empirical factors, since there is a lack of studies on this correlation (LI et al., 2016; ALVES et al., 2015).

Therefore, the perception and ability of nursing to recognize risk factors improves the quality of patient care, as well as reducing complications (WELYCZKO, 2020). In this perspective, knowledge of the pharmacological properties of drugs is a determining factor in increasing vigilance during care. Despite this, most professionals did not recognize this aspect regarding low pH in this study.

It is known that pH and osmolarity increase the risk of chemical phlebitis, especially when administered in a smaller caliber. Thus, it is essential to recognize that adequate hemodilution of these drugs reduces the risk of phlebitis (YING et al., 2019; WELYCZKO, 2020). However, the professionals' lack of knowledge about this variable was also identified in the studies by Li et al., (2016).

The nursing team is primarily responsible for infusional therapy, which requires manual skills, professional competence, and risk identification to plan the best care. Therefore, this care practice must be based on evidence and the updating of the professionals must be permanent for decision-making regarding the management of PIVIC (HOSSAIN et al., 2016; LAMSAL and SHRESTHA, 2019).

The limitations of this study refer to (i) the use of a non-validated questionnaire, (ii) the rate of refusal to study, and (iii) the absence of some answers in the questionnaires, which can induce the occurrence of bias. In addition, literature is scarce in terms of assessing the knowledge of this professional, especially when assessed in the categories of nursing and their skills.

5. Conclusion

Phlebitis is one of the most recurrent complications in intravenous therapy, and its management, prevention, and treatment are under the responsibility of nursing. Our study is relevant, as it was the first to assess the limited knowledge about phlebitis among the different Brazilian nursing categories. Second, it proved to be a clinical practice that was distant from scientific evidence and good care practices for venous therapy by PIVIC, mainly directed at the prevention and management of phlebitis.

Third, the refusal to participate in the study may be related to the fear of making mistakes or a high level of self-confidence. Finally, this study revealed the emergency need for continuing education in the service to improve care. Thus, additional studies are needed on the subject.

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Star Wars - an episode's battle

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Abstract

Mlodinow (2008) proposed a crazy market experiment: to release the same film under two titles: Star Wars: Episode A and Star Wars: Episode B. Their marketing campaigns and distribution schedule are identical except by their titles on trailers and ads. He looks at the first 20,000 moviegoers and record the film they choose to see. He claims it is most probable the lead never changes, and it is 88 times more likely that one of the two films will be int the lead through all 20,000 customers than it is that the lead continuously seesaw. We present a detailed mathematical explanation for Mlodinow claims.

Keywords: misperceptions of randomness; random walk; discrete arc sin law; combinatorial methods;

1. Introduction

Mlodinow (2008) discusses many problems that defy our intuition and common sense. He is interested in mistaken judgments due to misperceptions of randomness or uncertainty. In one of his examples, Mlodinow (2008) proposed a crazy market experiment: to release the same film under two titles: Star Wars: Episode A and Star Wars: Episode B. Their marketing campaigns and distribution schedule are identical except by their titles on trailers and ads. He looks at the first 20,000 moviegoers and record the film they choose to see. To mathematically model his experiment, we are going to use random walks and paths. Combinatorial methods allow us to prove Mlodinow claims: it is most probable that the lead never changes, and 88 times more likely that one of the two films to be in the lead through all 20,000 customers than it is that each film to be in the lead among 10,000 moviegoers. Mlodinow experiment straightly relates

to the classical fictitious gambler Peter, presented by Feller (1957). We combine Feller's (1957, 1968) and Border's (2017) results to prove Mlodinow's (2008) claim. In Border (2017), we have a comprehensive presentation of Feller's (1957, 1968) results. For completeness, we present their proofs.

2. Random walks and paths

A real Rademacher variable $X$is a random variable defined on some probability space which takes the values $+1$ or -1, each with probability $\frac{1}{2}$. That is $X: \Omega \to \{-1,1\}$ such that

$$P(X = +1) = P(X = -1) = \frac{1}{2}.$$

A Rademacher sequence is a sequence $(X_t)$of independent Rademacher random variables. The index t indicates an epoch. The set of epochs is the set E of non-negative integers. The epoch 0 is the moment before any vote.

For each t, we define the cumulative sum

$$S_t = X_1 + \cdots + X_t.$$

We define $S_0 = 0$. The sequence $S_0, S_1, S_2, \dots, S_t, \dots$ is a simple random walk on the integers.

Since the films and their marketing campaigns are the same, we can model the battle mathematically through a random walk. For the t-th viewer we associate a Rademacher variable X_t. If the viewer chooses Episode A, then $X_t = 1$; if the the viewer chooses Episode B, $X_t = -1$. To the sequence (X_t), we associate the random walk $S_0, S_1, S_2, \dots, S_t, \dots$.

2.1 Paths and reachable points

We associate the random walk (S_t) to a polygonal in the plane whose vertices are the points (t, S_t).

Definition 2.1. Let x, y be integers, $x > 0$. A path $s = (s_0, s_1, s_2, s_3, \dots, s_x)$ from the origin to the point (x, y) is the graph of the piecewise linear function whose vertices are (j, s_j), $j = 0,1,2, \dots, x$ satisfying:

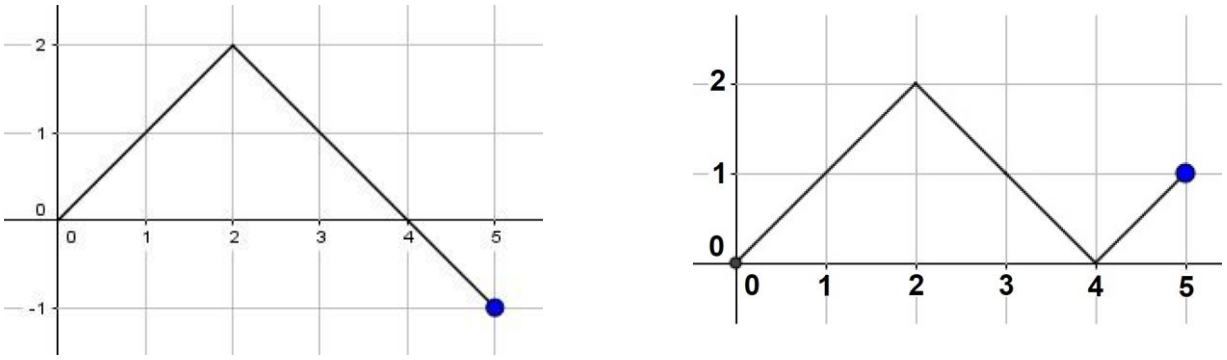
$$s_j - s_{j-1} = \pm 1, \quad s_0 = 0, \quad s_x = y. \tag{1}$$

When we associate the random walk (S_t) with a path s, with $s_j = X_j$, we have a geometric representation of the battle between the episodes. In (1), we have

$$s_j - s_{j-1} = X_j = \pm 1, \qquad \text{for } j = 1,2, \dots, x$$

If the j-th vote was for episode A, we have $X_j = +1$; if it was for episode B, we have $X_j = -1$. The abscissa of the endpoint of a path represents the total number of votes (remembering that each person votes in one of the two episodes). If the partial sum $s_k = X_1 + X_2 + \cdots + X_k$ is positive, the partial result up to the k-th vote indicates the victory of episode A. When it is negative, it indicates the victory of episode B. In Figure 1, five viewers voted. In Figure 1(a), three viewers viewers chose episode A and two, B. In Figure 1(b),

two viewers chose episode A and three, B.



(a) (b)

Figure 1. Five viewers vote.

Suppose that at the end of the vote, a viewers chose episode A and b, episode B, we have $x = a + b$ and $s_x = a - b$. If x is positive, A wins the contest. If the sum is negative, B wins. Any sequence of votes given to the episodes corresponds to a path and vice versa. Whenever the path is above the x-axis, it means that A has more cumulated votes than B. Similarly, in case B is winning, the polygonal will be below the x-axis. Thus, Episode A is in the lead as long as the polyline is above the x-axis. When it is below the x-axis, B is in the lead . A tie occurs when the polyline touches the x-axis. The cumulated sum of votes for each episode equals zero. That is, each episode received the same amount of votes. In this case, there has not yet been a change in the leading position. We assume that episode A is in the lead until time t if $S_t > 0$ or $S_t = 0$ and $S_{t-1} > 0$. Similarly, episode B is in the lead until time t if $S_t < 0$ or $S_t = 0$ and $S_{t-1} < 0$. That is, in the event of a tie, the episode that was ahead in the penultimate epoch is the lead.

When $s_t = k$, for $k \in \mathbb{Z}$, we say that the path s visits k at epoch t. If there is a path s such that $s_t = k$, we say that path s reaches the point (t, k) or that the point (t, k) is reachable from the origin.

The Proposition 2.1 tells us which points on the plane belonging to $E \times \mathbb{Z}$ are reachable.

Proposition 2.1 (Border (2017))**.** For the point (t, k) to be reachable, there must be non-negative integers a and b, such that

$$\begin{cases} a + b = t \\ a - b = k \end{cases} . \tag{2}$$

Note that not every point in the plan is reachable. For example, the point $(5,4)$ is not reachable. In fact, for $(t, k) = (5,4)$, the system has no solution (a, b) with a and b non-negative integers. That is, episode A cannot win by four votes if there are only five viewers.

Corollary 2.1. If $(t, k) \in E \times \mathbb{Z}$ is reachable, then the coordinates t and k have the same parity. Also,

$t \geq |k|$.

Proof. Let (t,k) be reachable. As $t \in E$, there are two possibilities for t:

1. $t$is even. That is, $t = 2v$ for some $v \in E$. We know by Proposition 2.1 that there is an non-negative integer solution of (2):

$$2v = a + b \qquad \text{and} \qquad k = a - b$$

Then $k = 2(a - v) = 2(v - b)$. Therefore, if t is even, k must also be even so that (2) has a non-negative integer solution. In this case

$$a = \frac{t+k}{2} \qquad \text{e} \qquad b = \frac{t-k}{2}.$$

2. t is odd. That is, $t = 2v + 1$ for some $v \in E$. Similarly, by Proposition 2.1, there is a non-negative integer solution (a,b) of (2). Then $k = 2(a - v) - 1 = 2(v - b) + 1$. Therefore, if t is odd, k must also be odd so that (2) has a non-negative integer solution. Again

$$a = \frac{t+k}{2} \qquad \text{e} \qquad b = \frac{t-k}{2}.$$

Since $t = a + b, a, b \geq 0$ and $k = a - b$, we have $|k| = |a - b| \leq max\{a, b\} \leq t$.

Definition 2.2. $N_{t,k}$ denotes the number of paths from origin to a point (t,k). If (t,k) is not reachable, then $N_{t,k} = 0$.

In Proposition 2.2, we calculate the number of different votes cast by t spectators ending with $S_t = k$.

Proposition 2.2 (Feller (1968))**.** If (t,k) is an achievable point, then

$$\mathrm{N}_{t,k} = \binom{t}{\frac{t+k}{2}} = \binom{t}{\frac{t-k}{2}}. \tag{3}$$

Proof. Since (t,k) is a reachable point, by Proposition 2.1, there are non-negative integers a and b that satisfy (2). Episode A received a votes. That is, a is the number of times $+1$ has occurred; b is the number of times -1 appears. When voting, $+1$ and -1 can appear in any order. That is, we have a permutation with repetition of $t = a + b$. Thus:

$$\mathrm{N}_{t,k} = \frac{(a+b)!}{a!b!} = \binom{a+b}{a} = \binom{a+b}{b} = \binom{t}{\frac{t+k}{2}} = \binom{t}{\frac{t-k}{2}}.$$

So there are precisely $N_{t,k}$ different paths from the origin to the point (t,k) corresponding to the possible votes during the contest.

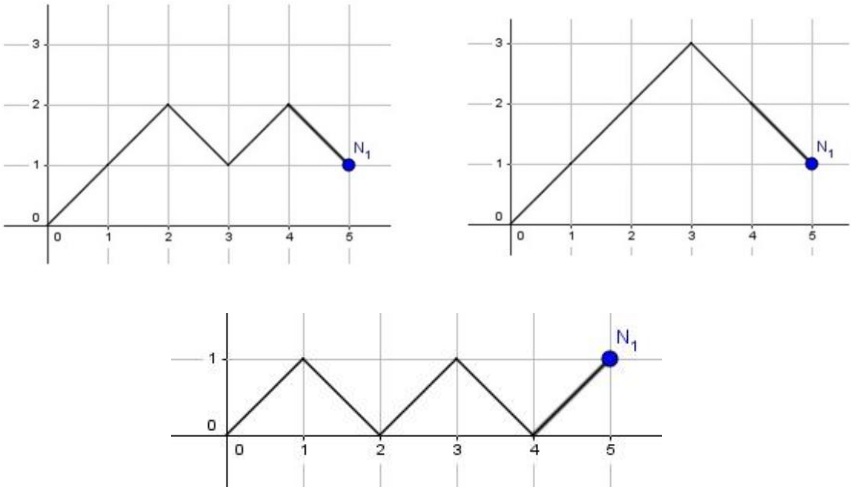


Figure 2. Episode A wins by one vote.

Figure 2 illustrates three scenarios of the episode A winning by one vote when five viewers voted. That is $(t,k)=(t,S_t)=(5,1)$. Ten different paths connect the origin to the point $(5,1)$.

On a path from origin to (t,k), We shall refer to t as the length of the path. For t, if we let k vary in (t,k), there are 2^t paths of length t. In fact, for each spectator's vote, there are two possible choices. By the multiplicative principle, after t votes, we obtain one of the 2^t possible paths. All paths are equally likely.

The event "at epoch t the vote difference between episodes is k" will be denoted by $\{S_t=k\}$. For its probability $P(S_t=k)$, we write $p_{t,k}$.

Corollary 2.2. If (t,k) is a reachable point, then

$$p_{t,k}=\binom{t}{\frac{t+k}{2}}\cdot 2^{-t}. \tag{4}$$

2.1.1 Special paths

We remember that episode A is in the lead until epoch t if $S_t>0$ or $S_t=0$ and $S_{t-1}>0$. Similarly, episode B is in the lead until epoch t if $S_t<0$ or $S_t=0$ and $S_{t-1}<0$. That is, in the event of a tie, the episode that was ahead in the penultimate epoch is in the lead.

- Let Z_t be the set of paths in which the two episodes received the same amount of votes. That is, the set of paths s where $s_t=0$.
- Let P_t be the set of paths in which episode A has always been in the lead, and there has never been a tie. That is, the set of paths s that satisfy $s_1>0,\dots,s_t>0$.
- Let N_t be the set of paths in which episode A has always been in the lead. That is, the set of paths s that satisfy $s_1\geq 0,\dots,s_t\geq 0$.

We now show some useful relationships between the sets Z_t, P_t and N_t.

Lemma 2.1 (Border (2017))**.** There is a one-to-one correspondence between P_{2m} and N_{2m-1}.
Proof. For all path s of P_{2m}, the first vote was for Episode A. In fact, as $s_1 > 0$, path s passes through (1,1). In addition, we also have $s_j \geq 1$ for $j = 1, \ldots, 2m$, because in P_{2m}, all partial sums are positive.

Let us consider point (1,1) as the new origin of the Cartesian plane (Figure 3).

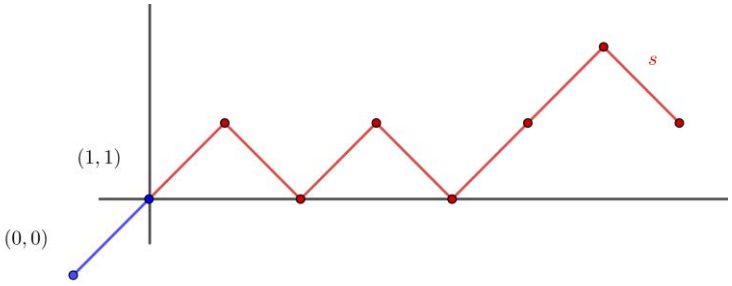


Figure 3. Path s.

In this way, we create a path s' of length $2m-1$ from s (Figure 4). The first vote was counted, $2m-1$ are left. Precisely, $s' = (s_0', s_1', \ldots, s_{2m-1}') = (s_1 - 1, s_2 - 1, \ldots, s_{2m} - 1)$. Thus, $s' \in N_{2m-1}$.

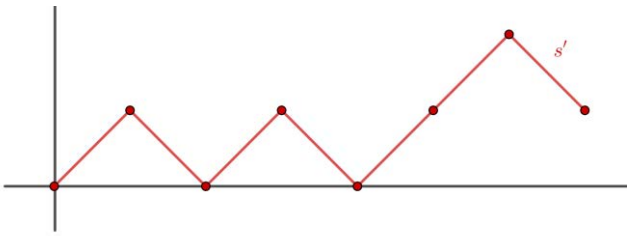


Figure 4. Path s'.

Similarly, with each s' in N_{2m-1}, we can always associate a single path $s \in P_{2m}$.
Lemma 2.2 (Nelson's lemma)**.** There is a one-to-one correspondence between Z_{2m} and N_{2m}. Furthermore, each path in Z_{2m} that has a minimum value of $-k$, corresponds to a path in N_{2m} that ends in $(2m, 2k)$.

Proof. (Border (2017)) To prove the lemma, we indicate how to build a bijective function $F: Z_{2m} \to N_{2m}$. Consider a path s in Z_{2m}. Since $s_{2m} = 0$, there is necessarily $j$such that $s_j \leq 0$. At some point $t \leq 2m$, it assumes a minimum value $-\hat{k} \leq 0$. Possibly $-\hat{k}$ is assumed more than once. Let $\hat{t}$ be the smallest t for which $s_t = -\hat{k}$.
Note that if the path s is already an element of N_{2m}, we have $s_t \geq 0$ for $t = 0, \ldots, 2m$. Consequently, $\hat{k} = 0$ and $\hat{t} = 0$. In this case, we define $F(s) = s$. If s does not belong to N_{2m}, we necessarily have $s_t < 0$ for some $0 < t < 2m$. Then, $\hat{k} > 0$ and $0 < \hat{t} < 2m$ (Figure 5).

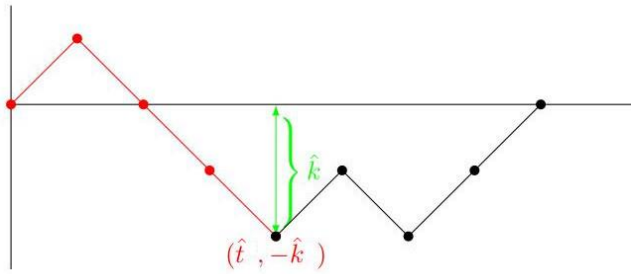


Figure 5. s does not belong to N_{2m}

To get a path s' in N_{2m}, we proceed as follows (see Figure 6):

- Take the section of path s from $(0,0)$ to $(\hat{t}, -\hat{k})$.
- Reflect this section over the vertical line $t = \hat{t}$.
- Slide the reflected section until the old endpoint $(\hat{t}, -\hat{k})$ coincides with the point $(2m, 0)$.
- Consider $(\hat{t}, -\hat{k})$ as the new origin of the Cartesian plane.

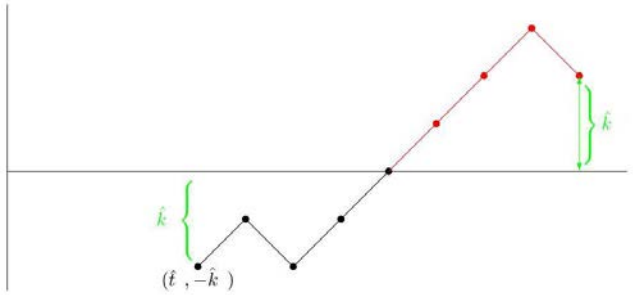


Figure 6. Path s' .

The path s' belongs to N_{2m}, and we define $s' = F(s)$ (see Figure 7).

$$s' = \left(s_{\hat{t}} + \hat{k}, s_{\hat{t}+1} + \hat{k}, \dots, s_{2m} + \hat{k}, s_{\hat{t}-1} + 2\hat{k}, \dots, s_1 + 2\hat{k}, 2\hat{k}\right).$$

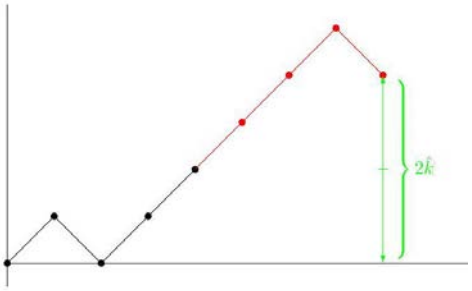


Figure 7. Path s' .

We now show that F is invertible: let s be a path in N_{2m}. If $s_{2m} = 0$, we have $F^{-1}(s) = s$. If $s_{2m} > 0$, we know from Corollary 2.1 that s_{2m} is even. That is, $s_{2m} = 2\overline{k}$, for some integer $\overline{k} > 0$. Consider $\overline{t}$ the last

epoch when $s_t = \overline{k}$ (see Figure 8)

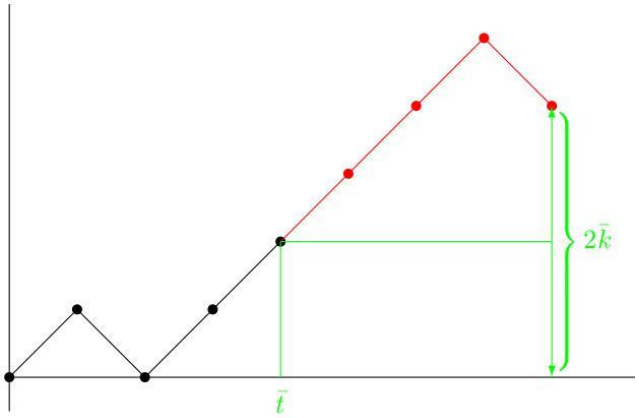
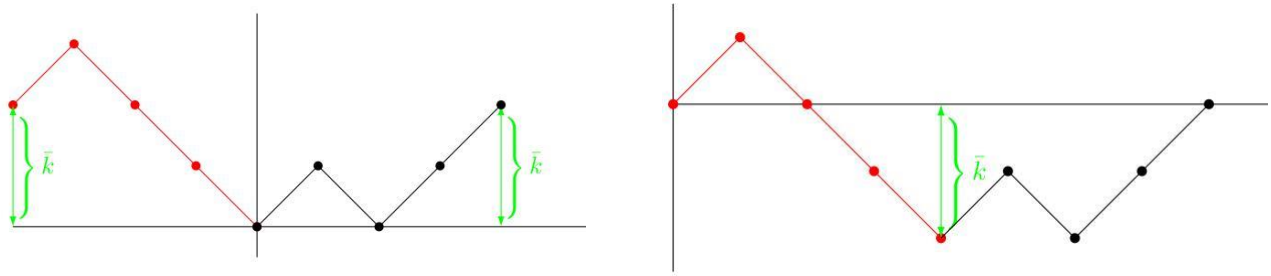


Figure 8. Last epoch when $s_t = \overline{k}$.

To get a path s' in Z_{2m}, we proceed as follows:

- Take the section of path s that runs from $(\overline{t}, \overline{k})$ to $(2m, 2\overline{k})$.
- Reflect this section over the vertical line $t = \overline{t}$.
- Slide the reflected section until the old endpoint $(\overline{t}, \overline{k})$ matches the origin (see Figure 9(a)).
- Consider the starting point as the new origin of the Cartesian plane (see Figure 9(b)).



(a) (b)

Figure 9. The path $s' = F^{-1}(s)$.

The path s' belongs to Z_{2m}:

$$s' = \left(s_{2m} - 2\overline{k}, s_{2m-1} - 2\overline{k}, \ldots, s_{\overline{t}} - 2\overline{k}, s_1 - \overline{k}, \ldots, s_{\overline{t}-1} - \overline{k}, 0\right).$$

The procedure described for s' construction reverses that described in the definition of F. Thus thre is a one by one correspondence between Z_{2m} and N_{2m}.

2.1.2 Special events

Let's calculate the probability of some events of interest in the episode battle:

- $H = \{S_{2m} = 0\}$, when both episodes received the same amount of votes.

- $H = \{S_1 \geq 0, \dots, S_{2m} \geq 0\}$, episode A has always been in the lead.
- $H = \{S_1 \leq 0, \dots, S_{2m} \leq 0\}$, episode B has always been in the lead.

Lemma 2.3. The odds are identical:

$$P(S_{2m} = 0), \tag{5}$$

$$P(S_1 \geq 0, \dots, S_{2m} \geq 0), \tag{6}$$

$$P(S_1 \leq 0, \dots, S_{2m} \leq 0). \tag{7}$$

Proof. (Border (2017)) Note that all the events mentioned can be associated with paths of length $2m$. To calculate the probability $P(H)$ of an event H related to paths of length $2m$, it is necessary to determine the number of paths associated with event H and divide by 2^{2m}.

The probability in (6) is associated with the situation in which Episode A always wins. Draws can occur, but A is still in the lead, as there is no $S_t < 0$. The associated path does not cross the x-axis. Thus, there is no change in lead. In probability (7), it is the same situation, but the one who always wins is B. In both cases, by symmetry[1], the sets have the same cardinality. That is

$$|\{s, s_1 \geq 0, \dots, s_{2m} \geq 0\}| = |\{s, s_1 \leq 0, \dots, s_{2m} \leq 0\}|.$$

Therefore, $P(S_1 \geq 0, \dots, S_{2m} \geq 0) = P(S_1 \leq 0, \dots, S_{2m} \leq 0)$.
To conclude the lemma's proof, we show that the probabilities in (5) and (6) are equal. By Nelson's lemma (Lemma 2.2), we have $|Z_{2m}| = |N_{2m}|$. So $P(S_{2m} = 0) = P(S_1 \geq 0, \dots, S_{2m} \geq 0)$.

3. Draws

We want to know if there was a change in the lead in the battle between the episodes. Thus, it is necessary to count the number of times that the associated paths crossed the x-axis. First, it is required to count how many times they have touched the mentioned axis. We now study the paths that connect the origin to an N point on the x-axis.

Definition 3.1 (Returns to zero)**.** When a path touches the x-axis, we say it returns to zero or the origin. In this case, $s_t = 0$ for some time t.

To return to the origin, the episodes must receive the same amount of votes. It follows from Corollary 2.1 that t is even. Consider $t = 2n$. The number of paths from the origin to $(2n, 0)$ is $N_{2n,0}$, so by Corollary 2.2, the probability u_{2n} of a path of length $2n$ ending at the point $(2n, 0)$ is given by:

$$u_{2n} = \binom{2n}{n} \cdot 2^{-2n}, \tag{8}$$

u_{2n} is the probability of a tie at epoch $t = 2n$.

[1] Just define $F: \{s, s_1 \geq 0, \dots, s_{2m} \geq 0\} \to \{s, s_1 \leq 0, \dots, s_{2m} \leq 0\}$, $F(s) = -s$.

Definition 3.2 (First return to zero)**.** The first return to zero occurs when a path touches the x-axis at the epoch $2m$ and$s_1 \neq 0, s_2 \neq 0, \dots, s_{2m-1} \neq 0$. We denote by f_{2m} the probability of occurring the first return to zero in the epoch $2m$. That is,

$$f_{2m} = P(S_1 \neq 0, S_2 \neq 0, \dots, S_{2m-1} \neq 0, S_{2m} = 0).$$

Lemma 3.1 (Border (2017))**.** An explicit formula for f_{2m} is

$$f_{2m} = u_{2m-2} - u_{2m} = \frac{1}{2m-1} u_{2m} = \frac{1}{2m-1}\binom{2m}{m}\frac{1}{2^{2m}}. \tag{9}$$

Proof. As $2m-1$ is odd, by Corollary 2.1, we necessarily have $s_{2m-1} \neq 0$. So we can write the first return event at the epoch $2m$ as $\{S_1 \neq 0, S_2 \neq 0, \dots, S_{2m-2} \neq 0, S_{2m} = 0\}$. The paths associated with this event belong to the difference between two sets: of events in which s_t never vanishes until epoch $2m-2$ minus the events in which s_t never vanishes until epoch $2m$. That is,

$$\{s, s_1 \neq 0, s_2 \neq 0, \dots, s_{2m-2} \neq 0, s_{2m} = 0\} = \{s, s_1 \neq 0, s_2 \neq 0, \dots, s_{2m-2} \neq 0\} \setminus \{s, s_1 \neq 0, s_2 \neq 0, \dots, s_{2m} \neq 0\}.$$

Note that for paths of length $2m$, we have

$$\{s, s_1 \neq 0, s_2 \neq 0, \dots, s_{2m} \neq 0\} \subset \{s, s_1 \neq 0, s_2 \neq 0, \dots, s_{2m-2} \neq 0\}.$$

Besides, the number of paths of length $2m$ such that $s_1 \neq 0, s_2 \neq 0, \dots, s_{2m-2} \neq 0$ is equal to four times the amount of paths of length $2m-2$ such that $s_1 \neq 0, s_2 \neq 0, \dots, s_{2m-2} \neq 0$.

By Lemma 2.3, for $\Delta = P\big((S_1 \neq 0, S_2 \neq 0, \dots, S_{2m-2} \neq 0) \setminus (S_1 \neq 0, S_2 \neq 0, \dots, S_{2m} \neq 0)\big)$, we have

$$\Delta = \frac{4 \cdot |\{s, s_1 \neq 0, s_2 \neq 0, \dots, s_{2m-2} \neq 0\}| - |\{s, s_1 \neq 0, s_2 \neq 0, \dots, s_{2m} \neq 0\}|}{2^{2m}} = u_{2m-2} - u_{2m}$$

By (8), we have

$$u_{2m-2} - u_{2m} = \binom{2m-2}{m-1} \cdot 2^{-2(m-1)} - 2^{-2m} = \frac{1}{2m-1}\binom{2m}{m}\frac{1}{2^{2m}}.$$

We can also obtain a recursive formula for the return to zero involving the first returns.

Corollary 3.1 (Feller (1968))**.** For $m \geq 1$, we have

$$u_{2m} = \sum f_{2r}\, u_{2m-2r}. \tag{10}$$

Proof. If a return to the origin occurs in the epoch $2m$, then the first return to zero occurs in an epoch $2r \leq 2m$. Every such path s has a section of length $2m$ where $s_1 \neq 0, s_2 \neq 0, \dots, s_{2r-1} \neq 0$ and a section of length $2m-2r$ where$s_1 \neq 0, s_2 \neq 0, \dots, s_{2r-1} \neq 0$. Therefore, the number of paths of length $2m$ from the origin to the point $(2m, 0)$, whose first return to zero happened at the point $(2r, 0)$ is given by

$$2^{2r} \cdot f_{2r} \cdot 2^{2m-2r} \cdot u_{2m-2r}.$$

Adding over r, we get (10).

4. In the lead

It is important to note that the analysis made by Feller (1957) and adapted by Mlodinow (2008) for the battle of episodes is not interested in uninterrupted leads, but in studying how long an episode is in the lead. In the Figures, each episode remained half the time in the lead.

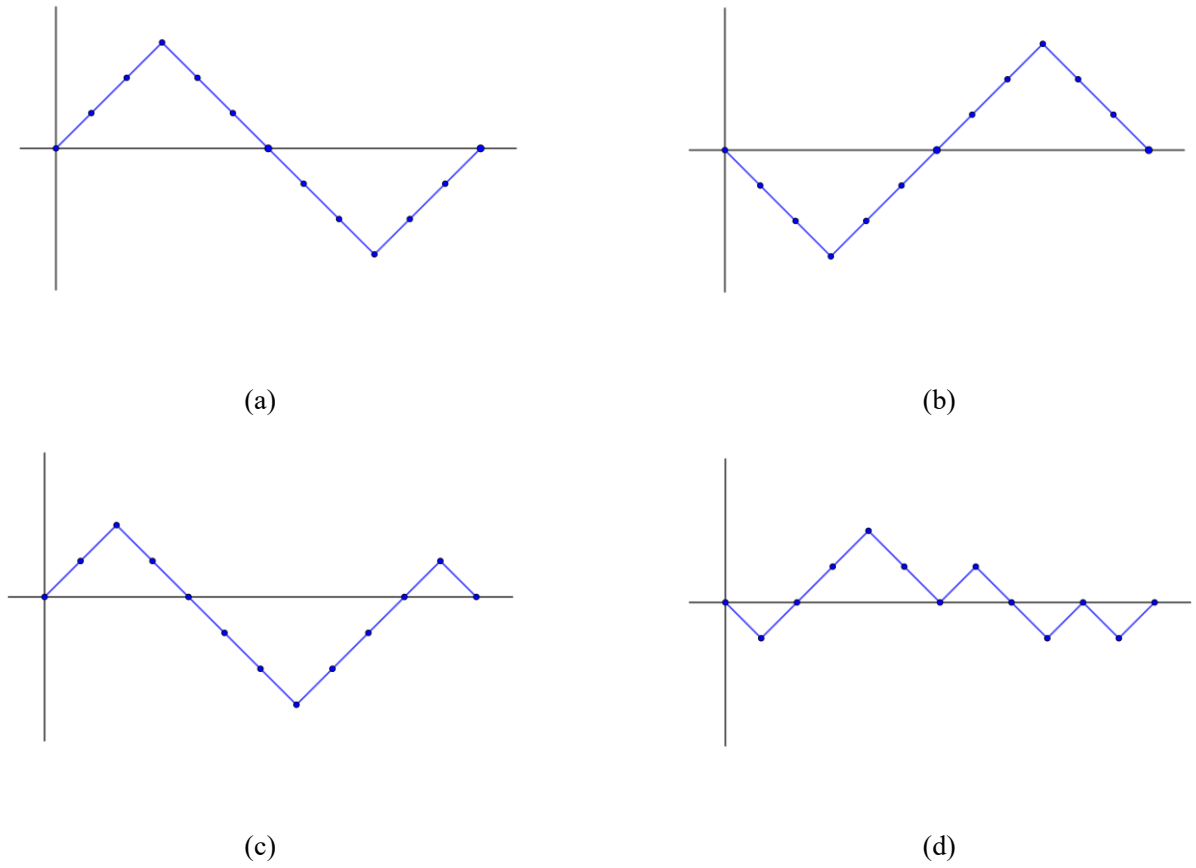


Figure 10. Half the time in the lead

Our intuition leads us to believe that in the contest between the episodes, each of them would stay about half the time in the lead, and frequent changes do not occur. However, as the following result shows, our intuition played a trick with us. The next theorem analyzes the fraction of the total time that a path remains above the x-axis. That is, the probability of episode A to stay in the lead over a fraction of the total votes. Fractions close to 1 are the least likely.

Theorem 4.1. Let $\alpha_{2k,2n}$ be the probability that during the interval from 0 to $2n$, episode A remains for 2k votes in the lead, and episode B remains for $2n-2k$ votes in the lead. So

$$\alpha_{2k,2n} = u_{2k}u_{2n-2k}, \qquad k = 0,1,\dots,n. \tag{11}$$

Proof (Feller (1957)). We prove by induction on n. First, let's deduce a recursive expression for $\alpha_{2k,2n}$, with $1 \le k \le n-1$, which also involves probabilities of first return to zero. If episode A remains for $2k$

votes in the lead and episode B remains for $2n-2k$ votes in the lead, there is a tie at some point. Let $2r$ be the time when the first return to zero occurred. As $1 \le k \le n-1$, we have $2r < 2n$. That is, the first tie must take place before the voting ends. Otherwise, only one episode would remain in the lead at all times. Thus, as the first tie takes place in epoch $2r$, the path s associated with the contest of the episodes belongs to one of two classes:

- In the first class, episode A led the entire range from 0 to $2r$.
- In the second class, episode B led the entire range from 0 to $2r$.

In the first class, we necessarily have $r \le k \le n-1$, and in the section of the path s after $(2r, 0)$, episode A remains in the lead by exactly $2k-2r$ more votes. Let's calculate how many paths of length $2n$ there are in the first class. Note that we have $2^{2r} \cdot f_{2r}$ paths of length $2r$, whose first return occurs at the time $2r$. By symmetry, in half of them, episode A leads all the time. Also, there are $2^{2n-2r} \cdot \alpha_{2k-2r,2n-2r}$ paths of length $2n-2r$ in which episode A remains for $2k-2r$ votes in the lead. Consequently, the total number of paths of length $2n$ in the first class is given

$$\frac{1}{2} \cdot 2^{2r} \cdot f_{2r} \cdot 2^{2n-2r} \cdot \alpha_{2k-2r,2n-2r} = \frac{1}{2} \cdot 2^{2n} \cdot f_{2r} \cdot \alpha_{2k-2r,2n-2r}.$$

On each of these paths, episode A remains for $2k$ votes in the lead. Therefore, episode B remains for $2n-2k$ votes in the lead.

In the second class, episode B led until season $2r$. By an analogous argument, we have $k \le n-r$, and the total number of paths of length $2n$ in the second class is given by

$$\frac{1}{2} \cdot 2^{2r} \cdot f_{2r} 2^{2n-2r} \cdot \alpha_{2k,2n-2r} = \frac{1}{2} \cdot 2^{2n} \cdot f_{2r} \cdot \alpha_{2k,2n-2r}.$$

On each of these paths, episode A remains for $2k$ votes in the lead. Therefore, episode B remains for $2n-2k$ votes in the lead.

Note that the classes are disjoint with each other and are also disjoint with the classes corresponding to different values of r. Thus,

$$\alpha_{2k,2n} = \tfrac{1}{2}\sum f_{2r} \cdot \alpha_{2k-2r,2n-2r} + \tfrac{1}{2}\sum f_{2r} \cdot \alpha_{2k,2n-2r}. \quad (12)$$

Let us now prove (11), by induction on n. For $n=1$, we only have two possible values for k: $k=0$ or $k=1$. According to Lemma 2.3, the odds are the same for episode A remain in the lead throughout the interval from 0 to $2n$ and for that both episodes receive the same amount of votes until the $2n$ season. So, using (8), we get

$$P(S_1 \geq 0, \dots, S_{2m} \geq 0) = P(S_{2m} = 0) = u_{2n} = \binom{2n}{n} \cdot 2^{-2n}.$$

Therefore, $\alpha_{2n,2n} = u_{2n}u_0 = u_{2n}$. Similarly, using (7) from Lemma 2.3, we obtain $\alpha_{0,2n} = u_0 u_{2n} = u_{2n}$. That is, each episode is just as likely to remain in the lead for the entire 0 to $2n$ interval. Thus, (11) is verified for $n = 1$.

Our induction hypothesis is

$$\alpha_{2k,2v} = u_{2k}u_{2v-2k}, \qquad v = 1,2, \dots, n-1, \qquad k = 0,1, \dots, n-1.$$

Note that in the first summation in (12), we have $n - k \leq n - r \leq n - 1$. In the second summation, $k \leq n - r \leq n - 1$. Using the induction hypothesis in (12), we obtain

$$\alpha_{2k,2n} = \frac{1}{2}\sum f_{2r} \cdot \alpha_{2k-2r,2n-2r} + \frac{1}{2}\sum f_{2r} \cdot \alpha_{2k,2n-2r}$$

$$\alpha_{2k,2n} = \frac{1}{2}\sum f_{2r} \cdot u_{2k-2r}u_{2n-2k} + \frac{1}{2}\sum f_{2r} \cdot u_{2k}u_{2n-2r-2k}$$

$$\alpha_{2k,2n} = \frac{1}{2} \cdot u_{2n-2k}\sum f_{2r} \cdot u_{2k-2r} + \frac{1}{2} \cdot u_{2k}\sum f_{2r} \cdot u_{2n-2r-2k}.$$

By (10),

$$\alpha_{2k,2n} = \tfrac{1}{2} \cdot u_{2n-2k}u_{2k} + \tfrac{1}{2} \cdot u_{2k}u_{2n-2k} = u_{2k}u_{2n-2k}.$$

We use Theorem 4.1 to determine the probability of episode A to be in the lead over a fraction of the total votes. $2k$ is the number of votes over which episode A remains in the lead. We remember that

$$u_{2n} = \binom{2n}{n} \cdot 2^{-2n}.$$

Let $2n = 20.000$ and $k = 0$, that is, episode A will never take the lead. Substituting in formula (11), we have

$$\alpha_{0;20,000} = \frac{20{,}000!}{10{,}000! \cdot 10{,}000!} \cdot \frac{1}{2^{20,000}} = \frac{20{,}000!}{(10{,}000!)^2 \cdot 2^{20,000}}.$$

For $2k = 10{,}000$, both films remain in the lead for the same period,

$$\alpha_{10,000;10,000} = \frac{(10{,}000!)^2}{(5{,}000!)^4 \cdot 2^{20,000}}$$

To verify[2] that one probability is about 88 times greater than the other:

$$\frac{20{,}000!}{(10{,}000!)^2 \cdot 2^{20,000}} \div \frac{(10{,}000!)^2}{(5{,}000!)^4 \cdot 2^{20,000}} = 20{,}000! \cdot \left(\frac{5{,}000!}{10{,}000!}\right)^4 \simeq 8{,}8625 \cdot 10 = 88{,}625.$$

The probability that one of the films will remain in the lead for the entire period of the choice of 20,000 viewers is almost 88 times greater than that of having equal lead times for both films.

[2] We calculate factorials by https://www.calculatorsoup.com/calculators/discretemathematics/factorials.php.

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Extractive Reserves and Public Policies Intended to The Traditional Peoples and Communities of Brazilian Amazon

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Abstract

This study aims to analyze, by means of a bibliographic and documentary research, the public policies developed in the Extractive Reserves (RESEX[1]) of Brazilian Amazon, with a primary focus on Educational and Health Policies and Agrarian Reform. The main theoretical and methodological framework was based

[1] For the purpose of greater clarity, fluid reading and facilitated search, acronyms have been kept in their original language, while proper names, Plans and Organs have been translated by the authors of this paper.

on literature exploration, and followed by data collection, on books, official documents, articles, theses and dissertations dealing with the proposed theme. Subsequently, data analysis and textual production were performed. Results reveal that, despite recent improvements, Brazil still presents unbalanced distribution of its wealth when considering the rural and forest populations, especially in terms of constitutional rights such as territoriality, health and education, which stem from bureaucratic decisions disregarding the knowledge of traditional peoples and communities.

Keywords: RESEX; Public policy; Traditional Communities.

1. Introduction

This paper aims to analyze the public policies that are developed in the Extractive Reserves (RESEX) for the traditional peoples and communities of Brazilian Amazon by means of a bibliographic and documentary review.

Economic inequalities are one of the major issues that impact the most diverse sectors of the Brazilian society, notably the social sector. This fact accounts for the importance of constant revisiting and ressignifying such reality by means of the available literature and contributing with elements that may produce effective indicators and alternatives to minimize poverty and social exclusion, in particular, those arising from precarious income distribution, concentration of land in the hands of a few and absence of public policies that embrace communities and municipalities in less favored regions, as in the case of Brazilian Amazon.

We chose to start by carrying out a brief historical contextualization in order to apprehend how the first public policies emerged – the public policies presented in this work involve the Agrarian Reform, Educational and Health Policies –, and their connection to the creation of Extractive Reserves (RESEX) in Brazil. It is worthwhile emphasizing that the purpose of this study is not to focus on one specific extractive reserve, but on Extractive Reserves as a set of public policies. Sequentially, some analytical reasoning evolves as theorists bring the discussion closer to social issues and affirmative actions with regard to socio-environmental issues related to public policies.

Since the beginning of the colonization process by the Portuguese in Brazil, there was an evident denial of any knowledge held by the colonized indigenous people. This unfriendly and disproportionate interaction took place in a harsh environment permeated by violence, domination, conflicts and many territorial disputes besides the appropriation of natural resources, especially within the Brazilian Amazon region. Additionally, the colonizers had slavery as their basic convenience, supported by the Eurocentrism that has oriented their exploitation mode (Castro, 2015).

Furthermore, "[...] the memory registered in the documents does not reach the warlike dimension of the Brazilian territorial occupation" (Castro, 2015, p. 19). An example of such assertion may be found during the rubber cycle, a conspicuously violent process – a rather common practice at that time, adopted as a way to coerce and guarantee high productivity in the extractive the work in order to meet the demands of the market at the time.

Amidst this conjuncture characterized by violence, provoked by the belief in a predatory development,

based on the unbridled expansion of livestock, Extractive Reserves emerge, due to resistance actions taken from traditional populations, who defended the sustainable use of natural resources. Castro (2015, p. 18) states that "[...] history reveals essential dimensions for understanding how the processes of domination and resistance took place – movements which have always been present in the history of Brazil".

The importance of Extractive Reserves is not only justified by its productive and conservationist nature, but also by the socioenvironmental issues it involves in the most diverse Brazilian territories, therefore it also permeates the context of the struggles and resistance of the people living in and from the forest resources. This aspect is very clear in Art. 18 of Law 9,985 / 2000, where it defines an Extractive Reserve as:

> [...] an area used by traditional extractivist populations, whose subsistence is based on extraction and, on a complementary basis, on subsistence agriculture and small animal breeding, and aims to protect these populations' livelihoods and culture, and to ensure the sustainable use of the unit's natural resources (Brasil, 2008).

The episodes of the second half of the eighties were decisive and important role should be given to the increased popularity and political projection of Chico Mendes and the environmental movement, his assassination, the new Federal Constitution of Brazil (1988), and the creation of the Brazilian Institute of the Environment (IBAMA). These facts undeniably contributed to the development of public policies, although it is widely accepted that it was the political situation resulting from the succession of José Sarney's government that was crucial for the creation of the first four Reserves in the early 1990s (CUNHA & ALMEIDA, 1999; 2000), *Alto Juruá* I the state of Acre, created by Decree No. 98,863, of January 23, 1990, with 506,186 hectares; *Chico Mendes* also in Acre, created in March 1990, with 970,570 hectares; *Rio Cajarí* in Amapá, created by Decree No. 99,145, of March 12, 1990, with 481,650 hectares, and; Rio Ouro Preto in Rondônia, created by Decree No. 99.166, of March 13, 1990, with 204,583 hectares.

Federal Law No. 9985 of 2000, which created the National System of Nature Conservation Units (SNUC), has classified the RESEX under the category of 'sustainable use'. In 2004, the National Commission for the Sustainable Development of Traditional Peoples and Communities was created with the purpose of triggering public policies, aiming at combating the history of denial and invisibility of these traditional peoples, who organized themselves in social movements - as unions, associations and cooperatives – in search of their social and environmental rights.

The concept of "traditional peoples and communities" was incorporated into the legal system through Decree no. 6,040, of February 7th, 2007. This, in turn, foments discussions in the sense that 'traditional populations' and 'indigenous peoples' do not share the same meaning. Both the legislation that addresses these groups and the various scientific researches on the issue make it clear that these two groups effectively differ in several aspects. In the Brazilian case, Almeida & Cunha (1999) raise 'territorial issues' as one of the main differences between these groups. Whereas indigenous peoples have ownership of the lands they inhabit, recognized through the historical context of their occupation; traditional populations – except quilombola communities – are still in the slow, embryonic and rigorously bureaucratic process of seeking this recognition as the State proposes.

Importantly, of course, is to stress that the concept that characterizes traditional peoples and

communities emerges from their territory and culture, according to Decree No. 6.040 / 2007, which states:

> Culturally differentiated groups who recognize themselves as such, possess their own peculiar forms of social organization, occupy and use territories and natural resources as a condition for their cultural, social, religious, ancestral and economic reproduction, by using knowledge, innovations and practices generated and transmitted by tradition (CNPCT / Brasil, 2007. Our translation[2]).

It is also important to emphasize that indigenous peoples have their specific languages, that differ from the official Brazilian language, in contrast, some groups regarded as 'traditional' disseminate dialects that are their own, although not adopted as official by the community.

The public policy debate has been at the heart of several researches and studies in the scope of governmental and non-governmental institutions, more precisely, those conducted by universities and social movements. Accordingly, the relevance of researches on this issues, within the academic scope and by means of the main existing literature is being able to contribute to the scientific community as it fosters possibilities of future studies that might bring potential improvements to these policies – mainly in respect to the creation of RESEX – and, later, to other policies directed to the subjects that belong this space.

Another relevant point of this study is the fact that it approaches an issue, which might be interpreted trough distinct perspectives, as the scenarios in which public policies are applied are also different. According to data from the last demographic census conducted by IBGE in 2018, 15.6% of the population dwells in rural areas. Therefore, it proves necessary that a scientific production explaining to society as a whole, and more specifically, to those who have the right to enjoy public policies (and for various reasons, are unaware of them) be made available.

On account of the above facts and contextualization, our main objective is to analyze public policies related to the creation of RESEX through a bibliographic and documentary survey and to provoke a theoretical understanding about the implementation processes of such public policies regarding their contexts. It is also our purpose to encourage the discussion and production of scientific works on the proposed theme, bearing in mind that in Brazil, the socio-cultural reality is marked by a distinct trend in the modes of life produced by the belief in the management of territory and natural resources.

2. Methodology

Our first theoretical reference to address this topic was Arroyo (2006, p. 104). The author alleges that "researching on the historical inequalities suffered by the people of the countryside is something that needs urgency", consequently, forwarding this issue to traditional peoples and communities is something that requires care and prudence in order not to harm the contextual and political principles of these peoples. Accordingly, as knowledge represents the paramount element for the construction of the object, the research activity becomes a fundamental and indispensable factor (Severino, 2007). On this point, the study sought to analyze public policies presented in the context of traditional peoples and communities in what concerns

[2] All quotations originally published in portuguese language from authors and documents have been translated by the authors of this paper.

the creation of Extractive Reserves and, reflected upon which policies are directed to, effective and promptly reach the populations, in an effort to break with any positivist research traces. Positivism – in its "ideal-typical" configuration – is based on a number of premises that structure a coherent and operational "system": society is governed by natural laws, that is, invariable laws, independent of human will and action in social life (Lowy, 1998, p. 17). In this sense, this study is based on a qualitative approach, because "[...] it deals with interpretations of social realities" (Bauer, 2014, p. 23).

Methodologically, it is based on a bibliographic and documentary study, which requires analytical and interpretive rigor from the point of view of content analysis, especially considering it involves complex conceptual categories, an embryonic ideological struggle and resistance to advances in developmentalist discourses. According to Gil (2002, p. 44), "[...] a bibliographic research is based on literature review already available, consisting mainly of books and scientific articles", as it allows the researcher to enjoy thoughts realized through research, ideologies and discourses already produced, allowing for further developments and new guidances for future research, debates and prospection in the field of sciences and traditional knowledge.

In addition, regarding documentary research, "[...] it is a rich and stable source of data" (Gil, 2002, p. 29), requiring obvious respect to the space-time dimension of the scientific production, and the political context in which the documents were produced. This research also "[...] makes use of all sorts of documents, prepared for different purposes, such as settlements, authorization, communication, etc." (Gil, 2002, p. 30). Therefore, it is valid to consider the importance of these research tools as methodological paths to be followed, making it possible to understand a given context.

Research procedures started with the collection of secondary data – official website searches, Federal University of Pará (UFPA) data platform, Sucupira digital environment and Coordination for the Improvement of Higher Education Personnel (CAPES) platforms. In addition, documents captured via the World Wide Web, which "(...) have become relevant instruments in conducting research" (Flick, 2013, p, 164) were used. Data were collected from February to May, 2019.

Collected data underwent conscientious appreciation and interpretation and thorough understanding of content analysis, which "(...) corresponds to a classical procedure for analyzing text material from any source, from media products to interview data" (Flick, 2013, p. 134). Content analysis also allows inferences to be made in light of discursive purposes to gauge a particular debate or set of elements, essential to the matter under focus – public policies designed for Extractive Reserves.

Minayo (2000, p. 27) affirms that "[...] qualitative analysis is not a mere classification of the informants' opinions, it goes far beyond that. It is the discovery of their social codes based on speeches, symbols and observations". Therefore, the data were treated qualitatively, seeking a better analysis with a view to promoting the accomplishment of a dissertative text supported by argumentative refinement in the light of what has already been theoretically produced in this regard.

3. Results and Discussion

3.1 Agrarian Reform

It is important to highlight that promoting a dialogue between the bibliographic data and the other

documents presented in this work means to establish a link with the policies directed to Extractive Reserves through Agrarian Reform, Educational Policies and Health Policies. This is the research cutting for the moment.

By historically studying the territorial configuration in Brazil, it is easy to perceive that since the process of colonization by the Portuguese in 1530, social inequality and land concentration has characterized the Brazilian society. Three strands constitute the colonial model that has been established in Brazil, namely: the expressive land ownership; monoculture or extraction of a single product for the purpose of exportation and slave work (Diegues, 1999). This inequality, with regard to land tenure is historical and dates back to the colonial period.

The 1960s is characterized by the emergence of militancy actions in the sectors of rural workers and the social movements themselves. These demands started to trigger the problematization of social inequalities in Brazil, which reflected – among other factors – the concentration of lands in the hands of a few. The Agrarian Reform movement gains strength when João Goulart assumes the presidency of the country, however; the reform does not happen, due to a pact entered into by the elites who defended the modernization of large properties (Palmeira, 1989).

With the end of the military dictatorship, the first democratic government took place led by José Sarney and the First National Plan for Agrarian Reform (PNRA) was proposed. However; the plan remained ineffective in the government drawers and this stagnation certainly made it difficult to carry out any type of reform, because the "(...) land ownership issue is of interest to all powerful sectors of the economy" (Martins, 1997, p. 35), furthermore, it has always been clear how the dominant class interests were favored at the time, reflecting landowning hegemony over the "minorities" up to the present days.

The II National Plan for Agrarian Reform (PNRA) launched in 2003 during the government of President Luís Inácio Lula da Silva targeted, among other segments, the landless rural workers, the current settlers, family agriculture sectors, riverside populations, squatters, extractivist people and quilombola communities (Brasil, 2005). The Plan identifies the various social segments under its focus and also "differentiated instruments appropriate to their specificities and to the characteristics of each region" (Brazil, 2005). As a consequence, the Plan made the issue of traditional peoples and communities visible and expanded the need for recognition of their ethnic, cultural and territorial characteristics.

The Plan also presents a broad vision with regard to the Agrarian Reform, understanding that, in order to make the settlements viable and, mainly, to achieve a change in the Brazilian agrarian structure, it is necessary to:

> [...] democratize access to land, deconcentrating the structure of land ownership, and intervene on the productive structure by guaranteeing Credit, Agricultural Insurance, Technical Assistance and Rural Extension, marketing policies and agroindustrialization (Brasil / MDA, 2003, p. 4).

The instruments that constitute the PNRA arise amidst different historical contexts, characterized by different reasons, namely: "to organize the process of territorial occupation of the country, encourage the settlement of regions regarded as remote" (Lima, 2005, p. 77), "appease conflicts over land" (Bergamasco & Norder, 1996, p. 9), as well as "[...] create spaces for environmental protection simultaneously preserving

the territorial rights of traditional peoples" (Menezes, 2011, p. 345), in order to "[...] respond to the strong demands of social movements that fight for the right of access to land" (Sauer, 2005, p. 59). Such reasons were probably the main motivation for social struggles throughout the national territory and certainly represent embryonic issues in the struggles processes and initial claims.

The Agrarian Reform projects were created by means of land acquisition by the National Institute for Colonization and Agrarian Reform (INCRA), known as the Settlement Project (PA); Project for Agroextractive Settlement (PAE); Sustainable Development Project (PDS); Forest Settlement Project (PAF); and the Quilombolas Special Settlement Projects (Special PA).

The creation of Extractive Reserves (RESEX), Sustainable Development Reserves (RDS), National Forests (FLONA) and Quilombola Territories is part of the second group of projects - Agroextractive Settlement – which are recognized by INCRA. As pointed out by Sauer (2005, p. 59) "[...] settlement projects are geographic spaces that bring together families who benefit from agrarian reform actions", making explicit the issues of territoriality and natural resources. Carvalho (1999) supports the above argument advocating that these projects are consolidated when a process of expropriation of a private rural property takes place as the result of struggles promoted by social movements in defending better redistribution of land. This process was not carried out peacefully, it certainly cost the lives of many who sought for opportunities and the maintenance of their cultural, social and productive experiences.

An alternative configuration stemming from the Plan, requires that traditional peoples and communities have their memories alive so that the struggles and resistance actions undertaken are not forgotten, but remain continuously at hand instead, as "there are few cases in which the memory of facts and achievements, stories of place foundations are not associated to struggles for rights, conflicts and land expropriation" (Diegues, 1999, p. 359).

The literature on Agrarian Reform holds special emphasis on the transformation of the latifundio – a large unproductive area – which, by means of the Reform, becomes fruitful, workable and supportive for dozens of families (Sauer, 2005). As a consequence, a "new economic, political, social and environmental organization arises, envisaging the possession of land by a social heterogeneity of families of landless workers" (Carvalho, 1999, p. 5).

It is noticeable that, despite all the barriers imposed, going through several historical moments, there has always been resistance movements. Brazil is the fifth largest country in territorial dimension in the world, however; there are still thousands of families with little or literally no land to live, plant, harvest, etc. There have been some undeniable advances, nonetheless, Brazil's agrarian problems are still far from being solved. There is a social debt to these "minorities", who have suffered from enslavement, exploitation and denial of their rights. This accounts for the need for projects that correct, or gradually mitigate, social inequalities in the country.

3.2 Educational Policies

Education is a right of all and a duty of the State, as the Federal Constitution of 1988 emphasizes in its article 205, therefore; it is expected that it will be offered with quality for all those who need it, covering diversity and plurality, which are evident trademarks in the Brazilian society, especially for traditional peoples and communities. Diversity and plurality are directly linked to their cultures, ethnicity, political

stands and religions. Furthermore, it is emphasized that the educational process for these peoples has disregarded their ethnic, cultural and environmental basis, that is, the knowledge acquired during their life trajectories, following an evident urbancentric perspective.

It is believed that these groups have built a model of culture "through the observation and experimentation of an extensive and detailed knowledge of the natural processes – the only management practices adapted to tropical forests until today" (Arruda, 1999, p. 83).

According to Teixeira (2002, p. 2) "[...] public policies are guidelines, leading principles for government action; rules and procedures to conduct relations between public power and society, mediations between society and State actors". Educational policies must be thought of as means of combating social exclusion, so, it is necessary that choices and decisions are made – such as public policies – aiming to contemplate all groups through concrete actions.

For Shiroma (2002), in Brazilian education, the policies intended to these groups were summed up in assistance actions of negligible effect, producing very timid results in what concerns the advances and the quality of teaching. The need for an educational model that contemplates traditional peoples and communities is fundamental for the basic conditions underlying citizenship. Understanding the processes of inequalities is also decisive, thus "[...] it should be urgent to research on how these inequalities deeply mark the construction or non-construction of the educational system, educational policies, rights guarantees, specifically the right to education." (Arroyo, 2006, p. 104).

For the above reasons, the debate on public policies proves highly relevant, considering the need and importance of building a critical debate around the RESEX, providing a greater understanding of factors that are part of the scenario experienced by traditional communities, that involves: environmental, socioeconomic, cultural and political scenes. "These peoples developed a deep and extensive knowledge of the environmental characteristics and the possibilities of handling the natural resources of the territories they occupy" (Diegues, 2000, p. 26). Understanding all this process imbricated in education is a step of paramount importance so that the subjects who live in the areas of RESEX have their educational demands met satisfactorily.

It is likewise important to highlight the cultural aspects, beliefs, values, which must be present in the educational process. The Brazilian Law of Directives and Bases for Education (LDB), No. 9.394 / 96, in its article 28, states that "[...] in the provision of basic education for the rural population, the education systems will provide the necessary adaptations to the suitability and peculiarities of rural life and of each region". Therefore, education for rural populations should be directed towards the construction of new knowledge and the valuation of traditional knowledge that constitute these subjects' lives. Diegues (2000, p. 30) acquiesces that "[...] traditional knowledge is defined as the set of knowledge and know-how about the natural, supernatural world, transmitted orally from generation to generation". These specificities need to be part of the educational context that is (or should be) developed in the areas of RESEX.

The act of democratizing education is far beyond allowing new students access to schools, instead, it should also provide opportunities for transformation. Education is one of the social factors that guide a country's social development, as Fernandes (1960, p. 48) points out:

> Education is the element of social life, responsible for organizing the experiences of individuals in everyday life, for developing their personality and for ensuring the survival

> and functioning of human collectivities themselves.

Providing these subjects with schooling – in addition to being a legal right – and professional qualification, will allow them to contribute to activities, such as forest management, so that it is performed in a sustainable way. The partnership established between traditional and scientific knowledge can be a great helping tool in combating the unrestrained use of natural resources. Demo (1990) assures that a continuous and good quality education serves as an indispensable lever of emancipatory political processes, therefore; the education defended in this work is a critical, emancipatory and liberating one.

Education is an important and fundamental practice for human beings. It is permanently under construction, and the risk of an ethnocentric education becomes real due to some factors, such as: some communities that belong to the RESEX are interpreted as "lagging" and / or "underdeveloped" and should, according to the ethnocentric vision, require only some welfare policies. The stagnation in the political scene, in that sense, makes the risk even more solid.

Strategies that favor and accelerate the educational process in the RESEX are necessary and valid to promote respect to the ethnicity, culture and knowledge of these Conservation Units users. They support the purpose of strengthening the educational process and intellectual, financial and social development of the residents of these protected areas. All this, however, will only be possible when public authorities and traditional communities get closer for shared management and planning, and public policies reflect the real needs of these peoples.

3.3 Health Policies

The Federal Constitution of 1988 guarantees the right to health in its Art. 196, when it states: "health is the right of all and the duty of the State, guaranteed through social and economic policies aimed at reducing the risk of disease and other illnesses and universal and equal access to actions and services for their promotion, protection and recovery ". However, for the people of traditional communities, the effective compliance with this right has always been far from happening, since access to health care has been neglected. One example of this absence is the lack of medicines and health professionals in Basic Health Unit (UBS), when they do exist, in a community.

In 2011, the Ministry of Health presented the National Policy for Comprehensive Health for Populations in the Countryside and the Forest (PNSIPCF), established by Ordinance No. 2,866, of December 2, 2011, whose main objective was to contemplate the peculiarities and specificities of these populations (Brasil, 2011).

Brazil possesses the Unified Health System (SUS), which has been validated by the State, and the particularities of the Brazilian territories have been homogenized (Brazil, 1988). Nevertheless, when taking into account the specificities of the various Brazilian regions, it turns essential to create differentiated health policies for populations that live far and / or isolated from large urban centers. That said, we emphasize the need for policies that seek a fair and universal way of guaranteeing the solution of health problems with quality for the populations of the countryside and the forest.

> [...] to overcome the differences, it is necessary to treat unequally those who are socioeconomically unequal (affirmative action or positive discrimination). A homogeneous

> offer to meet heterogeneous situations can only result in maintaining the original differences. This offer will correspond to the needs of a certain subset of the population and will not be suitable for others, whether for cultural or socioeconomic reasons [...] (Cohen & Franco, 2007, p. 50-51).

Historically, in Brazil, public policies have been planned and executed based on a homogeneous and reductionist vision of the population and of the national reality as a whole, because these policies "mostly express a narrow perspective of the countryside, conceived in opposition to the urban" (Carneiro, 2014, p. 15). In pursuance of universal access to public health services be guaranteed, in accordance with Law 8,080 / 90, it is necessary that these services be adjusted to the reality of their users. In the case of RESEX spread throughout Brazil, the financing of public health actions and projects must be ready to meet the cultural and environmental specificities of these territories. The same can be said about the creation of mechanisms for the participation of the population, in order that health demands can be dictated by those who know their needs and, thus, diagnosed by organizations and public authorities, under the guidance of RESEX residents themselves.

Even considering the legal advances regarding the guarantee of rights to traditional peoples and communities – culture, the right to land and health – it is necessary to break with a reductionist vision of rural populations in what concerns the health / disease process. Health practices require essential redefinition in its organization, so that the Brazilian health system (re) considers the subjectivities of these subjects.

A distinguishing look and the expansion of investments, the improvement of policies for rural and forest populations are means of guaranteeing the right to health for all. In this sense, representatives of these communities should progressively apprehend the policies embodied in the PNSIPCF and foster their empowerment, strengthening the movement in search of the execution of real, effective policies, in addition to the need to create strategies among the sectors involved with coordinated actions for the consolidation and promotion of health quality for the population, always considering the knowledge that has been acquired and developed over time by traditional populations and communities through relationships with nature.

4. Final remarks

Based on the bibliographic and documentary review of policies developed for traditional peoples and communities in RESEX, one can observe that there are some inconsistencies in relation to cultural, environmental, territorial and social specificities. These inconsistencies, which reveal gaps, appear as challenges to be overcome, so that the subjectivities of these regions can be recognized. The findings, therefore, lead us to conclude the general objective proposed by the present study has been achieved.

Research results corroborates our vision that the appreciation and importance of social groups with specific cultural practices to their regions appear as a possibility to open the way for the recognition and valorization of traditional knowledge. Another way of seeking equity is to subsidize the promotion of future public policies and give visibility to the difficulties that make the effectiveness of these public policies

unfeasible, in order to break barriers that hinder concrete actions by the State.

The observation of or sensitivity for the creation of laws aimed at these populations is recent, unfortunately, even though the existence of these peoples dates back to the arrival of the so-called "colonizers". The creation of legal policies resulted of several political struggles led by social movements in search of rights, reinforced by the pressure from international bodies that emphasized the importance of preserving biodiversity. We reaffirm the need to take into account historical, social, economic and cultural phenomena in the regions of the RESEX, in order to create possibilities of further creation of differentiated policies for traditional peoples and communities.

Despite recent achievements, Brazil still portraits injustices in the distribution of wealth, with many and significant sectors of its population living under poverty, which deprive them from enjoying the minimum essential conditions and dignity every human is entitled to. Inconsistently, this holds true despite the recognition that, in regard to environment, these populations are rich, privileged by the natural experience and by the expert management of the natural resources. We conclude it is necessary to understand that poverty does not refer only to the lack of access to material goods, but, additionally, it is represented by the vulnerability arising from the lack of opportunities and options between different possibilities.

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Water and Energy Savings in Microirrigation Systems Design Using Optimization Models

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Abstract

The main disadvantage of trickle irrigation systems is its comparatively high initial cost, which depends on the layout, design, and management of its hydraulic network. Designing the sub-main and lateral lines aiming the emitter uniformity maximization can reduce the microirrigation system costs. This research aimed to compare linear and nonlinear programming models and maximization versus minimization criteria to optimize the crop net benefit, considering the water and energy savings. Two versions of LP and NLP models were developed: the first minimized the equivalent annual cost of the irrigation system considering the pipeline cost and the energy cost; the second maximized the yearly increment in the net benefit (Bn) of the irrigated crop. In both cases, uncertainty about the crop price was considered. The models were applied in a 40 ha citrus orchard in São Paulo State, Brazil. The highest net benefit was found using the NLP model with the maximization criterion. The worst result was obtained with the LP model and the minimization of the total annual cost. The layout and management previously established by the designer are subjective and rarely results in the best solution, although the linear programming model always gets the global optimum. The NLP models get local optimal, but they defined the layout, design, and management of the systems, with more chance to obtain a higher net benefit. The NLP model for maximization showed to be an adequate option for designing microsprinkler irrigation systems, defining the hydraulic network and the operational conditions that maximize Bn and WUE, with the lowest water consumption and lowest energy cost.

Keywords: Linear programming; nonlinear programming; trickle irrigation; maximization; citrus; profit.

1. INTRODUCTION

Trickle irrigation is a convenient and efficient method of supplying water, in high frequency, and low volume, to the root zone of crops and trees [1]. It stands out for its agronomic and environmental advantages, such as the possibility of automation, irrigation systems durability, fertigation adequacy, and improvement of the water resources management [2];[3].

As a permanent irrigation system, the hydraulic network design greatly influences the initial equipment cost and also the energy consumption. Thus, optimization of the system design is key to maximizing profitability and emission uniformity.

Microirrigation systems are recommended in sloping lands, usually with lateral lines in level, following the row of trees. When the irrigated area has a high slope gradient in the manifold line direction, an option is to use a tapered pipeline. This is done to economize on pipe costs and to keep the pressure head variations within the desired limits. A tapered-manifold system is cheaper, more straightforward, and more durable than a system requiring flow or pressure regulators [4].

Designing the submain and lateral lines aiming the emitter uniformity maximization can reduce the microirrigation system costs by optimizing water use and energy savings [5].

The design criterion adopted in trickle irrigation systems defines the allowable pressure variation in the subunit, and, generally, it is equally divided between lateral and manifold lines. The permissible pressure variation is the difference between the maximum and minimum pressure in the outlets of the line, and the location of these extremes pressure points is required to design the manifold line. In downhill lines, the location of the maximum and the minimum pressure heads are variables and depend on the relationship between the total energy gain by slope and the total head losses due to the pipe friction. There is an analytical solution for single diameter lines, but in the case of tapered lines, the problem becomes more complex and requires complex analytical procedures [6];[7].

Design optimization of trickle irrigation systems using Operational Research has been presented by [8];[9]; [Anonymous, 1994];[11]. [Anonymous, 2002] developed a linear programming (LP) model to design microirrigation systems with tapered, downhill manifold lines, minimizing the equivalent annual cost of the hydraulic network and the annual pumping cost, and maximizing the emission uniformity.

A nonlinear programming (NLP) model was developed for the design and management of a trickle irrigation system and applied it in a flat area [13]. The model was extended the application of the nonlinear model to sloping areas [Anonymous, 1996]. Because both models work with the diameter as a continuous variable, the hydraulic network is designed with diameters that are usually not available as nominal diameters.

The enumeration approach was used by [15] in a nonlinear model for the optimum design and operation of drip irrigation systems. Still, it was applied only on flat terrain. [16] developed a method for designing microirrigation subunits using the lateral flow rate equation, finite element method, and the golden section search. The procedure allows designing the manifold line with different lengths in the uphill and downhill sections to compensate for the slope gradient. This is the right solution for a low gradient slope. In situations with high slope, however, the entire manifold line must be downhill to assure the desired emission uniformity in the subunit.

This research aimed to compare linear and nonlinear programming models and maximization versus minimization criteria to optimize the crop net benefit, considering the water and energy savings

2. MODELS DEVELOPMENT

In this research, four optimization models were developed: a) NLP-MAX – a nonlinear programming model to maximization of the annual increase in the crop net benefit due to irrigation adoption; b) NLP-MIN - a nonlinear programming model to the minimization of the yearly cost of the irrigation system considering the pipeline cost and the energy cost; c) LP-MAX – a linear programming model to maximization; and d) LP-MIN - a linear programming model to minimization.

The models were used in a 40-ha citrus orchard in São Paulo State, Brazil, to compare linear and nonlinear models and maximization versus minimization criteria.

The assumptions in the models were as follows:

(1) the area must be rectangular;

(2) the pump and control stations are placed at the middle of one edge of the field (in the x-direction);

(3) the lateral lines are polyethylene and are in level. The others are polyvinyl chloride (PVC);

(4) the uncertainty in crop prices is considered.

A trickle irrigation system is usually composed of subunits, that in this paper, consist of emitters (or microsprinklers), pipes (laterals, manifold, and auxiliary), and accessories such as valves (Figure 1).

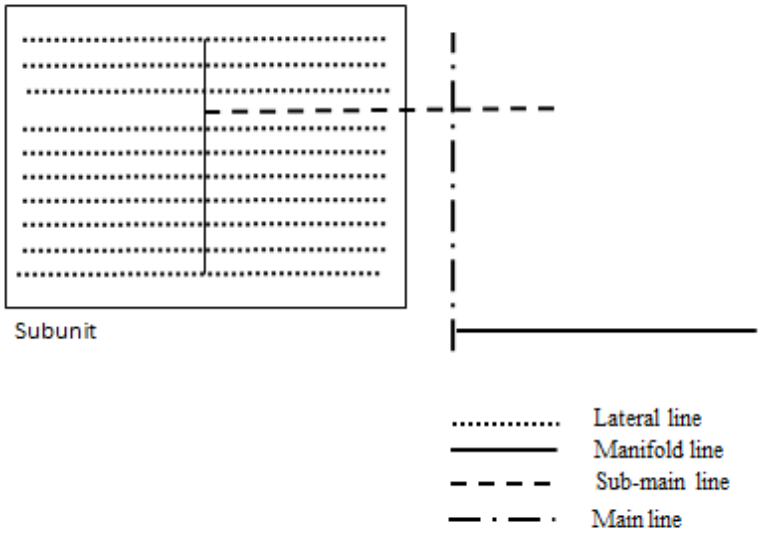

Fig 1. Subunit configuration, submain, and main lines adopted by the optimization model.

2.1. Nonlinear model – Maximization (NLP-MAX)

2.1.1. Objective function

The objective function to be maximized is the annual increase in the net benefit when the irrigation is adopted and is given by:

$$B_n = B_g - C_{ip} - C_{prod} \quad (1)$$

where $B_n =$ annual increase in the crop net benefit due to irrigation adoption, in US$/ha.yr; $B_g =$ annual increase in the crop gross benefit due to irrigation adoption, in US$/ha.yr; $C_{ip} =$ annual cost with

investment and pumping (cost of irrigation system) in US$/ha.yr; $C_{prod} =$ annual production cost without irrigation, in US$/ha.yr.

The increase in the crop gross benefit is given by:

$$B_g = P\,\Delta Y \tag{2}$$

$$\Delta Y = Y - Y_r \tag{3}$$

in which $P =$ product price in US$/kg; $\Delta Y =$ increase in the actual yield when irrigation is adopted, in kg/ha.yr; $Y =$ crop yield with irrigation, in kg/ha.yr; $Y_r =$ yield in rainfed condition, in kg/ha.yr.

The yield increases due to irrigation (Y), when any other required resource is at the optimum level, was estimated by:

$$Y = AW^2 + BW + C \tag{4}$$

where $W =$ volume of water applied per tree, per year; A, B and C are regression coefficients.

The volume of water applied per plant (or tree) per season (W), in m^3, is given by:

$$W = (3600 N_m q_w I_d I_h E_a)/I_f \tag{5}$$

where $N_m =$ number of emitters per emission point; $q_w =$ average emitter discharge en m^3/s; $I_d =$ number of irrigation hours per set of subunits working simultaneously, during an irrigation interval; $I_h =$ number of irrigation days during the year; $E_a =$ application efficiency; $I_f =$ number of days in the irrigation interval (irrigation frequency).

The annual production cost without irrigation is calculated by:

$$C_{prod} = C_{pb}.\Delta Y \tag{6}$$

where C_{pb} is production cost in US$/kg.

The cost with investment and energy (C_{ip}) is:

$$C_{ip} = \{[(C_{mi}TM + C_{pe}TLL + NSU\ LM\ C_{pvm} + C_{pva}\ TAL + C_{pvs}\ TSL + C_{pvn}\ TNL + CV + CCP + CF + CP)CRF + CPP + CW]1000\}/At \tag{7}$$

where C_{mi} =microsprinkler cost, in US$/unit; $TM =$ microsprinklers total number; C_{pe} =cost (US$/m) of polyethylene pipe expressed as a function of the diameter (m); $TLL =$ lateral line total length in m; $NSU =$ number of subunits; $LM =$ manifold line length in m; $C_{pvm} =$ cost (US$/m) of PVC pipe

expressed as a function of the manifold line diameter (m); C_{pva} = cost (US$/m) of PVC pipe expressed as a function of the auxiliary line diameter (m); TAL = auxiliary line total length in m; C_{pvs} = cost (US$/m) of PVC pipe expressed as a function of the submain line diameter (m); TSL = total length of submain line in m; C_{pvn} = cost (US$/m) of PVC pipe expressed as a function of the main line diameter (m); TNL = total length of main line in m; CV = cost (US$) of valves; CCP = cost (US$) of control panel; CF = cost (US$) of filter system; CP = cost (US$) of the pump station; CRF = capital recovery factor; CPP = annual pumping cost (US$/yr); CW = water cost (US$/yr), and At = total area, m^2.

The pipe costs expressed as a function of line diameter were obtained by regression and are given by:

$$C_{pe} = C_1\,(DL) - C_2 \quad (8)$$

$$C_{pvm} = C_3(DM)^{C_4} \quad (9)$$

$$C_{pva} = C_5(DA)^{C_6} \quad (10)$$

$$C_{pvs} = C_7(DS)^{C_8} \quad (11)$$

$$C_{pvn} = C_9(DN)^{C_{10}} \quad (12)$$

where DL is the lateral line diameter, in m; DM is the manifold line diameter, in m; DA is the auxiliary line diameter, in m; DS submain line diameter, in m; DN is the main line diameter, in m; $C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9$ and C_{10} are coefficients.

The amount of each item in a trickle irrigation system can be obtained with the following equations:

$$LL = (NML - 0.5)S_M \quad (13)$$

$$LM = LMU + LMD \quad (14)$$

$$LMU = (NLLU - 0.5)S_L \quad (15)$$

$$LMD = (NLLD - 0.5)S_L \quad (16)$$

$$LMD = JP\,L_M \quad (17)$$

$$LA = NML\,S_M \quad (18)$$

$$LS = L_Y - (NLLU\,S_L) \quad (19)$$

$$LSUX = 2NML\,S_M \quad (20)$$

$$LSUY = NLL\,S_L \quad (21)$$

$$TM = (A\,N_m)/(S_M S_L) \quad (22)$$

$$TLL = NSU\,NLL\,S_M[(2NML) - 1] \quad (23)$$

$$TML = (NLL - 1)S_L NSU \quad (24)$$

$$TAL = NSU\,NML\,S_M \quad (25)$$

$$TSL = \frac{0.25At}{NML\,S_M} - \frac{0.25L_X S_L NLLU}{NML\,S_M} \quad (26)$$

$$TNL = L_X - (4NML\,S_M) \quad (27)$$

$$NS = TSL/[L_Y - (NLLU\ S_L)] \quad (28)$$

$$NSL = \frac{NSU\ LSUY}{2L_Y} \quad (29)$$

where LL = lateral line length, m; NML = number of emission points in a lateral line; LM = manifold line length (uphill + downhill), m; LMU = uphill manifold line length, m; LMD = downhill manifold line length, m; $NLLU$ = number of outlet in the uphill section of the manifold line; $NLLD$ =number of outlets in the downhill section of the manifold line; NLL = number of outlets in the manifold; L_X is the length of field in x-direction, in m; L_Y = length of field in the y-direction, in m; JP = manifold position ratio, which gives the same minimum uphill and downhill pressure head along a pair of manifolds.

The cost of valves (CV), in US$, expressed as a function of the total number of subunits is given by:

$$CV = C_{11}\ NSU \quad (30)$$

where C_{11} = constant.

The cost (US$) of control panel expressed as a function of the total number of subunits is given by:

$$CCP = (C_{12}NSU) + C_{13} \quad (31)$$

where C_{12} and C_{13} are constants.

The cost (US$) of the pump station expressed as a function of the required power is given by:

$$CP = (C_{14}QT\ HT) + C_{15} \quad (32)$$

where C_{14} and C_{15} are constants; and HT = total head losses plus the total difference in elevation, in m, given by:

$$HT = 0.75HFL + H_{AV} + 0.75HFMU + HFA + HFS + HFN + HCS + 0.5LMU\ S_Y + LS\ S_Y C_{pb} Y \quad (33)$$

where HFL = lateral line head loss (m); $HFMU$ =uphill manifold line head loss (m); HFA = auxiliary line head loss (m); HFS = submain line head loss; HFN = main line head loss; HCS = head loss in the control station, m.

The annual cost (US$/yr) of electric energy expressed as a function of the consumption is given by:

$$CPP = C_{kw}\left(\frac{10.787\ Q_{SU}HT\ I_d I_h NSU}{\eta I_f}\right) \quad (34)$$

where C_{kw} = cost of kWh, in US$; η = pump and motor efficiency; Q_{SU} = operational subunit discharge (m^3/s).

The annual water cost is:

$$CW = \frac{10{,}000W\ P_W}{S_L S_M E_a} \tag{35}$$

where P_W = water cost, in US$/$m^3$; S_M = distance between emission points in a lateral line, in m; S_L = distance between lateral lines, in m.

2.1.2 Constraints

The constraints in the present analysis are the hydraulic conditions, the irrigation criteria, the geometric limitations, and the operational characteristics.

In sloping fields, the model solves the design of a trickle irrigation system assuming that the manifold is in the same direction as the slope. The uphill and the downhill section of the manifold line have different lengths, but the same diameter.

The manifold position ration, which gives the same minimum uphill and downhill pressure head in a manifold pair, is calculated by [4]:

$$\frac{SY\ LM}{HFM} - 0.36\left(\frac{SY\ LM}{HFM}\right)^{1.57} = JP^{2.75} - (1-JP)^{2.75} \tag{36}$$

The Darcy-Weisbach equation is used to determine the pipe head loss. For use with smooth plastic pipes this equation is given by:

$$H_f = 7.89(10^{-4})L\frac{Q^{1.75}}{D^{4.75}} \tag{37}$$

in which H_f = head loss due to pipe friction (m); L = length of pipe (m); Q = flow rate in the pipe (m^3/s); D = inside diameter of the pipe (m).

The head loss in each line is given by:

$$HFL = (8.1267\ 10^{-4} LL\ QL^{1.75} F_L)/DL^{4.75} \tag{38}$$
$$HFMU = (7.89\ 10^{-4} LMU\ QMU^{1.75}\ FMU)/DM^{4.75} \tag{39}$$
$$HFMD = (7.89\ 10^{-4} LMU\ QMU^{1.75}\ FMU)/DM^{4.75} \tag{40}$$
$$HFM = HFMU + HFMD \tag{41}$$
$$HFA = (7.89\ 10^{-4} LMU\ QMU^{1.75} FMU)/DA^{4.75} \tag{42}$$
$$HFS = (7.89\ 10^{-4} LMU\ QMU^{1.75} FMU)/DS^{4.75} \tag{43}$$
$$HFN = (7.89\ 10^{-4} LMU\ QMU^{1.75} FMU)/DN^{4.75} \tag{44}$$

where $QL =$ lateral line discharge, m^3/s; $QMU =$ uphill manifold line discharge, m^3/s; $QMD =$ downhill manifold line discharge, m^3/s; $QA =$ auxiliary line discharge, m^3/s; $QS =$ submain line discharge, m^3/s; $QN =$ main line discharge, m^3/s; FL, FMU, FMD, FA, FS and FN are the Christiansen's coefficients for the lateral, uphill manifold, downhill manifold, auxiliary, submain and main line, respectively.

The discharge in each line is given by:

$$QL = NML\ NM\ QM \quad (45)$$

$$QMU = 2NLLU\ QL \quad (46)$$

$$QMD = 2NLLD\ QL \quad (47)$$

$$QA = 2\ NLL\ QL \quad (48)$$

$$QS = NSUS\ QSU \quad (49)$$

$$QN = NSUS\ QSU \quad (50)$$

$$QSU = 2NSUS\ NM\ QM\ NLL\ NML \quad (51)$$

$$QSU = 2NLL\ NML\ NM\ QM \quad (52)$$

$$QT = 2NSUS\ NM\ QM\ NLL\ NML \quad (53)$$

$$2QM\ NM\ NML\ NLL\ NSUS \leq QAV \quad (54)$$

The laterals and manifold lines are designed as a function of the emission uniformity. For design purposes, the allowable head variation in a subunit that will give a reasonable emission uniformity (EU) can be computed by (Keller and Bliesner, 1990):

$$APVS = 2.5\ (H_{AV} - H_{MIN}) \quad (55)$$

where $APVS =$ allowable pressure head variation in the subunit (m); $H_{AV} =$ average pressure head in the subunit (emitter working pressure), in m; $H_{MIN} =$ pressure head that will give the minimum emission rate in the subunit (m).

To estimate the emission uniformity for a proposed design, [17] adopted:

$$EU = 100\left(1 - 1.27\frac{E_{MV}}{\sqrt{NM}}\right)\frac{q_{MIN}}{QM} \quad (56)$$

in which $EU =$ emission uniformity (expressed as a decimal); $E_{MV} =$ manufacturing variation in emitter expressed as a coefficient of variation; $q_{MIN} =$ minimum emission rate in the subunit (m^3/s).

[4] recommended, as a general design guideline, that the allowable subunit head variation ($APVS$) can be allocated equally between the lateral and manifold head variations. This paper accepted values between 40% and 60%, but the sum must be 100%. Thus:

$$HFL \geq 0.4\ APVS \quad (57)$$

$$HFL \leq 0.6\ APVS \quad (58)$$

$$HFMU + (LMU\ SY) \geq 0.4\ APVS \quad (59)$$

$$HFMU + (LMU\ SY) \leq 0.6\ APVS \quad (60)$$

$$APVS = HFL + HFMU + LMU\ SY \quad (61)$$

$$A = 2\ NML\ NLL\ S_M\ S_L\ NSU \quad (62)$$

The velocity in the auxiliary, submain and main lines must be between 0.2 and 2m/s, and they are estimated by:

$$VA = 1.27324\frac{QA}{DA^2} \quad (63)$$

$$VS = 1.27324\frac{QS}{DS^2} \quad (64)$$

$$VN = 1.27324\frac{QN}{DN^2} \quad (65)$$

where VA is the velocity in the auxiliary line, m/s; VS is the velocity in the submain line, m/s, and VN is the velocity in the main line, m/s.

The available time to irrigate the total field area is a restriction:

$$\frac{NSU\ I_h}{NSUS\ I_{fr}} \leq T_{av} \quad (66)$$

$$\frac{NSU\ I_h}{NSUS\ I_{fr}} \geq 18 \quad (67)$$

in which $T_{av} =$ number of hours available for irrigation per day.

The nonlinear model defines the layout and the operations conditions of the irrigation system. Some of the outputs are the number of subunits, the number of subunits working simultaneously, uphill and downhill manifold sections length, head losses in all the lines, length of all the lines, allowable head loss in the subunit and others.

The output data from the nonlinear model are used in a Linear Programming model to obtain the final solution with a combination of commercial diameters in all the lines of the hydraulic network, except in the lateral line.

The set of linear equations adopted is based on the model developed by [Anonymous, 2002] only with one modification: in this case, the manifold line has uphill and downhill sections. The constraints are given by:

$$HM_O - HMU_{end} \leq APM \quad (68)$$

$$HM_O - HMD_j \leq APM\ ,\quad j = 1, \dots, J \quad (69)$$

$$HMD_j - HM_o \leq APM\ ,\quad j = 1, \dots, J \quad (70)$$

$$HMD_g - HMD_j \leq APM\quad ,\forall\ j = 1, \dots, J; g = 1, \dots, J;\ \text{and}\ g \neq j \quad (71)$$

$$HMD_j - HMU_{end} \leq APM\ ,\quad j = 1, \dots, J \quad (72)$$

$$HMU_{end} - HMD_j \leq APM\quad j = 1, \dots, J \quad (73)$$

where $HM_o =$ pressure head at the inlet of the manifold line (m); $HMD_j =$ pressure head at the outlet j of the manifold line (m); $HMD_g =$ pressure head at the outlet g of the manifold line (m); $HMU_{end} =$ pressure in the last outlet of the uphill manifold; and $APM =$ maximum allowable pressure head variation in the manifold line (m).

2.2. Nonlinear model – Minimization (NLP-MIN)

When the objective is to minimize the total cost of the irrigation system, no production function is involved. It is necessary to define the volume water to be applied during the season, and the selection of this value is done according to technical considerations. The volume of applied water that maximizes the production doesn't mean maximum net benefit.

The equations system is almost the same as the maximization problem, except the exclusion of the benefit component in the objective function and production function. The volume of water applied is no more a variable and must be previously selected.

So, the minimization objective function is given by:

$$\text{Minimize} \qquad B_n = C_{ip} - C_{prod}$$

2.3 Linear programming models (LP-MAX and LP-MIN)

In the linear programming models, the irrigation system lay-out was previously defined according to the experience of the designer. The optimization process only selects the combination of diameter to be used in the hydraulic network. The maximization and minimization models were based on the equations system developed by [Anonymous, 2002].

The variable annual volume of water applied per plant (W) was a component of non-linear equations that define several other variables in the objective function. Thus, the LP-MAX model considered W an input parameter and simulated the increase in B_n for different values of the annual irrigation volume per plant, aiming to establish a relationship between these two variables and find the optimal point.

3. APPLICATION OF THE MODELS

The models were used to design a microirrigation system for a citrus orchard in the state of São Paulo, Brasil. The area is 600 m $\times$ 400 m and the slope in the y-direction is 3%.

The nominal flow rate versus pressure curve for the microsprinkler adopted in this work is given by:

$$q = 9.8918h^{0.5326} \qquad (76)$$

where $q =$ microsprinkler discharge (L/h); and $h =$ microsprinkler pressure (m).

The microsprinkler working pressure is 15.5m with an equivalent discharge of 43 L/h. The emitter coefficient of manufacturing variation from the manufacturer is 2.3% and the emission uniformity adopted is 90%.

3.1. Input data

The input data required by the models are shown in Tables 1 and 2. They describe hydraulic and operational conditions, equipment prices, design criteria, and irrigated area dimensions.

The lateral lines have a single diameter and use polyethylene pipes. Three diameters were analyzed in the NLP models : 13, 16, and 20 mm.

Table 1. Input parameters: values of the coefficient C_i of the equations.

Ci	Equation	Value
1	8	17.229
2	8	-0.0894
3	9	122.26
4	9	1.6599
5	10	193.19
6	10	1.7049
7	11	193.19
8	11	1.7049
9	12	193.19
10	12	1.7049
11	30	272.20
12	31	42.29
13	31	76.32
14	32	76.32
15	32	76.32

Table 2. Values of the input parameters.

Parameters	**Value**
Citrus price (US$/kg)	0.0686
Number of trees per hectare	357
Production cost per kg	0.0417
Number of microsprinklers per tree, N_m	1
Spacing between lateral lines, S_m	4 m
Spacing between microsprnklers in the lateral line, S_L	7 m
Irrigation frequency, I_{FR}	3
Efficiency of application	90%
Maximum available time for irrigation	24h/day
Minimum available time for irrigation	18h/day
Slope gradient in the y-direction (m/m)	0.03
Microsprinkler price, C_m	US$0.59/unit
Capital recovery factor, CRF, for a discount rate of 6% and an irrigation system life-cycle of 10 years	0.13587

Electricity price, E	US$0.0476/kWh
Length of the field in the x-direction	392 m
Length of the field in the y-direction	576
Total area, A	225,792 m^2
Pump system efficiency, η	61.6%
Emitter coefficient of manufacturing variation, E_{mv}	0.023
Head loss in the control station, H_{es}	12 m
Head losses in the valves, H_v	2 m
Microsprinkler working pressure, q_w	15.5 m
Design emission uniformity,EU	90%
Microsprinkler discharge at the working pressure, q_w	43 L/h
Yield in rainfed condition (Y_r), in kg/ha yr (or 3 box/tree; 1 box =40.8kg and 357 trees/ha)	43,697

All the other lines used PVC pipes. In the manifold, the nominal diameters were 35, 50, 75, 100, 125, and the pressure rating is 40 m. In the auxiliary, submain, and main lines, the nominal diameters available were 50, 75, 100, 150, 200 for the 80 m class. Table 3 shows the pipe prices as a function of diameter and pressure class.

Table 3. Price of the PVC pipes as a function of diameters and pressure classes.

Pressure class (m)	Nominal Diameter (ND) (mm)	Price (US$/m)
40	35	0.54
	50	0.75
	75	1.44
	100	2.31
	125	3.78
	150	5.37
80	75	2.14
	100	4.23
	150	8.45

In the case of the linear programming models (LP-MAX and LP-MIN), the layout must be previously defined. Adopting the pipeline with 13 mm of internal diameter in the lateral line that gives the lowest cost and respecting the emission uniformity desired, the system was designed by an experienced, containing 24 subunits, 4 submains, and 4 subunits working simultaneously (Figure 2).

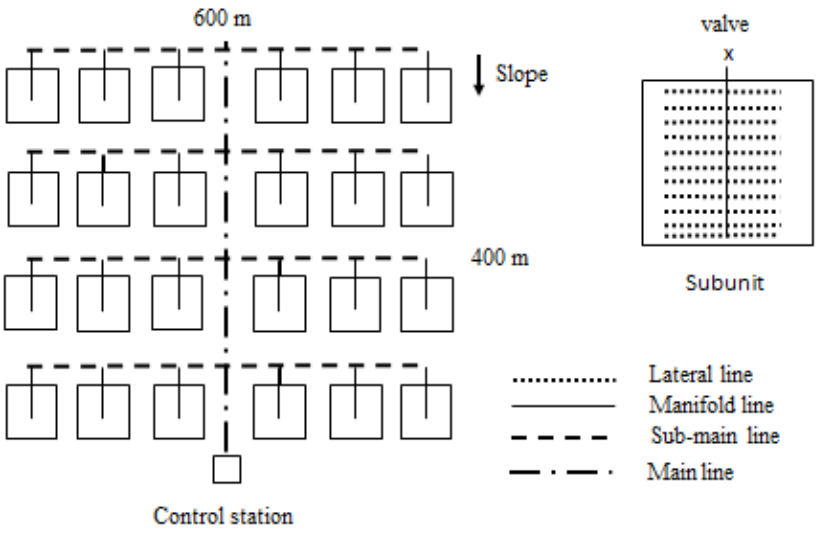

Fig. 2. Irrigation system layout with the 24 subunits adopted in the linear programming models.

There was considerable fluctuation in the citrus price. So, it was used the mathematical expectation of the price (US$ 0.0686/kg).

The crop water production function (CWPF) was obtained using data from [18], and an equation was adjusted:

$$Y = -5.1466\ 10^{-8}W^2 + 8.1133\ 10^{-4}W + 2.7334 \qquad (77)$$

with $Y =$ yield with irrigation, in box (40,8kg) per tree; $W =$ water applied in L per year, per tree ($2390\ L \leq W \leq 14342\ L$).

The average daily evapotranspiration in the peak period was 4 mm.d^{-1}, and the number of days of irrigation during the annual critical period was 90 days. Once the orchard was established at a spacing of 4m × 7m and considering the values of average daily evapotranspiration and duration of the peak period, the annual volume of water effectively applied per tree by irrigation was 10.08 m^3.yr^{-1}.

The water use efficiency (WUE) was calculated by the ratio between citrus yield and total water depth applied (irrigation + effective rainfall). The citrus yield was the sum of the increase in the actual yield when irrigation is adopted (ΔY) and the yield in rainfed condition (122.4 kg/tree). The total water depth applied was the sum of the average effective rainfall in the region (1,021 mm/yr or 28.6 m^3/tree.yr) and the irrigation depth obtained in each optimization model.

There is not an available solver to run the models with nonlinear variables that are simultaneously discrete. The solution is to run the model with some of them as continuous variables and, in a second step, based in the results obtained, built a linear model with the lay-out and operational conditions established by the primary nonlinear model, only optimizing the hydraulic networks with commercial diameters.

The GAMS [19] software version 2.50 solved the LP and NLP models.

4. RESULTS AND DISCUSSION

4.1. Design of the hydraulic network

The hydraulic network characterization for each optimization model is described in Table 4.

The layout and operational characteristics were previously established for the LP models as 24 operating units in the total, with 4 working simultaneously. So, the models defined the diameters combined in the hydraulic network, assuming that the manifold line is in a downhill condition.

Otherwise, the NLP models (maximizing and minimizing) defined 8 operational units (Figure 3), with only one operating at a time, adopting auxiliary and manifold lines in downhill and uphill conditions. They were efficient in defining the derivation line best insertion point of the auxiliary line. The uphill section of the manifold line had 38.5m ND75 and 35m ND50, while the downhill section had 52.5m ND75, 28m ND50, and 35m ND35, according to NLP-MAX model.

There are essential differences between LP and NLP models. The necessity to define the layout in the LP models becomes the optimization process restricted to establish the hydraulic network components (pipeline length and diameters used). Part of the process is dependent on the designer experience and the choices that he makes. The layout and the operation conditions are previously defined, and there is always subjectivity in this selection process, as also described by [Anonymous, 1996].

The nonlinear model gets local optimal, but it defines the layout, design, and management of the systems, with more chance to obtain a higher net benefit.

In all optimization models, the total pressure head was close to 55mca. The emission uniformity was 87% in NLP models and 90% in LP models.

Table 4. The hydraulic network characterization for each optimization model.

Item	NLP-MAX	NLP-MIN	LP-MAX	LP-MIN
Number of subunits	8	8	24	24
Number of subunits working simultaneously	1	1	4	4
Number of submains	2	2	4	4
Lateral line	70m ND16	70m ND16	46m ND13	46m ND13
Manifold line				
- Uphill	38.5m ND75 35m ND50	45.5 ND75 28m ND50	----	----
- Downhill	52.5m ND75 28m ND50 35m ND35	52.5m ND75 28m ND50 35m ND35	59.5m ND50 35m ND35	66.5m ND50 28m ND35

Auxiliary line				
- Section 1	72m ND100	72m ND100	----	----
- Section 2	72m ND100	72m ND100	----	----
Submain line				
Section 1	119m ND100	119m ND100	146m ND75 and 104m ND50	146m ND75 and 104m ND50
Section 2	196m ND100	196m ND100	167.5m ND75 and 82.5m ND50	167.5m ND75 and 82.5m ND50
Section 3	----	----	213.3m ND75 and 36.7m ND50	213.3m ND75 and 36.7m ND50
Section 4	----	----	250m ND75	250m ND75
Main line				
Section 1	144m ND100 (PC80)	144m ND100 (PC80)	98m ND100 (PC80)	98m ND100 (PC80)
Section 2	----	----	98m ND100 (PC80)	98m ND100 (PC80)
Section 3	----	----	98m ND100 (PC40)	98m ND100 (PC40)
Section 4	----	----	98m ND100 (PC40)	98m ND100 (PC40)
Total operating head (HT)	55.5m	55.3m	55m	54.8m
Emission uniformity (EU)	87%	87%	90%	90%

*ND: nominal diameter; PC=pressure class

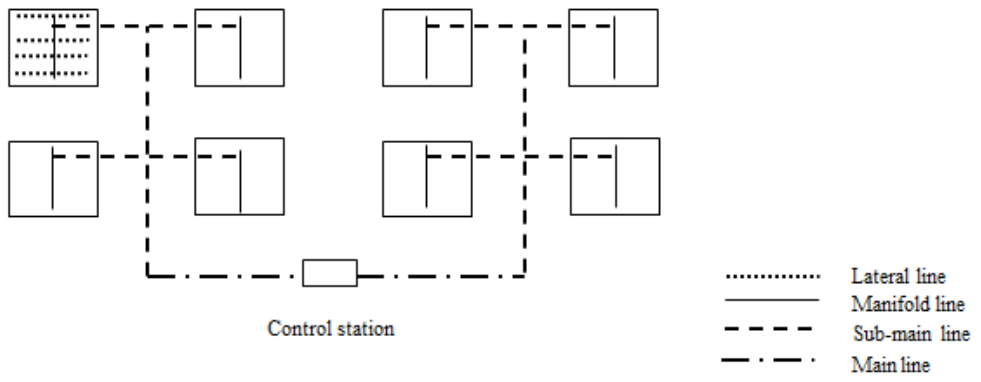

Fig. 3. Irrigation system layout obtained with the nonlinear programming models.

4.2. Productivity and economic performance of the LP and NLP models

The LP model for maximization considered W an input parameter and simulated the increase in B_n (Table 5) for different values of the annual irrigation volume per plant (2.390 / 4.780 / 7.170 / 7.500 / 7.865 / 7.882 / 8.000 / 9.560 / 11.952 / 14.342 m^3). The second-degree polynomial equation (Figure 4) was found, representing the relationship between B_n and W. It allowed identifying the optimum solution for the LP-MAX model (W = 8.000 m^3/tree and B_n = US$970.4/ha.yr).

Table 5. Results of B_n as a function of W, adopted in the maximation LP model.

Volume of water per tree (W), in m^3, during the critical season (90 days/yr)	Annual increase (B_n) in the irrigated crop net benefit(US$/ha.yr)
2.390	430.9
4.780	817.3
7.170	968.7
7.500	969.4
7.865	970.1
7.882	970.2
8.000	970.4
9.560	896.6
11.952	588.8

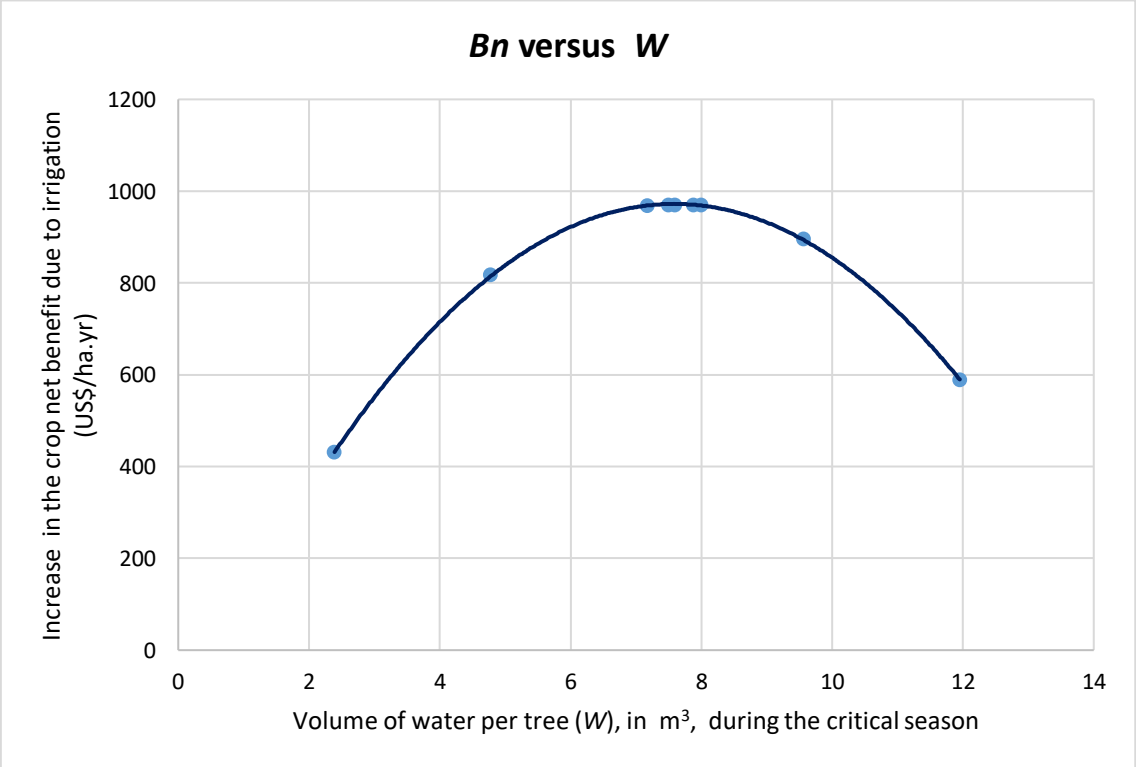

Fig. 4. Annual increase in the crop net benefit due to irrigation adoption (US$/ha.yr) as a function of the annual volume of water applied per tree, in m^3, obtained by simulation and associated with LP-MAX model.

The maximizing models have generated better results than minimizing models in terms of *Bn* and costs. Likewise, NLP models performed better than similar PL models (Table 6).

The most significant increase in B_n was obtained with the NLP-MAX with US$ 1007.9/ha.yr. The second best option was the LP-MAX, US$ 970.4/ha.yr, followed by the NLP-MIN, US$ 881.0/ha.yr, and finally, by the LP-MIN (US$847.0/ha.yr).

The design generated by the maximization NLP-MAX provided the most significant increase in net benefit, associated with the lowest water consumption, lowest cost of the hydraulic network, and lowest energy cost (Table 6) since it considers the CWPF in the optimization process. The second best option was obtained with the LP-MAX model, but with B_n 4% less than the NLP-MAX, volume of irrigation water and energy consumption 5% higher, in addition to the pipeline 19% more expensive.

The NLP-MAX model, compared to the LP-MIN, increased by 19% the B_n and decreased by 25%, 24%, 25%, and 20% the water consumption, energy cost, water cost, and pipeline cost, respectively.

The LP and NLP maximization models generated the most significant increases in *Bn* due to the possibility of using the crop water production function, expanding the universe of possible solutions considerably.

In most cases, the maximization of the net benefit is not equivalent to maximizing the yield, as described by [20]. The results corroborate this fact, once the maximum yield from the CWPF is obtained with $W = 8.882$ m^3/tree.yr, which is equivalent to *Bn* of US$ 970.2/ ha.yr.

In the minimization models, the volume of water to be applied must be defined in advance, resulting in the highest water demands in this research (Table 6) and the worst economic values.

Table 6. Productivity and economic performance of the NLP and LP models

Item	NLP Model		LP Model	
	Maximization	Minimization	Maximization	Minimization
Volume of irrigation water, in m^3/tree.yr (W)	7.60	9.72	8.00	10.08
[1] Total volume of water, in m^3/tree.yr	36.20	38.32	36.60	38.68
Increase in the actual yield when irrigation is adopted (ΔY), in kg/tree.yr	119.41	112.5	119.6	109.4
[2]Total yield, in kg/tree.yr	241.8	234.9	242.0	231.8

WUE (kg/m^3)	6.7	6.1	6.6	6.0
Energy (pump system) annual cost, US$/ha.yr	38.6	49.1	40.4	50.7
Annual water cost, US$/ha.yr	53.6	68.7	56.51	71.2
Pipeline cost, US$/ha.yr	193.7	206.3	229.7	240.2
Annual increase of net benefit due to irrigation, US$/ha.yr	1,007.9	881.0	970.4	847.0

[1] Considering the effective rainfall of 28.6 m^3/tree.yr

[2] Considering the yield in rainfed conditions of 122.4 kg/tree.yr

The water use efficiency (WUE) was estimated by the ratio between the total yield and the total volume of water applied (Table 6). The highest WUE was obtained with the NLP-MAX model, followed by LP-MAX, NLP-MIN, and finally by the LP-MIN (Figure 6).

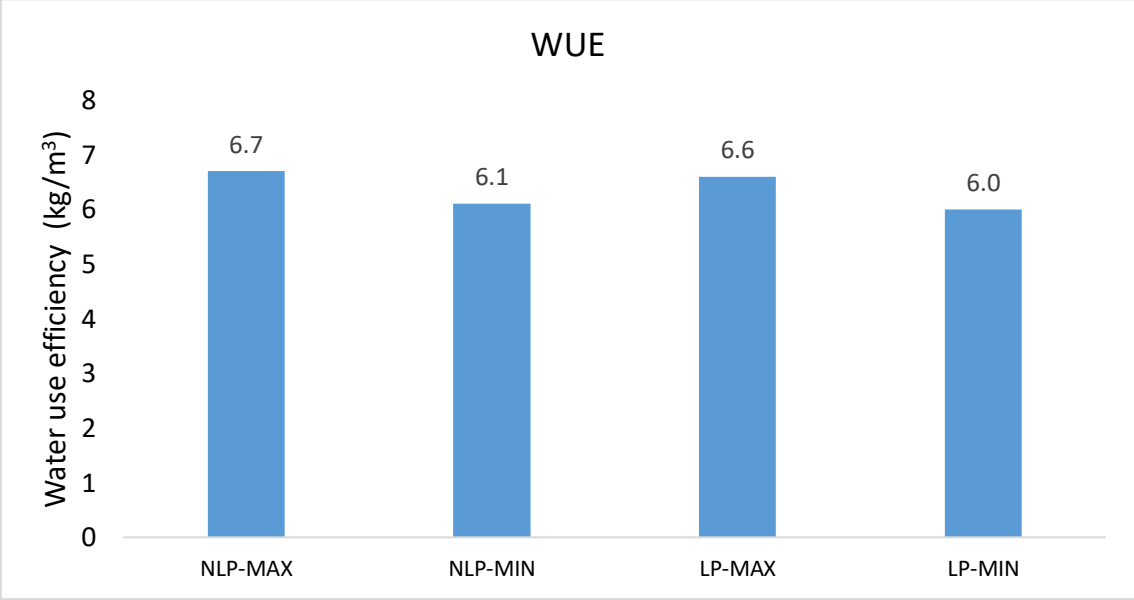

Fig. 5. Water use efficiency (WUE), in kg/m^3, for the NLP-MAX, NLP-MIN, LP-MAX, and LP-MIN models.

The NLP model for maximization was a very appropriate option for microsprinkler irrigation systems design, defining operational conditions that maximize B_n and WUE, with an economy in the water consumption and the energy cost, as showed in Figure 6.

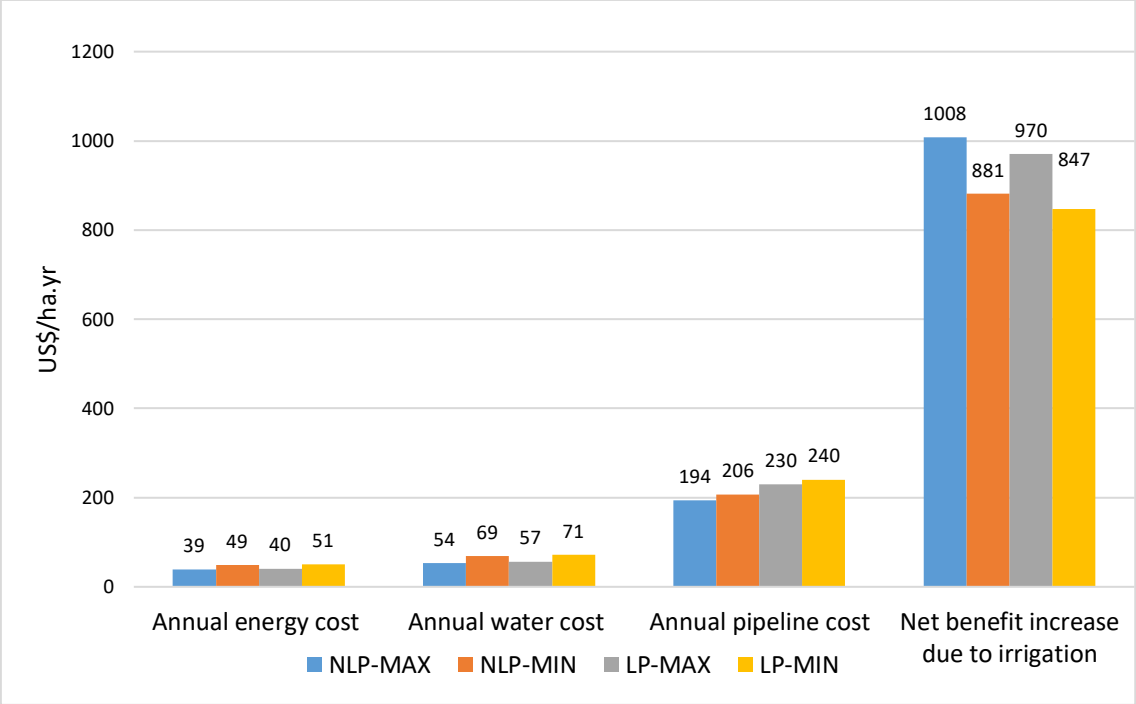

Figure 6. Annual energy cost, annual water cost, annual pipeline cost, and net benefit increase due to irrigation for the NLP and LP models.

5. CONCLUSIONS

The highest net benefit was found using the NLP model with the maximization criterion. The worst result was obtained with the LP model and the minimization of the total annual cost. The layout and management previously established by the designer are subjective and rarely results in the best solution, although the linear programming model always gets the global optimum. The NLP models get local optimal, but they defined the layout, design, and management of the systems, with more chance to obtain a higher net benefit.

The NLP model for maximization showed to be an adequate option for designing microsprinkler irrigation systems, defining the hydraulic network and the operational conditions that maximize *Bn* and WUE, with the lowest water consumption and lowest energy cost.

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7. APPENDIX A. NOTATION

The following symbols were used in this paper:

A = regression coefficient;

$APM =$ maximum allowable pressure head variation in the manifold line (m);

$APVS =$ allowable pressure head variation in the subunit (m);

$At =$ total area (m^2);

B = regression coefficient;

$B_g =$ annual increase in the crop gross benefit due to irrigation adoption (US$/ha yr);

$B_n =$ annual increase in the crop net benefit due to irrigation adoption (US$/ha yr);

$C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9, C_{10}, C_{11}, C_{12}, C_{13}, C_{14}, C_{15}$ = constants;

C = regression coefficient;

$CCP =$ cost (US$) of control panel;

$CF =$ cost (US$) of filter system;

$C_{ip} =$ annual cost with investment and pumping (cost of irrigation system) in US$/ha.yr;

$C_{kw} =$ cost of kWh (US$);

C_{mi} =microsprinkler cost (US$/unit);

$CP =$ cost (US$) of the pump station;

C_{pb} = production cost without irrigation (US$/kg);

C_{pe} =cost (US$/m) of polyethylene pipe expressed as a function of the diameter (m);

$CPP =$ annual pumping cost (US$/yr);

$C_{prod} =$ annual production cost (except irrigation) (US$/ha yr);

C_{pva} = cost (US$/m) of PVC pipe expressed as a function of the auxiliary line C_{pvm} = cost (US$/m) of PVC pipe expressed as a function of the manifold line diameter (m);
C_{pvn} = cost (US$/m) of PVC pipe expressed as a function of the main line diameter (m);
C_{pvs} = cost (US$/m) of PVC pipe expressed as a function of the submain line diameter (m);
CRF = capital recovery factor;
CV = cost (US$) of valves;
CW = water cost (US$/yr);
D = inside diameter of the pipe (m);
DA = auxiliary line diameter (m);
DL = lateral line diameter (m);
DM = manifold line diameter (m);
DN = main line diameter (m);
DS = submain line diameter (m);
E_a = application efficiency;
E_{MV} = manufacturing variation in emitter expressed as a coefficient of variation;
EU = emission uniformity (expressed as a decimal);
FA = the Christiansen's coefficient for the lauxiliary line;
FL = the Christiansen's coefficient for the lateral line;
FMD = the Christiansen's coefficient for the downhill manifold line;
FMU = the Christiansen's coefficient for the uphill manifold line;
FN = the Christiansen's coefficient for the main line;
FS = the Christiansen's coefficient for the secondary line;
h = microsprinkler pressure (m);
H_{AV} = average pressure head in the subunit (m);
HCS = head loss in the control station (m);
H_f = head loss due to pipe friction (m);
HFA = auxiliary line head loss (m);
HFL = lateral line head loss (m);
$HFMU$ =uphill manifold line head loss (m);
HFN = main head loss (m);
HFS = submain head loss (m);
HMD_g = pressure head at the outlet g of the manifold line (m);
HMD_j = pressure head at the outlet j of the manifold line (m);
HM_o = pressure head at the inlet of the manifold line (m);
H_{MIN} = pressure head that will give the minimum emission rate in the subunit (m);
HMU_{end} = pressure in the last outlet of the uphill manifold;
HT = total head losses plus the total difference in elevation (m);
I_d = number of irrigation hours per set of subunits working simultaneously, during an irrigation interval;
I_f = number of days in the irrigation interval (irrigation frequency);
I_h = number of irrigation days during the year;

$JP =$ manifold position ratio, which gives the same minimum uphill and downhill pressure head along a pair of manifolds;
$L =$ length of pipe (m);
LL = lateral line length (m);
$LM =$ manifold line length (m);
$LMD =$ downhill manifold line length (m);
$LMU =$ uphill manifold line length (m);
L_X = length of field in the x-direction (m);
$L_Y =$ length of field in the y-direction (m);
$NLL =$ number of outlets in the manifold;
$NLLD =$number of outlets in the downhill section of the manifold line;
$NLLU =$ number of outlets in the uphill section of the manifold line;
$N_m =$ number of emitters per emission point;
$NML =$ number of emission points in a lateral;
$NSU =$ number of subunits;
$P =$ product price (US$/kg);
P_W = water price (US$/m^3);
$Q =$ flow rate in the pipe (m^3/s);
$q =$ microsprinkler discharge (L/h);
$QA =$ auxiliary line discharge (m^3/s);
$QL =$ lateral line discharge (m^3/s);
$QMU =$ uphill manifold line discharge (m^3/s);
$QN =$ main line discharge (m^3/s);
$q_{MIN} =$ minimum emission rate in the subunit (m^3/s);
$QS =$ submain line discharge (m^3/s);
Q_{SU} = operational subunit discharge (m^3/s);
$q_w =$ average emitter discharge (m^3/s);
$S_L =$ distance between lateral lines (m);
$S_M =$ distance between emission points in a lateral line (m);
$T_{av} =$ number of hours available for irrigation per day;
$TAL =$ auxiliary line total length (m);
$TLL =$ lateral line total length (m);
$TM =$ total number of microsprinklers;
$TNL =$ total length of main line (m);
$TSL =$ submain line total length (m);
$VA =$ velocity in the auxiliary line (m/s);
$VN =$ velocity in the main line (m/s);
$VS =$ velocity in the submain line (m/s);
$W =$ annual volume of water applied per plant, in L $(2390\ L \leq W \leq 14342\ L)$;
$Y =$ crop yield with irrigation, in kg/ha yr;

$Y_r =$ yield in rainfed condition (kg/ha yr);
$\Delta Y =$ increase in the actual yield when irrigation is adopted (kg/ha.yr);
$\eta =$ pump and motor efficiency;

Hybrid Nanocomposite from γ-Fe_2O_3 Nanoparticles Functionalized in the Amazon Oil Polymers matrix

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Luciene Batista da Silveira

Abstract

tIn recent years, there was a crescent increase in studies involving hybrid magnetic nanocomposites from renewable resources, because of its importance in the synthesis of new organic biomaterials. Herein, we report a synthesis of Magnetic Nanocomposites (MNCs) from superparamagnetic nanoparticles based on iron oxide of maghemite (γ-Fe_2O_3) coated by a polymeric matrix. In this study, we used γ-Fe_2O_3 which are prepared using co-precipitation method, where salts with ions Fe^{+2} and Fe^{+3} are dissolved in distilled water and stirred until they reach about 60 ° C. Shortly after the mixture is add a solution of NH_4OH. After this step, the magnetite solute (Fe_3O_4) is left in oxidizing solution, thus forming nanoparticles of γ-Fe_2O_3. For activation of the functional groups and extraction of the polymer we used polycondensation method, wherein the oil extracted from Carapa Guianensis Aubl. is diluted in ethylene glycol ($C_2H_6O_2$). After that, the mixture undergoes processes: hydrothermal and isobaric-isothermal. Then, purification was performed polymer, thus obtaining a polymer of natural oil. The nanoparticles was coated for the polymeric matrix using dispersion method and freeze drying, thereby forming a hybrid MNCs ready for characterization. For the samples characterization was utilized X-ray diffraction (XRD) and spectroscopy: UV-Vis, Fourier Transform Infrared (FTIR), EDX and PAS. The results indicate that magnetic-polymeric nanocomposites structure formed was type core/shell, wherein the core was formed γ-Fe_2O_3 nanoparticles, coated by the polymer matrix, which presents some characteristics of the natural oil used in their synthesis.

Keywords: Hybrid Nanostructures; Nanocomposites; Organic Polymers;

1. Introduction

There was an expansion in Nanosciences researches, in the last century, due mainly its interdisciplinary nature. Advances in Nanoscience leads development of Nanotechnology its products have a wide variety of applications such as microelectronics, environment and medicine [1-4]. Among this research can highlight the development of hybrid nanostructures of polymer type that can provide new physical-chemical properties of the material [5]. It is also included the development of nanocomposites hybrids with magnetic properties polymeric matrix. For the synthesis of magnetic nanocomposites is common to use magnetic nanoparticles based on iron oxides (SPIONs). These nanoparticles exhibit a good attraction due to its characteristic superparamagnetic, as well as low toxicity, biocompatibility and stability in organic

media [6,7]. Another group of compounds that has promising properties and possible applications are polymers based on vegetable oils. The synthesis of this type of polymer is described in the literature as a great alternative, due to both its origin and its renewable unexploited properties [8].

In this work was synthesized magnetic nanocomposites (MNCs) from superparamagnetic nanoparticles based on iron oxide (SPIONs) coated by a polymeric matrix. The matrix used is extracted from natural oil of almond Carapa guianensis Aubl. Popularly known in the Amazon Region as Andiroba, the oil is formed by triglycerides rich in unsaturated fatty acids being traditionally used in medicine and in cosmetics [9]. For material characterization are employed optical techniques, aiming at the analysis of the crystal structure of the NPs, the molecular structure of Carapa guianensis almond oil, the molecular structure of the polymer extracted and the encapsulation of nanoparticles in the polymer matrix [10].

2. Experimental

2.1 Materials

The analytical grade reagents were commercially available and used without further purification protocols. Iron (III) chloride hexahydrate ($FeCl_3 \bullet 6H_2O$) and iron (II) chloride tetrahydrate ($FeCl_2 \bullet 4H_2O$) were purchased from Aldrich. Ammonium hydroxide (NH_4OH), ethylene glycol ($C_2H_6O_2$) and potassium hydroxide (KOH) were purchased from Sigma. Then, the Carapa guianensis oil was extracted from seeds, found in the Amazon Rainforest, through artisanal processes.

2.2 Synthesis of nanocomposite

In this study, we used maghemite nanoparticles (γ-Fe_2O_3) which are prepared using co-precipitation method, where salts with ions Fe^{+2} and Fe^{+3} are dissolved in distilled water and stirred until they reach about 60 ° C. Shortly after the mixture is add a solution of ammonium hydroxide (NH_4OH), thereby forming a precipitate of dark color. Then, the solution is heated to 70 °C and left for about 30 minutes under constant agitation. After this step, the magnetite solute (Fe_3O_4) is washed for several days with distilled water until the pH reaches between patterns 8 and 9. Finally, SPIONs are left in oxidizing solution, thus forming nanoparticles of γ-Fe_2O_3 [11]. For activation of the functional groups and extraction of the polymer we used polycondensation method [12,13], wherein the oil extracted from *C. guianensis* is diluted in ethylene glycol ($C_2H_6O_2$). After that, the mixture undergoes processes: hydrothermal and isobaric-isothermal. Then, purification was performed polymer, thus obtaining a polymer of natural oil. The SPIONs was coated for the PLCG using dispersion method and freeze drying, thereby forming a hybrid MNCs ready for characterization.

3. Characterization of Nanocomposites

For the samples characterization was utilized X-ray diffraction (XRD) technique, used for evaluation the crystallinity and the average size of the crystalline domains of SPIONs and spectroscopy: UV-Vis, Fourier Transform Infrared (FTIR), EDX and PAS, for analyze the molecular structure of the polymer matrix and the MNCs and checks of encapsulation of SPIONs for the polymeric matrix.

The XRD patterns showed characteristics peaks of crystalline structure of y-Fe_3O_4 nanoparticles (Fig. 1).

The reflection peaks relative to 220, 311, 400, showed similar results regarding from cubic spinel structured of Iron Oxide composite (JCPDS file No. 19-0629). Using the Debye-Scherrer equation, with it is possible to calculate the average diameter of the crystalline domains in this work have an average value of 6.9 ± 0,1 nm.

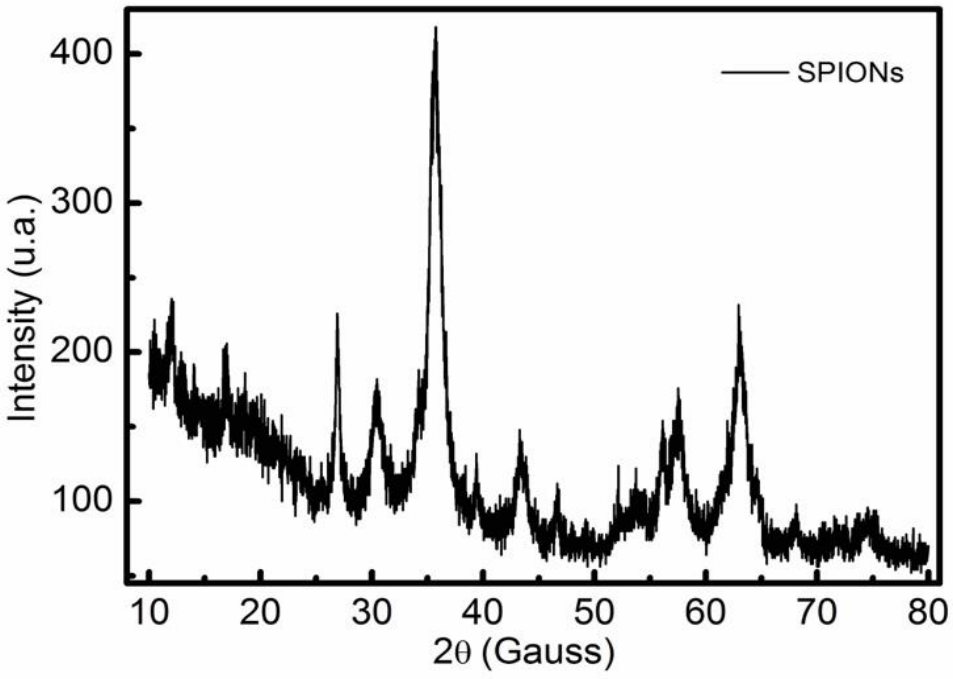

Figure 1: X-ray diffraction patterns (XRD) of SPIONs.

TEM was carried out using a JEOL 100 CXII. The figure 02 show the agglomeration of the nanoparticles, the data were treated generating a histogram thus estimating the polydispersity and the mean diameter. For nanoparticles the diameter remained at 6.4 nm with a polydispersity of 0.23 nm with an acurrancy of 0.1 nm. The estimated mean particle diameter measured from the TEM images is found to be consistent with the XRD results. The images of the MNC at a magnification of 80.000x it was possible to visualize a large agglomerate with branches of about 200 nm in length, by increasing the magnification to 300,000x it is observed that within these branches are the *y*-Fe_3O_4 nanoparticles.

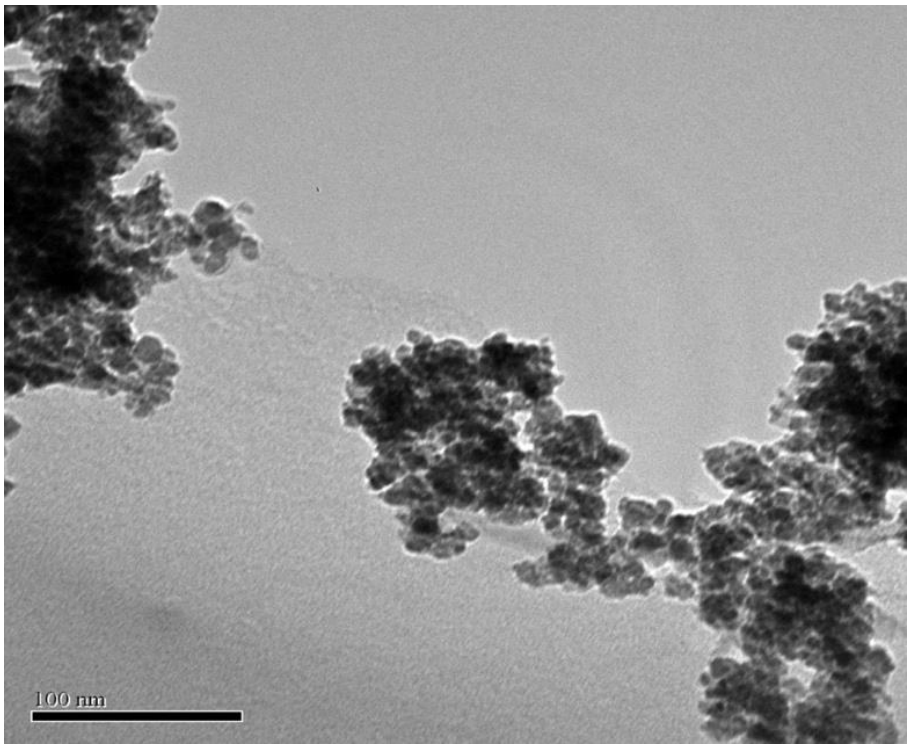

Figure 2 - Transmission electron microscopy of γ-Fe2O3 synthesized nanoparticles.

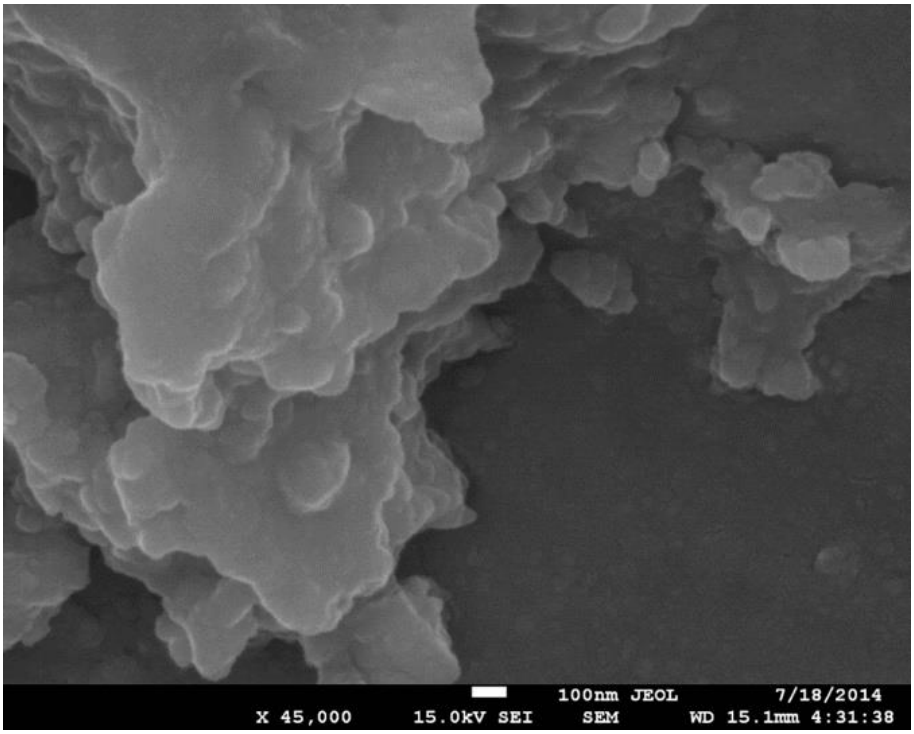

Figura 3 – Scanning electron microscopy of magnetic polymer nanocomposite, the base of the oil extracted from the seed of Carapa guianensis, with an increase of 45,000 x.

Having seen the image obtained by Scanning Electron Microscopy with a magnification of 45,000 x the NMC (Figure 3) it was possible to observe the surface observing a large structure, probably the surface of the polymer layer that surrounds the maguemita nanoparticles.

In Figure 4a, we have the FTIR comparison between the natural oil of C. Guianensis (OCG) and polymeric

matrix extracted (PLCG). At both was observed peaks at 2918 cm-1 and 2851 cm-1 that are characteristic vibrations of symmetric and asymmetric stretching of C-H bonds. In the OCG was observed interactions in 1754 cm-1 have the C=O bonds, in 1212 cm-1 and 1167 cm-1 have bonds esters CO and in 1095 cm-1 have the OCC bonds. For the PLCG the FTIR showed peaks at 881 cm-1 and 1035 cm-1 that are characteristic bands of asymmetric vibrations of the CO bond of ethyl esters, in 3309 cm-1 have characteristics of OH band with the suppression of C=O peak. The spectrum of the Andiroba natural oil has characteristic peaks of oils rich fatty acids, the appearance of connections CO in the organic polymer indicate the breakdown of the OH bonds that form the fatty oil caused by the attack using alcohol $C_2H_6O_2$, thereby forming a group of polyesters [14 - 16].

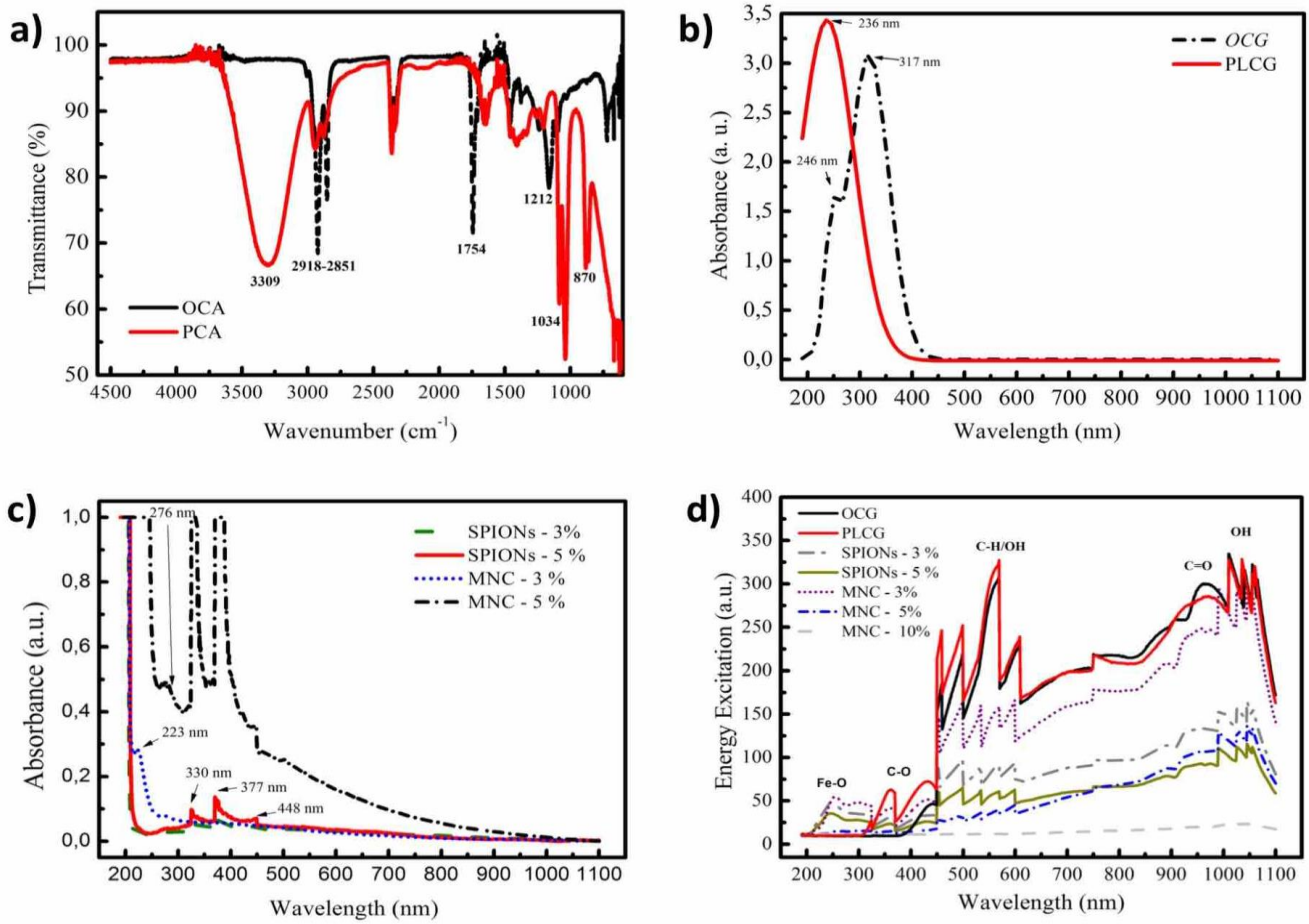

Figure 4: Spectrum FTIR and UV-Vis of samples: a) FTIR analysis of OCG and the PLCG. b) Absorbance spectrum (UV-VIS) of OCG and PLCG. c) Absorbance spectrum (UV-VIS) of SPIONs diluted (3% and 5%) and MNCs diluted (3%, 5%). d) Energy Spectrum (UV-VIS) of OCG, PLCG, SPIONs (3% and 5%) and MNC (3%, 5% and 10%).

The Figure 4b shows absorption peaks at 317 and 246 nm to the OCG and 236 nm for PLCG, we observe a displacement to the blue absorption and a prolongation of the line, suggesting polymerizing organic chains diterpene and sesquiterpene contributing to the formation of the polymer. Figure 4c shows spectra of SPIONs (3% and 5%) and MNC (3%, 5% and 10%). The spectra of SPIONs 5% and 3% have the same

characteristics only by difference the intensities of the signals of the structures. The data suggest electronics transitions in the O2 on the surface of nanoparticles in three regions 2.78, 3.35 and 3.85 (eV). Already the MNC 3 %, 5 % and 10% had responses in 3.28, 3.77 and 5.63 (eV), the response in 3% suggests two structures of type OH and Fe-O on the surface of SPIONs, in 5% the response occurs in three structures of type OH, C=O and Fe-O on the surface of nanoparticles. Consequently, to 10% the signal was saturated throughout the ultraviolet region and visible indicating coating of the SPIONs by polymer and formation of MNC.

Energy distributions in relation to wavelength were observed with specific structures as seen in Figure 4d. The SPIONs showed interactions associate the bonds OH and FeOH (253-324 nm, 450-600 nm and 1000-1068 nm). The OCG and PLCG presented peaks between 330-600 nm, 923-1000 nm and 1000-1068 nm. These interactions were associated the functional groups OH, C=O and CH. Compared the OCG with PLCG was possible to observe a change in spectrum behavior at approximately 965 nm which is related to the C=O bond, the decrease in the peak of excitement can be associate with removal of carbonyls links during polymerization. The MNC diluted to 3% and had much energy peaks PLCG, as the SPIONs, which suggests interaction of molecular structures Fe-O, C=O, CO and OH.

The PAS spectrum (Figure 3a) showed only interactions in the C-band (250-340 nm), this band is related to the absorption of the light that strikes the core of this nanomaterial and its encapsulation. The SPIONs strongly interacted at 265 nm, since the organic polymer obtained strong interaction peaks at 265, 291 and 306 nm, the spectrum peaks obtained MNC interaction was related to both polymer matrix and with the SPIONs, however, showed peaks with more intensity [17]. The EDX spectrum (Figure 3b) showed the chemical composition of OCG, PLCG and MNC. In the OCG was observed concentrations on Ru, Au, Cu. In the PLCG was observed the same concentrations in the OCG and the appearance of a small peak related to the K which was used in the synthesis. The MNC shows the chemical composition of PLCG, it was almost suppressed by a peak related interacting with iron, which can indicate a high concentration of SPIONs in its structure.

4. Considerations

This study reports on the successful preparation of the polymeric matrix from almond oil Andiroba (C. guianensis) and complexation nanocomposite maghemite nanoparticles (average diameter 6.9 nm). The procedures employed confirmed through the UV-Vis measurements, FTIR and EDX formation of the polymeric matrix. PAS measures indicate an encapsulation SPIONs by PLCG matrix. In summary, results from this study showed that the hybrid nanocomposite from PLCG showed good stability and biocompatible characteristics.

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Meaningful curriculum: the process of teaching and learning based on the reality of a traditional coastal community in the Brazilian Amazon

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Abstract

The study took place at Maria Benedita Mota School, located in the coastal community of Perimirim, which is part of the Araí-Peroba Marine Extractive Reserve (RESEX-Mar) in the municipality of Augusto Corrêa-PA. The participants of the study are educational agents (principals, pedagogical coordinators, teachers and students) immersed in the context and who have knowledge related to local biodiversity, such as the sea, mangroves, small-scale fishery, crustaceans, and family farming. The aim of the study is to understand how the school develops the meaningful curriculum based on the local reality and to systematize the traditional knowledge through oral texts about the mangrove and preservation of the local ecosystem in order to reach students. The methodology is a participatory observation of qualitative nature, which allows the understanding of the object under study having as starting point its reality. The project developed at the school comprised a class trip to the mangrove, drawings, paintings, poetry, paper folding, research, paper cutting and collage, ending up with the presentation in the pedagogical projects exhibition of the school. The results show that the teaching and learning processes become pleasurable, relevant and meaningful for students when the curriculum is based on the reality of people, especially students.

Keywords: Meaningful Curriculum; Tradicional Coastal Community; Tradicional Knowledge; School.

1. Introduction

Everyone has the right for education regardless of social, economic and political class. Education makes human beings able to transform the world. Corroborating this idea, we can state that "[...] the human being, as a social being, is constituted and constituent of the work process through language, culture and education [...]" (Melo, 2012, p. 24).

However, we live in a discriminatory society, in which the judgments are based on economic status, that is, the less economically favored a group is, the more this group suffer, either because of the social and political situation, or because of the devaluation of their own culture. For the aforementioned, we believe

that the only way out of this discriminatory society in order to consolidate values and culture is through education. Education can make people spread their culture and knowledge and also value their identities.

To support this idea, it is observed that:

> [...] Education can be understood as a fundamental category that allows the understanding of the relationship between learning, development and culture. It has a socializing function: its social nature makes us know and approach values, norms, practices and knowledge strategies specifically related to the group with which we interact [...] (Stolz, 2012, p. 78).

Education has a socializing function that consists in enabling people to know, respect and value the other, so that they become enlightened and aware people. This function refers to the cultural diversity that exists in traditional communities, which are also built through relationships with the environment in which they live. Therefore, we can conclude that culture is essentially important in the life of each human being. It is through culture that we build and value the environment in which we live, and seek for the fulfillment of rights and duties in society, reflecting on the human development (Stolz, 2012) that has its origin in cultural interactions of social nature, through language or other socialization processes. The result of these interactions is an awareness of cultural identity, since these people are bonded with the territory where they live.

Perimirim community, for instance, has fish and crab fisheries and family farming as main source of subsistence. Therefore, their identity representations are outlined in the territorialities, starting from individual and collective actions related to several aspects of culture and subsistence existing in the community.

The school is also an essential part in the definition of territorialities and, consequently, of identities. It helps, or should help, to create conditions for respecting culture and valuing the environment, which certainly develop the feeling of belonging, as in the case in Perimirim community. Therefore, the teaching and learning processes of children and adolescents start from the local reality, with pedagogical practices that teach them to value the resources related to the biodiversity of the fauna and flora existing in the mangrove, as well as the traditional knowledge acquired in fish, crab and shrimp fishery. Furthermore, family members transmit this kind of knowledge to current generations through orality, which is essential for the recognition and appreciation of the nature in which they live.

Perimirim community, which is part of the Araí-Peroba Marine Extractive Reserve (RESEX-Mar), is located 9 km from the headquarters of the municipality of Augusto Correa, on the Brazilian Amazon coast, in the Northeast of the state of Pará. It is a traditional community and has environmental resources linked to marine life, such as small-scale fishery, crustacean and shellfish extraction with emphasis on the mangrove ecosystem.

Therefore, this study aims at understanding how the local school develops the school curriculum and its relationship with the natural resources available in the community, as well as identifying pedagogical practices and their connection with activities that are representative in traditional communities. Our assumption is that children know the natural resources, especially the mangrove ecosystem and its

biodiversity, as they reside in the community and maintain a direct relationship with this territory in their everyday life.

The mangrove ecosystem in the Brazilian Amazon has been noticeable due to its richness in natural resources and its ecological and economic importance, as well as to being an essential nursery for the (re)production of animals (Schaeffer-Novelli, 1989). The current study is sustained in this environmental scenario and draws forth debates that are necessary to be done within a traditional coastal community in the Amazon.

1.1 School Curriculum and its Interfaces in Traditional Communities

Before addressing issues related to the school curriculum and its interfaces in traditional communities, there is a need to make inferences about the definition of territoriality. This element sometimes consolidates the direct relationship with education, since the development of meaningful learning consists of the relationship between the school curriculum and the territory in which the school is located.

According to Raffestin (1993, p. 158), "[...] territoriality reflects the multidimensionality of territorial living by members of a collective and by societies in general". It results in the valorization and conservation of the environment (mangrove), in which knowledge, culture and the definition of identity are concerns and their location, that is, their cultural roots are taken into account.

In this scenario of definitions, we understand the identity of the human being constituted by rich memories. For instance, we mention the project "*Meu Amigo Manguezal*" (My Friend Mangrove), that was developed in the aforementioned school, which aims to teach and learn through the knowledge of people who have direct relationship with the mangrove ecosystem, such as fishers and crab collectors, who are important characters that can help to develop meaningful learning with children.

Corroborating this idea, Arroyo (2011, p. 195) argues that:

> When real childhood becomes the focus, collectivities are led not to ignore the diversity of ways to live it. Pedagogical proposals are compelled to articulate with the specificity of the ways of living childhoods, conditioned by their social, ethnic, racial, or gender differences, or if they live in the countryside, urban areas or peripheries. Generic visions of a single childhood are overcome.

We know that the understanding of childhood in school spaces is becoming "prominent" in school curricula. This understanding is caused by the entrance of children and adolescents from the lower classes into public schools, and it requires schools to "[...] overcome generic visions of childhood [and] pedagogical, curricular, didactic, and evaluative proposals that are generic and decontextualized from the diversity of ways of living this human time [...]" (Arroyo, 2011, p. 195). Although the term childhood is quite broad, it has different meanings according to their social differences, and it is up to the school to incorporate these differences into the curriculum. Consequently, childhood will have its rights fulfilled and the curriculum will be significant, since it comes from the experiences lived by children.

It is worth remembering that, even today, the curriculum is considered as something utopian in schools. The contents comprised in it "[...] are poor in social experiences [...]", that is, they do not match the experiences lived by children, and "[...] their knowledge becomes poor in social, political, economic and cultural meanings [...]" (Arroyo, 2011, p. 119). Consequently, the school is no longer interesting and attractive to children. We believe that children's learning is affected and has no meaning when the school curriculum is constructed based on a generic reality. Therefore, the school curriculum needs to reflect the reality of the students and be translated into a fertile field for understanding the local and regional aspects and extended to territorial, political, social, economic and cultural dimensions.

This scenario is prescribed by Arroyo (2011, p. 128) when he points out that:

> [...] Curricula have to be translatable into experiences in order to be interesting and thought-provoking. They need to be able to capture and reframe the rich and cruel questions that popular children, adolescents, young people or adults carry to schools. If this process is blocked, the mobilization for teaching-learning is unlikely to be achieved by teachers. Blaming them is unfair.

Based on these reflections, this study proposes to analyze the representations that coastal environments raise in the learning of students from the Perimirim community. It is essential to consider the importance of the meaningful curriculum and its insertion in the pedagogical practices for in the first grades of elementary school students from an educational institution located in a traditional coastal community.

1.2 ***School Curriculum: a feasible meaningful action***

According to Moreira (1990), the Brazilian school curriculum had its theoretical bases in the American curricular models. However, it was adapted to the Brazilian school reality through the experiences of Anízio Teixeira, Francisco Campos and Fernando de Azevedo, who are considered the Pioneers of the Manifesto of New School in Brazil, a political document that addressed problems related to teacher training and to the needs of this "new" educator in order to work in the new school. These pioneers analyzed the educational background of a given period and recognized its historical and social context: "every education always varies according to a conception of life, reflecting, in each era, the predominant philosophy which is determined by the structure of society" (Azevedo, 1932, p. 40-41).

In the 19th century, society underwent major transformations: industrialization, urbanization, immigration in large metropolises. Certainly, these transformations also affected the school in an extraordinary way, since the curriculum is constituted from what society and economy dictates yet.

> Then the school was noticed as capable of playing an important role in fulfilling these functions and facilitating the adaptation of new generations to the economic, social and cultural transformations that were taking place. The curriculum was considered the instrument of excellence in social control that the school intended to establish [...] (Moreira & Silva, 2009, p. 10).

Corroborating this idea, Frigotto (2010) emphasizes that education is the main human capital. It is conceived as a producer of work capacity, enhancing the work factor, that is, education is seen as a commodity, through which we are educated for the labor market. The current curriculum in Brazilian schools, for the most part, is still produced by the hegemonic power and, certainly, dictates the representations of this ideology in the curriculum.

For Apple (2009), there are still many struggles and resistances to create a curriculum focused on realities, because we need to break some paradigms that we have been inculcated of, for instance, that hegemonic power is superior to heterogeneities.

In the view of Sacristan (2000), the curriculum must have a relationship between theory and practice. It must be constructed from a distinguished perspective, related to the realities in with people live in order to transform them through educational praxis. In other words, "[...] the most important parts of the curriculum are the experience, the re-creation of culture in terms of experiences, the incitation of problematic situations [...]" (Sacristan, 2000, p. 41). Therefore, the curriculum is location, space, territory, confrontation and the identity marks of children, young people and adults. That is why it is so influenced and constantly moves.

Usually, the school curriculum does not concern about traditional communities, cultures, traditional knowledge and local biodiversity, that is, these issues are denied and silenced by the curriculum designers. By not concerning about these concepts, the school proposes a "tourist curriculum" that marginalizes and denies the existence of local and cultural richness (Santomé, 1995).

The school aforementioned needs a curriculum that differs in its specificity, that focuses and takes into consideration the reality of the locus of our research: the coastal community in which the RESEX-Mar is located. This kind of curriculum should be meaningful for the student, making they feel that the context to which they belong is inserted in the educational process (Arroyo, 2011). The teachers need to be permanently trained to guide their school activities (Hage, 2014), in order to enable significant transformations to happen in the school and consequently in the community.

Finally, we expect that the school curriculum contemplates coastal environmental education, traditional knowledge and its relationship with the natural resources of the mangrove ecosystem and its surrounding areas, through teachers' reflection and autonomy.

2. Methodological Procedures

Methodologically, the approach used in the research was qualitative. According to Ludke & André (1986, p. 18), this approach considers that "[...] knowledge is not something finished, but a construction that is constantly made and remade [...]". We used the participatory research, in which the researcher "[...] shares the experiences of the other participants of the research, also participating in a systematic and permanent way [...]" (Severino, 2016, p. 126).

In addition, we used the technique of direct observation, which is considered essential for any type of field research within the scope of Human Sciences, supported by the field notes and the photographic record in order to materialize the research (Severino, 2016).

The data were collected from March to December, 2019. The research involves a group of 23

preschool students (Kindergarten) and a group of 30 first-grade elementary school students, who were part of the project "*Meu Amigo Manguezal*", developed by the teachers of the aforementioned classes at Maria Benedita Mota School, located in Perimirim community, Augusto Corrêa-PA.

Data analysis was carried out in the light of field observations and impressions collected as the mangroves came and went. We also conduct readings and understandings of the pedagogical practices applied by the teachers during the research.

2.1 Community and School Profiles

Perimirim community is located in a coastal area in the Amazon, Northeast of the State of Pará (Figure 1). The community is rich in natural resources, with typical characteristics of traditional communities (Brandão & Borges, 2014). In addition to the natural resources, it is rich in memories, cultures and knowledge that are directly connected to the "uses of natural resources" (Diegues, 2000, p. 8).

Figure 1. Location map of Perimirim Community in the Araí-Peroba Marine Extractive Reserve (highlighted) in Northeast of Pará, Brazilian Amazon Coast. (**Source:** QGis. Eyzaguirre L. A. Indira, 2020).

This community is located within the Araí-Peroba RESEX-Mar, regulated by the National System for the Conservation of Nature (Serviço Nacional de Unidade de Conservação da Natureza – SNUC), through Law no. 9,985, of June 18, 2000, which characterizes RESEX-Mar as:

> Art. 18. The Extractive Reserve is an area used by traditional extractive populations, whose subsistence is based on extractivism and, in addition, on subsistence agriculture and the creation of small animals, and has as basic

> objectives to protect livelihoods and the culture of these populations, and ensure the sustainable use of the unit's natural resources (Brasil, 2000).

Perimirim community is within a Conservation Unit. Therefore, it aims at protecting the culture and the livelihoods of the community. The community should strive for "[...] conservation, preservation and sustainable use of natural resources in expressive areas of the Brazilian marine coastal ecosystem [...]" (Santos, 2015, p. 44).

Maria Benedita Mota School is part of this context of a traditional community within a RESEX-Mar. The school was founded in 1974 by people coming from Coroa Comprida beach, located on the other shore of the Atlantic Ocean, which was being destroyed by erosion. The families from the beach had to migrate to the other side of the Ocean due to this situation (Political-Pedagogical Project).

The school operates in two buildings far from each other: the first is located close to the waterfront of the community, and the second building approximately 1,000 meters from the first one. The school comprises morning and afternoon sections of classes. The building structures is simple and unsuitable for serving educational agents and school activities appropriately. Some teachers come from Perimirim community, while other teachers come from nearby communities, from Augusto Corrêa headquarters and from Bragança, a neighboring municipality.

3. Results and Discussions

The School has the power to influence and transform the reality in which it is inserted. With this understanding, we observed that there was a process of environmental degradation on an accelerated scale in Perimirim community. Having this scenario in mind, two teachers from the second building of Maria Benedita Mota school carried out the project: "*Meu Amigo Manguezal*". The project had as initial objective to raise awareness among children about the importance of the mangrove ecosystem for the minimization of the degradation process that part of that community's territory was undergoing, and about the need to conserve the environment in order to guarantee that people are more aware about the preservation of the environment.

3.1. ***School and Meaningful Curriculum: experiences in traditional communities***

The aforementioned project was developed as follows: initially, the teachers presented students the project and talked about the importance of the mangrove, its vegetation, fauna, flora, types of soil in the community, and the importance of this ecosystem for the subsistence of the people who live there. The teachers organized a class trip to the mangrove, "[...] with the purpose of observing the natural and human environment [...]" (Legrand, 2010, p. 15). The students observed several types of trees in the mangrove. Back to the school, there was a conversation about what they observed and the students made their representations of the mangrove through the production of oral texts and pictorial texts (drawings), among other activities. Then, the students with the help of the teachers built a panel with the types of mangrove trees found in the class trip (Figure 2). In concomitance with these activities, observations and conversations about the significant curriculum were carried out with the educational agents of that school.

Figure 2. Panel built after the class trip with students and teachers. (**Source:** School's photo collection, 2019).

With the construction of the panel, the children realized the differences between the three types of mangrove trees: the *mangueiro* (*Rhizophora mangle*), the *tinteiro* (*Laguncularia racemosa*) and the *siriubeira* (*Avicennia schaueriana*) and their respective seeds. The identification of the types of mangrove trees was based on the traditional knowledge of a very experienced fisher from the community, who taught the children about the differences between those trees, which are popularly named as: black mangrove (*mangueiro*), red mangrove (*tinteiro*) and the white mangrove (*siriubeira*). We could notice that the presence of symbols and their meanings are essential to understand the local culture (Laraia, 2001).

In another moment, the teachers worked with two poems: *No mangue tem...* (In the mangrove, there is...) and *Introdução à poesia* (Introduction to poetry), both written by Ronivalber Ferreira. We present the original poems in Portuguese and their translation into English below:

Poem 1: **No mangue tem...**

No Mangue tem de tudo	In the mangrove, there is everything
Da natureza a desfrutar	From the nature to enjoy
Tem caranguejo, tem Siri	There's crab, there's *siri*
Tem peixe e tem Guará.	There's fish and there's *guará*.
No Mangue tem de tudo	In the mangrove, there is everything
Que podemos admirar	That we can admire
Tem árvores grandes	There's big trees
Para os pássaros pousar.	For the birds to sit.
No Mangue tem de tudo	In the mangrove, there is everything
Para nos deliciar	To delight us
Tem crustáceos, Tem Turú	There are crustaceans, there's *turú*
Tem Macacos a pular.	There are monkeys jumping.
No Mangue tem de tudo	In the mangrove, there is everything

Na Maré da preamar	In the high tide
Tem peixes e revoadas	There's fish and flock of birds
Precisamos preservar.	We need to preserve.
No Mangue tem de tudo	In the mangrove, there is everything
Tem bela vegetação	It has beautiful vegetation
Siriubeira, tinteira e mangueiro	Siriubeira, tinteira and mangueiro
Abrigo para reprodução.	Shelter for animal breeding.
No Mangue tem de tudo	In the mangrove, there is everything
Dia e noite, noite e dia	Day and night, night and day
É sustento das famílias	It's support for families
É comida com alegria.	It's food with joy.
No Mangue tem de tudo	In the mangrove, there is everything
Tem a biodiversidade	There's biodiversity
Da fauna e da flora	Of fauna and flora
A natureza é liberdade.	Nature is freedom.
No Mangue tem de tudo	In the mangrove, there is everything
Vamos todos preservar	Let's all preserve
Explorando com respeito	Exploring with respect
Para nunca acabar.	To never end.

Poem 2: **Introdução em poesia**

O mangue é tudo de bom	The mangrove is all the best
É fauna e vegetação	It's fauna and vegetation
Biodiversidade com fartura	Plenty of biodiversity
Não é brincadeira não.	It's no joke.
Tem caranguejo, tem peixe	There's crab, there's fish
Tem até camarão,	There's even shrimp,
Já vi até sururu	I've even seen *sururu*
Brincando de ser mexilhão.	Playing mussel.
O mangue é tudo de bom	The mangrove is all the best
Pra toda população	For the whole population
Com raízes entrelaçadas	With intertwined roots
Muita lama no chão	Lots of mud on the floor
Tem pássaros trabalhando	There are birds working
Querendo alimentação	Wanting food

O guaxinim despreocupado	The carefree raccoon
Com o caranguejo na mão.	With the crab in hand.
Aqui vamos começando	Here we begin
Com o nosso projeto legal	With our cool project.
"O que o mangue nos oferece"	"What the mangrove offers us"
É muito sensacional	Is very sensational.
Viva o nosso sistema	Cheers for our system
Que se chama manguezal.	That is called mangrove.

The poems read in the classroom were very important for students to develop oral skill and, through orality, they exposed their opinions about the constitution of the mangrove, the names of the animals they knew and other features of this ecosystem. After the students' inferences, another panel in which students could express their memories through drawings was built (Figure 3). The panel is entitled *No mangue tem...* (In the mangrove, there is...).

Figure 3. Panel elaborated using students' drawings. (**Source**: Authors' photo collection).

After the previous activity, there was another discussion of the poems with the students, highlighting the animals existing in the mangrove ecosystem, such as crab (*Callinectes sapidus, sp.*), uçá-crab (*Ucides cordatus*), *sururu* (*Mytella charruana*) and *turu* (*Teredo sp.*). Students performed paper folding activities, having in mind the colors previously set for each of them, (Figure 4). They also learn the song *Caranguejo não é peixe* (Crab is not fish)

Figure 4. Panel elaborated with students' paper folding activities representing the mangrove animals. (**Source**: Authors' photo collection).

Another activity carried out was the display of videos about the main birds that inhabit the mangrove ecosystem in the region: *guará*, heron, *taquiri*, among others. At this moment, we talked about nature, in order to raise awareness of the importance of preserving and conserving this ecosystem, and then there was the activity of cutting and pasting figures related to the theme exposed.

There was another class trip to the mangrove and the teachers and students debated about the importance of preserving and conserving the environment free from solid waste left by humans and the study of the soil (Figure 5).

Figure 5. Class trip to the mangrove (**Source**: Authors' photo collection).

Finally, the project culminated in a pedagogical projects exhibition carried out by the educational agents of Maria Benedita Mota School along with all the students. In the presentation, the students who participated in the project were representing the mangrove animals, and each student recited a verse from the aforementioned poems. The poem *Introdução à poesia* was recited at the beginning of the presentation. Then the students explained to the visitors about the mangrove using a model, they showed videos about the uçá-crab, and exposed the panels made in the classroom. In the end of the presentation, each student recited a verse of the poem *No mangue tem...*

The project "*Meu Amigo Manguezal*" was meaningful for the students, since we noticed the direct involvement and the awakening of the feeling of belonging to the community, especially when they were encouraged and provoked to reflect on their own realities.

Finally, it is clear that the project developed at the school, based on meaningful school curriculum, took into account the everyday life of that school and that community, since students' realities were represented and reframed as the teachers emitted stimuli from their daily experiences.

5. Conclusion

In this study, we reflected on the meaningful curriculum, which is often denied and silenced by schools. Nevertheless, some teachers dare to reflect and break the impositions of the hegemonic curriculum present in most Brazilian schools. When this happens, education is no longer treated in a marketing view, but becomes meaningful since it concerns about diversities existing in the knowledge of traditional communities, that is, it forms individuals considering local specificities.

The autonomous teacher, being responsible for the education of these children, must seek strategies to innovate the school environment, and projects with different pedagogical practices are forms that represent the reality of the students and can be modified according to the needs of the group of students.

The result of this study shows us other possibilities for future studies. Some of them are: the relationship of biodiversity and its specificities with the curriculum in the school context; the knowledge related to fish, crab, shrimp, *sururu* and other possibilities to teach through theory and practice; the effective incorporation of local culture in the school curriculum; the breaking of ideologies that deny and silence the

presence of traditional communities in the curriculum, among others. All of these study possibilities motivate us, since they are broad and meaningful themes.

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Social Media Marketing Communication: Effects on Brandy Equity and on Consumer's Purchase Intention

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Abstract

The objective of this work is to evaluate the effects of firm generated content (FGC) and user generated content (UGC) on brand equity (BE) and on the consumer's purchase intention. To achieve it, the research methodological approach was quantitative, cross-section survey type. Data collection was carried out by an online survey, and 322 valid responses were obtained. The proposed model was analyzed using the Structural Equation Modeling method (PLS-SEM). The results show that both the firm generated content and the user generated content influence brand equity. The content generated by the company, however, has a greater effect and has greater power to explain brand equity than the content generated by the users. On the other hand, the direct effects of FGC and UGC on the intention to buy are not significant when the effect of brand equity is considered. Therefore, this research contributes to the theoretical framework of marketing, specifically in the areas of relationship and digital marketing, by being one of the first to assess the joint effects of the content generated by the brand and by the consumer on brand equity and purchase intention.

Keywords: brand equity; structural equation modeling; firm generated content; user generated content; purchase intention;

1. Introduction

New communication and information technologies are changing market dynamics, especially the media landscape, which has undergone an intense transformation over the past two decades with the emergence and popularization of social media (Bruhn, Schoenmueller, & Schäfer, 2012; Kaplan & Haenlein, 2010; Mangold & Faulds, 2009a). The term social media is defined as a group of interactive applications, based

on the internet, developed from the ideological and technological bases of Web 2.0, and which allows the creation, editing, diffusion and exchange of content generated by users (Kaplan & Haenlein, 2010). Linked to this new dynamic, consumers have been using the virtual environment in the purchase decision process, to acquire and share knowledge about brands (Datta, Ailawadi, & van Heerde, 2017). This shared knowledge is not just about brand facts, but also covers all thoughts, feelings, perceptions, images, and experiences connected to the brand in consumers' mind (Keller, 2009).

In the process of brand evaluation, one of the most popular and potentially important topics in marketing has emerged in recent years: the concept of brand equity (Keller, 2009). Central to the theory and practice of marketing, brand equity is the result of the effort over time to build brand capital (Datta et al., 2017). The marketing literature points to two main strands for the study of brand equity: one is accounting-financial based and the other is based on consumer behavior (Keller, 1993; Yoo & Donthu, 2001). From the behavioral view, customer-based brand equity (CBBE) is understood as a set of perceptions linked to the name and symbol of a brand that adds (or subtracts) value to a product or service in the consumer's mind (Aaker, 1991; Keller, 2009). In this sense, it is theoretically established that the various marketing communications activities reflect both on the development of CBBE (Keller & Lehmann, 2006), and on consumer behavior (Keller, 2001).

In social media, these activities occur through content created and disseminated in the virtual environment (Kumar, Bezawada, Rishika, Janakiraman, & Kannan, 2016b), in which not only the company acts as a communicator, but also the consumer, who can actively participate as creator and disseminator of content about the brand (Bruhn et al., 2012; Kaplan & Haenlein, 2010). Due to the significance of active consumer participation in the social media marketing process when evaluating the effects of marketing communication in the creation of CBBE, it is essential to consider both the firm generated content (FGC) and user generated content (UGC) (Kumar et al., 2016b). This differentiation is important because while the communication initiated by firm is under managers' control, the communication initiated by users is independent of company's control.

However, previous research that investigated the effects of social media marketing communication on CBBE did not make this differentiation, treating the two types of content as a single variable (Godey et al., 2016; Kim & Ko, 2012; Seo & Park, 2018), or studied only one type of content (Christodoulides, Jevons, & Bonhomme, 2012a; Kumar et al., 2016b). Even though it is theoretically established (Keller, 2001), such prior research also did not evaluate the direct effects of social media marketing communications on the consumer's purchase intention (Bruhn et al., 2012; Christodoulides, Jevons, & Bonhomme, 2012b; Godey et al., 2016; Kim & Ko, 2012; Kumar, Bezawada, Rishika, Janakiraman, & Kannan, 2016a; Seo & Park, 2018). Following this literature gap, the purpose of this paper is to evaluate the effects of firm generated content and user generated content [on social media] make on brand equity and on consumer's purchase intention. Also, the combined effect of FGC, UGC and CBBE on consumer's purchase intention is investigated. Thus, this research aims to answer the following research question: What are the effects of firm generated content and user generated content on social media on brand equity and on consumer purchase intention?

To answer it, a questionnaire about the electronic products of smartphones and notebooks was applied in a sample of Brazilian university students. Data analysis was carried out using the Structural Equation

Modeling method (PLS-SEM) (Hair et al, 2017). The results show that the effects of the FGC and UGC variables on the brand equity variable are positive and significant, with the effect of FGC greater than the effect of UGC. However, the direct effects of these two variables on purchase intention variable are not significant, that is, they do not have a direct effect on purchase intention. Finally, the effect of brand equity variable on purchase intention variable is positive and significant.

Thus, this study contributes to both literature in the field of relationship marketing and digital marketing and its practice. By being pioneer in evaluating the effects of firm and user generated content on CBBE and on purchase intention, this research shows that social media marketing communications are capable of considerably increasing brand equity but are not capable of generate purchase intention directly. For practice, it is relevant to note that both generated contents can influence consumer's perception about a brand. Therefore, companies and marketers need to recognize the importance of engagement in social media and in carefully define a clear strategy for this. As through social media it is possible to find numerous opportunities to listen and engage consumers, it is possible to achieve positive results in brand equity and in purchase intention.

The rest of the paper is presented as following. Next section discusses the main concepts worked on. The development of research hypotheses is made on third section. In the fourth section, the methodological design is described. In the fifth section, data analysis and empirical results are reported. In sequence, is developed the discussion about the results and its implications. Finally, the final considerations are made.

2. Theorical Framework

2.1 Brand Equity

Starting from the consumer's perception, the most influential concepts of brand equity are those of Aaker (1991) e Keller (1993). Aaker (1991) understands brand equity as a set of assets linked to the name and symbol of a brand that adds (or subtracts) value provided by a product or customer service. Thus, a consumer perceives brand equity as the "added value" to the product, associating it with a brand name. Keller (1993) defines brand equity as customer-based brand equity (CBBE), stating that the power of a brand is inside consumer's mind. Meaning the things about the brand that consumers learned, felt, saw, and heard about the brand over time.

2.2 Social Media Marketing Communication

The definition of social media requires a discussion of two concepts: that of Web 2.0 and that of user-generated content (Kaplan & Haenlein, 2010). Web 2.0 is considered as the read-and-write Web. This is a new way in which software developers and end users have started using the internet: as a platform where content and applications are not only created and published, but also continuously modified by users in a participatory and collaborative way (Kaplan & Haenlein, 2010; Yen, Zhang, Waluyo, & Park, 2015). In this way, electronic word-of-mouth (eWOM) on social media can occur in several different ways. Users can intentionally post about brands and their products or services; or they may unintentionally display preferences to their network, such as becoming a fan of brands, interacting with brand posts, liking and commenting or posting content including the brand without any advertising purpose (Erkan & Evans, 2016).

Marketing communications represent the voice of a brand and define the means by which companies can establish a dialogue with consumers, allowing marketers to inform, persuade, encourage and remind consumers about their brands (Keller, 2001). Thus, FGC can be defined as types of communications that are posted on social media by brand managers or their representatives to consumers who are followers or fans of brand pages, accounts or channels on social media. (Kumar et al., 2016b).

2.3 Purchase Intention

The intention to exert some behavior is a central construct of Ajzen's Theory of Planned Behavior Theory (1991). According to the author, intentions are assumed to capture the motivational factors that influence a behavior, in addition to indicating the intensity of the effort that people plan to exert to carry out the buying behavior. Thus, the purchase intention refers to the mental stage in the decision-making process, in which the consumer develops a real willingness to act towards a product or brand (Wells, Valacich, & Hess, 2011).

3. Research Hypothesis

3.1 Social Media Marketing Communication and Brand Equity

In the context of social media, marketing communications developed through firm generated content are studied in several previous surveys (Godey et al., 2016; Kim & Ko, 2012; Seo & Park, 2018), such as those that investigated the effects that social media marketing efforts have on brand equity. Kim e Ko (2012) investigated this relationship in the luxury brand sector, and founded a positive and significant relationship between the constructs, that is, the better is the consumers' perception of social media marketing communications on the brand, the higher the CBBE. In a similar study, Godey et al (2016) also analyzed luxury brands and founded that social media marketing activities on have a significant positive effect on brand equity and its main dimensions: brand recognition and brand image. In turn, Seo and Park (2018) investigated the effects of social media marketing activities on brand equity and on customer response in the airline industry. The results showed that such activities have significant effects on brand recognition, brand image and brand equity.

As marketers seek to present their brand in a positive way, communication through social media, created and controlled by the company will be intended to convey positive content about the brand. A positive assessment of the FGC is predicted to positively influence brand equity. Thus, the hypothesis H1 is presented.

H1: The firm generated content on social media influences brand equity.

Regarding the effects of communication on social media generated by users on brand equity, it is necessary to recognize that the UGC is often not subject to intervention or control by the company. Therefore, user generated social media communication cannot be expected to be only positive, as it can be positive, negative or neutral (Bruhn et al., 2012).

Pior empirical research (Augusto & Torres, 2018; Bambauer-Sachse & Mangold, 2011; Colicev, Malshe, Pauwels, & O'Connor, 2018; Sijoria, Mukherjee, & Datta, 2018b) examined the direct effects of UGC on

brand equity.

In Bambauer-Sachse and Mangold's study (2011), the effects of online product analysis on CBBE were analyzed, and the research results showed that when the consumer analysis is negative, there is a negative effect on the company's brand equity. Augusto and Torres (2018) investigated the effect of brand and WOMe attitudes on CBBE in the banking sector. The results showed that a positive perception of the content positively influences brand equity. Additionally, Colicev et al (2018) investigated how UGC interact with brand recognition (one of the CBBE dimensions proposed by Keller (1993)), and with customer satisfaction. The authors found evidence that the user-generated content has a positive and significant effect on both variables.

Thus, it is expected that the content generated on social media by users about brands can influence brand equity, according to the hypothesis of research H2.

H2: User-generated content on social media influences brand equity.

3.2 Effects on Consumer Purchase Intention

The availability of brand content - both firm and user-generated - on social media offers a unique opportunity to observe customers' experiences with brands and try to decode how they relate to consumer behavior (Viswanathan, Malthouse, Maslowska, Hoornaert, & Van den Poel, 2018).

Ballantine and Yeung (2015) sought to understand how product evaluations can affect perceived credibility, brand attitude and behavioral intentions in the fashion market. The results indicated that negative analyzes led to lower ratings on brand attitude and purchase intention, while positive analyzes led to higher ratings on these two constructs. In turn, Baker, Donthu and Kumar (2015) investigated how the valence, the channel and the strength of the UGC's social bond impact on consumers' purchase intentions. The authors point out that the relationship between valence and purchase intentions is greater when the conversation takes place online, while offline conversations tend to be more strongly associated with the intentions of relaying the content, regardless of the validity of the conversation. In a study in the hotel sector, Nieto-García, Munoz-Gallego and González-Benito (2017) evaluated the effect of valence and UGC volume on consumers' purchase intention. The results showed a direct effect of valence on purchase intention, strengthened by volume. The conclusions suggested the relevant role of the UGC in determining consumers' purchase intention. Therefore, a significant relationship between the UGC and purchase intention is proposed, according to H3.

H3: User generated content on social media influences the brand's purchase intention.

In the view of Keller (2001), the marketing communications generated by the company can influence brand consumer's behavior. In the context of social media, the study by Kumar et al (2016) showed that FGC has a positive effect on both customer spending and cross-buying (buying several categories of products under the same brand). That is, the greater the perception of value in relation to the content generated by the company, the more consumers consume the brand.

In a complementary way, Hutter et al (2013) analyzed how marketing activities on social media, specifically

on the Facebook page of automakers, influence consumers' purchasing decisions. Their findings demonstrated that engagement in a Facebook fanpage has positive effects on purchase intention. The results also indicated that a negative perception of the fanpage content leads to negative effects on consumer behavior. Gautam and Sharma (2017), in turn, studied the direct and indirect impacts that social media marketing activities have on consumers' purchase intention of luxury fashion brands. The results revealed a positive and significant impact of marketing activities on consumers' purchase intentions in the context of social media. Thus, this work proposes that the FGc significantly influences the consumer's purchase intention, accordingly to hypothesis H4.

H4: Firm generated content influences the brand's purchase intention.

The seminal work of Cobb-Walgren, Ruble and Donthu (1995) explored some of the consequences of brand equity: consumer preferences and purchase intention. Their results reveal that the brands with the highest capital generated presented a significantly higher preferences and purchase intentions than the brands with the lowest value. The authors concluded that the consumer's purchase intention is one of the most significant consequences of CBBE.

In the air transport sector, Chen and Chang (2008) found similar results, with brand equity positively and significantly influencing consumers' purchase intentions. More recently, Foroudi et al (2018) investigated the relationship between the dimensions that constitute perceptual components of brand equity - brand perception, perceived quality, brand association, brand preference, brand image and country product image - in behavioral components brand loyalty and brand purchase intention. The results showed that all dimensions of the CBBE significantly influence consumer behavior.

Thus, it is proposed that brand equity significantly influences the consumer's purchase intention, according to the H5 research hypothesis.

H5: Brand equity influences the customer's purchase intention.

4. Methodological Design

To achieve the proposed objective and to test the research hypotheses, the research methodological approach was quantitative, of the survey type, and with transversal cut. To test the empirical model, it was chosen the electronic products sector, specifically smartphones and notebooks. These products can cover different consumer profiles, have an average replacement cycle and high prices depending on the product specifications. Due to these characteristics, and the wide expansion of the adoption of smartphones and personal computers in society, consumers tend to buy these products in a planned way, with extensive research on the internet (Akkucuk & Esmaeili, 2016).

4.1 Variables measurement

Assuming that the constructs of the theoretical model presented in the previous session cannot be observed directly (Hair, Hult, Ringle, & Rstedt, 2014), this section will present the operationalization of the

constructs that make up the research model. To measure brand equity, it was used the scale proposed by Baalbaki and Guzmán (2016), which is composed of four dimensions: perceived quality, preference, social influence, and sustainability; each supported by four to nine items, as shown in Figure 1. The constructs FGC and UGC are defined as proposed by Erkan and Evans (2016) and Park, Lee and Han (2007), and are measured by the consumer's perception about characteristics of the information expressed on the content. Finally, the scale used to measure the purchase intention construct followed the study of Bian and Forsythe (2012), in which the propensity of consumers to buy products from a certain brand is measured. The research model is shown in Figure 1.

4.2 Research Instrument

The questionnaire was composed of three parts. The first was formed by the control questions, to ensure the respondent was a consumer of technological products and that he had been exposed to the FGC and UGC during the purchase process. At this stage, it was also asked which product was purchased, its brand, the social media accessed, and which social media the respondent sought for opinions from other customers. Respondents who did not meet the criteria were eliminated at this stage. The second part of the questionnaire aimed to verify the respondents' perception of each construct of the proposed conceptual model. This section was built based on the operationalization of the variables. Respondents were asked to give their opinion on each of the indicators, on a 7-point Likert scale. Finally, the last part consisted of identifying the socioeconomic profile of the participants.

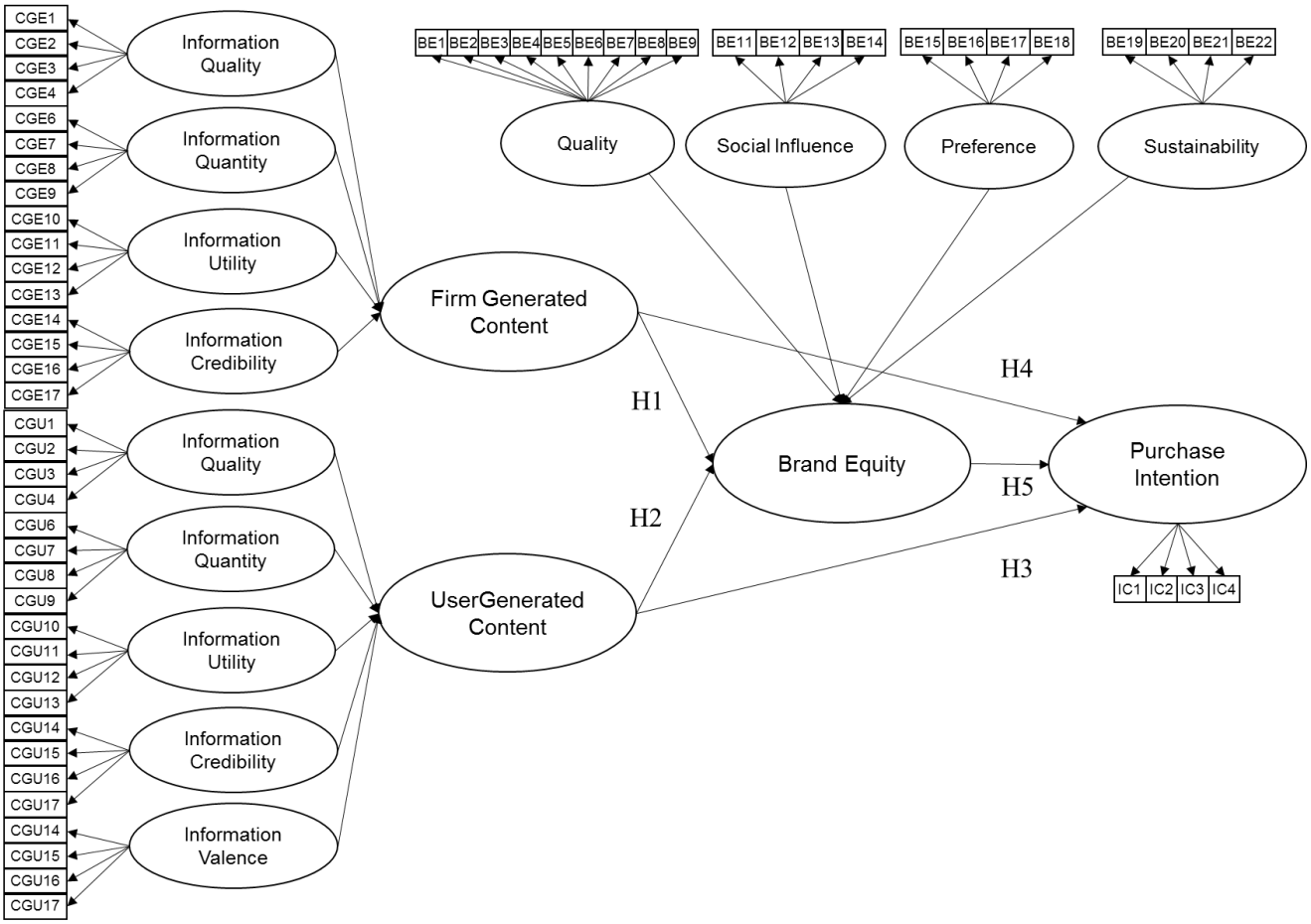

Figure 1. Conceptual model.

4.3 Data Collection

After the questionnaire elaboration, a pre-test with 20 university students was applied to assess the instrument in terms of writing, clarity, relevance, and time spent. After making minor adjustments, the questionnaire was sent via e-mail to about 100 undergraduate and graduate course coordinators from 21 Brazilian federal universities, asking that the questionnaire to be shared with students of the courses. Data collection occurred during the month of July 2019. In total, 858 responses were received. After eliminating respondents who did not meet the criteria, the final sample for analysis of the model was composed of 322 observations.

Most respondents are female (57%), have a family income of 4 to 10 minimum wages (38%), are undergraduate students (59%), and are 22 to 31 years old (50%). About the two types of products analyzed, smartphones were the products that respondents most bought in the last 12 months, with a total of 206 (64% of the sample), against 116 notebooks (36%). The most purchased smartphone brand was Samsung (28%) and Apple (25%). For notebook, the brands more purchased were Dell (36%) and Samsung (23%).

5. Data Analysis and Results

The proposed model was analyzed using the Structural Equation Modeling method (PLS-SEM). According to Hair et al. (2014), the PLS-SEM encompasses statistical techniques used to identify the relationship between several variables, independent and observable. To perform the data analysis, the software R (R Core Team, 2019) and specifically the package "plspm" (Sanchez, Trinchera, & Russolillo, 2017) were used. This method requires two main analyzes, discussed below: the confirmatory factor analysis (CFA), in which the measurement model was evaluated; and the analysis of the structural model, in which the relationships between variables were evaluated.

5.1 Confirmatory Factorial Analysis

The variables FGC, UGC, and CBBE are second-order reflective-formative constructs. That is, they are formed by first-order reflective constructs. Thus, for the realization of the CFA, the second order constructs were treated by the two-step approach (HAIR et al., 2014). In the first step, second order constructs received all the indicators of their first order constructs. In the second step, the scores generated for the first order constructs served as indicators in the measurement model of the second order construct. These new indicators are of a formative nature and must be evaluated by the criteria of this type of model.

Initially, the assessment of internal consistency and convergent validity was carried out. All constructs were within the acceptable limit for internal consistency. In convergent validity, the stroke of the UGC construct was below the recommended limit, as well as the load of several indicators. Thus, eight indicators were removed from the measurement models. The other indicators with loads below 0.70 were not removed as they did not generate a significant increase in stroke and the load of other factors. After removing the indicators, all constructs passed the criteria of internal consistency and convergent validity. Table 2 shows the results of convergent validity. The Fornell-Larcker criterion was used to assess the discriminant validity. It compares the square root of the AVE values with the correlations between the variables. Specifically, the square root of the AVE of each construct must be greater than its correlation with any other construct. The

only exception is between first order and second order constructs. As shown in Table 1, all constructs passed the criterion.

Table 1 - Results of Fonell-Larcker criterion

	Util	Quali	Quanti	Credi	FGC	Util1	Quali1	Quati1	Credi1	Valen	UGC	Qual	Pref	Sust	Infl	BE	IC
Util	**0.87**																
Quali	0.78	**0.86**															
Quanti	0.69	0.64	**0.76**														
Credi	0.74	0.78	0.63	**0.88**													
FGC	0.91	0.92	0.78	0.91	**0.76**												
Util1	0.42	0.46	0.44	0.57	0.53	**0.82**											
Quali1	0.31	0.39	0.40	0.37	0.41	0.66	**0.73**										
Quanti1	0.44	0.46	0.31	0.47	0.49	0.76	0.68	**0.85**									
Credi1	0.32	0.26	0.25	0.37	0.35	0.73	0.58	0.67	**0.86**								
Valen	0.35	0.40	0.27	0.46	0.43	0.58	0.50	0.49	0.52	**0.89**							
UGC	0.44	0.47	0.38	0.55	0.53	0.90	0.74	0.86	0.84	0.79	**0.72**						
Qual	0.51	0.55	0.35	0.58	0.58	0.45	0.41	0.49	0.36	0.60	0.58	**0.87**					
Pref	0.42	0.31	0.41	0.55	0.48	0.33	0.27	0.21	0.25	0.33	0.33	0.55	**0.83**				
Sust	0.29	0.23	0.22	0.43	0.34	0.26	0.11	0.14	0.27	0.19	0.25	0.26	0.44	**0.87**			
Infl	0.32	0.28	0.28	0.43	0.38	0.29	0.28	0.22	0.26	0.27	0.31	0.46	0.49	0.40	**0.80**		
BE	0.54	0.55	0.39	0.62	0.61	0.47	0.42	0.48	0.37	0.59	0.58	0.98	0.69	0.33	0.54	**0.89**	
IC	0.47	0.49	0.37	0.55	0.55	0.36	0.36	0.39	0.30	0.50	0.47	0.78	0.65	0.26	0.43	0.78	**0.80**

After confirming that all constructs passed the criteria of internal consistency, convergent validity and discriminating validity, a new measurement model was defined for the second order constructs, where the scores of the first order constructs were used as indicators of the second-order constructs, now with a formative nature (HAIR et al., 2014). Thus, it became necessary to evaluate these new measurement models. After confirming that all reflective and formative indicators passed the criteria, and with the question of second order constructs addressed, it was possible to proceed with the tests for the structural model.

Table 2. Results of convergent validity

Validade Convergente															
Variável	**Indicador**	**C.alpha**	**DG.rho**	**AVE**	**Carga**	**Variável**	**Indicador**	**C.alpha**	**DG.rho**	**AVE**	**Carga**	**Variável**	**Indicador**	**C.alpha**	**DG.rho**	**AVE**	**Carga**
Utilidade		0.895	0.927	0.760		Utilidade1		0.835	0.891	0.674		Qualidade2		0.960	0.966	0.758	
	CGE1				0.840		CGU1				0.866		BE1				0.904
	CGE2				0.886		CGU2				0.888		BE2				0.871
	CGE3				0.901		CGU3				0.694		BE3				0.861
	CGE4				0.859		CGU4				0.822		BE4				0.868
Qualidade		0.877	0.916	0.730		Qualidade1		0.702	0.817	0.528			BE5				0.848
	CGE19				0.844		CGU5				0.695		BE6				0.897
	CGE20				0.883		CGU6				0.799		BE7				0.792
	CGE21				0.822		CGU7				0.697		BE8				0.899
	CGE22				0.868		CGU8				0.709		BE9				0.889
Quantidade		0.641	0.807	0.582		Quantidade1		0.868	0.910	0.716		Preferência		0.845	0.896	0.683	
	CGE23				0.735		CGU9				0.840		BE10				0.795
	CGE25				0.773		CGU10				0.838		BE11				0.805
	CGE26				0.780		CGU11				0.859		BE12				0.828
Credibilidade		0.906	0.935	0.781			CGU12				0.846		BE13				0.875
	CGE27				0.881	Credibilidade1		0.879	0.917	0.733		Sustentabilidade		0.891	0.925	0.753	
	CGE28				0.920		CGU13				0.869		BE14				0.891
	CGE29				0.838		CGU14				0.864		BE15				0.866
	CGE30				0.894		CGU15				0.819		BE16				0.887
CGE		0.946	0.953	0.576			CGU16				0.871		BE17				0.826
	CGE1				0.740	Valência		0.909	0.936	0.786		Influência		0.829	0.888	0.639	
	CGE2				0.806		CGU17				0.914		BE18				0.819
	CGE3				0.832		CGU18				0.892		BE19				0.826
	CGE4				0.800		CGU19				0.870		BE20				0.820
	CGE19				0.803		CGU21				0.870		BE21				0.730
	CGE20				0.783	CGU		0.940	0.947	0.511		BE		0.944	0.952	0.613	
	CGE21				0.814		CGU1				0.742		BE1				0.898
	CGE22				0.718		CGU2				0.796		BE2				0.861
	CGE23				0.581		CGU3				0.714		BE3				0.859
	CGE25				0.632		CGU4				0.681		BE4				0.845
	CGE26				0.569		CGU6				0.644		BE5				0.828
	CGE27				0.772		CGU9				0.680		BE6				0.877
	CGE28				0.845		CGU10				0.773		BE7				0.783
	CGE29				0.801		CGU11				0.720		BE8				0.886
	CGE30				0.808		CGU12				0.720		BE9				0.856
IC		0.909	0.936	0.786			CGU13				0.694		BE11				0.547
	IC1				0.855		CGU14				0.685		BE12				0.619
	IC2				0.898		CGU15				0.748		BE13				0.573
	IC3				0.870		CGU16				0.752		BE19				0.613
	IC4				0.922		CGU17				0.709						
							CGU18				0.714						
							CGU19				0.653						
							CGU21				0.710						

Table 3 - Results of the multicollinearity of the formative model

Variables	CGE				CGU				BE				
Indicador	Util	Quali	Quanti	Credi	Util1	Quali1	Quanti1	Credi1	Valen	Qual	Pref	Sust	Infl
VIF	3.21	3.33	2.06	2.99	3.33	2.12	2.86	2.39	1.58	1.54	1.76	1.31	1.49

5.2 Structural Model

To analyze the structural model, four steps suggested by Hair et al (2017) were carried out. Initially, the model was evaluated for collinearity questions (VIF <5, Table 4), then the significance and relevance of the path coefficients and the levels of the R^2 determination coefficients were evaluated.

Table 4 - Results of the multicollinearity of the structural model

Endogenous variable	BE		IC		
Exogenous variable	FGC	UGC	FGC	UGC	BE
VIF	1.406	1.406	1.819	1.704	2.088

After confirming that all variables passed the collinearity test, the next step was to assess the significance and relevance of the path coefficients. This assessment ascertains the relevance and significance of each

path coefficient of the structural model, identifying whether each one is statistically significant in relation to the construct in which it is linked. The test seeks to estimate the direct relationships of the structural model, based on the path coefficients that typify the hypothetical relationships between the variables, revealing whether they are confirmed or refuted. For the analysis, the bootstrap procedure with 5000 sub samples was used again to generate the 95% confidence interval (HAIR et al., 2017). The results are shown in Table 5.

The results show that the effects of the variables FGC and UGC on the variable BE are positive and significant, with the effect of the FGC being greater than the effect of the UGC. Such results support the H1 and H2 research hypotheses. On the other hand, the direct effects of these two variables on the purchase intention variable are not significant, that is, they do not have a direct effect on the purchase intention. Thus, research hypotheses H3 and H4 are rejected. Finally, the effect of the BE variable on the purchase intention variable is positive and significant, thus confirming the research hypothesis H5.

Table 5 - Results of path coefficients

Path	Effect	p-valor	Hypothesis
FGC -> BE	0.445	0.000	Confirmed
UGC -> BE	0.378	0.000	Confirmed
FGC -> IC	0.051	0.242	Rejected
UGC -> IC	0.037	0.379	Rejected
BE -> IC	0.761	0.000	Confirmed

The next step in the evaluation of the structural model is the analysis of the coefficient of determination R^2. This coefficient is a measure of predictive accuracy of the model and is calculated by the square correlation between the real and predicted values of a specific endogenous construct. Therefore, the closer the R^2 value is to 1, the greater the predictive precision of the exogenous constructs to explain the variation in the behavior of the endogenous construct in question (HAIR et al., 2017). The bootstrap procedure with 5000 sub samples was again used to assess the significance of the R^2 values.

The results show that the R^2 of the BE variable is 0.521 and significant. Therefore, 52.1% of the variance in the BE construct is explained by the variation in the FGC and UGC constructs. This denotes a moderate R^2 value (HAIR et al., 2017). The R^2 of the purchase intention variable is 0.669 and significant. Thus, 66.9% of the variance of the variable is explained by the variables FGC, UGC and BE. This value also denotes moderate R^2 (HAIR et al., 2017). The non-significant results of the effects of FGC and UGC in the purchase intention raise the question of the occurrence of a mediating effect of CBBE in these relationships.

6. Discussion and Implications

Initially, the direct effects of the variables FGC and UGC on the variable CBBE were evaluated. The results show that the effects of both variables on brand equity are positive and significant. Together, the variables explain 52% of the CBBE variation. This result is consistent with the previous literature (Augusto & Torres, 2018; Colicev et al., 2018; Godey et al., 2016; Kim & Ko, 2012; Seo & Park, 2018; Sijoria, Mukherjee, &

Datta, 2018a) .

Comparing the effects of FGC and UGC, it is noteworthy that FGC has more effect on brand equity than UGC. Individually, the FGC explains 43% of the CBBE variation, against 39% of the UGC. Thus, the size of the f^2 effect of the FGC is also greater than that of the UGC. Bruhn, Schoenmueller and Schäfer's research (2012) showed that FGC and UGC can affect brand equity in different ways. According to the authors, the social media communication created by the company increases the functional brand image, while the social media communication generated by user affects the hedonic image of the brand. This work showed that in addition to influencing in different ways, the FGC has greater explanatory power than the CBBE than the UGC.

In turn, the effect of BE variable on the purchase intention variable is significant, and has a strong contribution to R^2, being its most important predictor. This relationship is consolidated in the literature, having been found in several studies (Chen & Chang, 2008; Cobb-walgren et al., 1995; Foroudi et al., 2018). On the other hand, the direct effects of the FGC and UGC on the purchase intention variable are not significant when the CBBE effect is considered. Regarding the contribution to the R^2 of the purchase intention, the UGC has no effect, while the variable FGC has a small effect. These results are in line with the findings of previous studies that point to a significant effect between these variables (Abubakar, Ilkan, & Sahin, 2016; Bambauer-Sachse & Mangold, 2011; Gautam & Sharma, 2017; Yadav & Rahman, 2017).

The non-significance of the effects of the FGC and UGC on the purchase intention raises the question of the possibility of a mediating effect of the CBBE on these relationships. When testing the direct effect of the variables FGC and UGC in the variable purchase intention without the inclusion of the mediating variable BE, a significant result was found for these relationships. Thus, the results show that the variable BE exercises complete mediation in the relationship between the variables FGC and UGC in the variable purchase intention, with the mediating variable absorbing 86.9% and 88.6% of the effects, respectively directly from the variables FGC and UGC in the Purchase Intent.

Marketing scholars have endorsed the importance of social media in marketing to retain and develop the customer base (Kaplan & Haenlein, 2010). Social media is also considered as a component of the marketing promotion mix (Mangold & Faulds, 2009b). This study contributes to the literature in the field of relationship marketing and digital marketing, as it is pioneer in evaluating the effects of the firms and consumer generated content on the CBBE and on the purchase intention. Another theoretically relevant finding is the mediating effect of brand equity in the relationship between FGC, UGC and purchase intention. Thus, the results of this research provide a greater understanding of such variables, showing empirically that social media marketing communications can considerably increase brand equity, but are not able to generate purchase intention directly.

As practical contributions, by showing that both the content generated by the consumer and that generated by the company are capable of influencing the consumer's perception of the brand, this work emphasizes that companies must recognize the need to engage in social media and define carefully a clear engagement strategy. Social media offers countless opportunities for the company to listen and engage with its consumers. Considering the FGC, marketers can focus on producing content that conveys quality information and that is useful to consumers. They must also be aware of the amount of information generated and their credibility with consumers.

On the other hand, the content generated by the brand's consumer on social media, is often beyond the reach of the company. Thus, the company must always be attentive to this type of content that can influence the value of the brand, devising strategies to soften the impact when this content is negative. In addition, companies can also promote electronic word-of-mouth, actively initiating consumer word of mouth advertising about their brand, leaving indelible impressions on consumers' minds.

6. Final Considerations

This research aimed to evaluate the effects of the firm generated content and user generated content on brand equity and consumer purchase intention. The joint effects of FGC, UGC and CBBE on the consumer's purchase intention were also analyzed. To achieve the proposed objective, five research hypotheses were raised, and a theoretical model was developed. The model was analyzed using structural equation modeling (PLS-SEM).

Theoretical model analysis showed that the effects of the firm and user generated content on the brand equity variable are positive and significant. Such results support the H1 and H2 research hypotheses. In addition, the effect and explanatory power of the FGC on the purchase intention is greater compared to the UGC. In other words, consumers take more into account the content generated by the company than that generated by the consumer when forming their perceptions about a brand. On the other hand, the direct effects of the variables FGC and UGC on purchase intention are not significant, that is, it do not had a direct effect on the purchase intention. Thus, research hypotheses H3 and H4 were rejected. As much as companies and consumers try to directly influence the purchase intention of other consumers through social media marketing communications, this direct relationship has not been found.

Finally, the effect of brand equity on purchase intent is positive and significant, confirming the H5 research hypothesis. Consumers' perceptions of a brand and how much value that brand brings to the product strongly influence their brand purchase intentions. In response to the research problem, the content generated by the company and the user about brands on social networks positively and significantly affects brand equity. However, they do not directly influence the purchase intention, but indirectly, being mediated by CBBE. Actions to improve the communication generated by the company and the consumer can lead to greater brand value. A high brand value, in turn, can directly influence the brand's purchase intention.

This work has some limitations. The focus on the university population ends up excluding most consumers of electronic products, and by limiting the interpretation of results to this specific population. Similarly, the choice to focus the search only on the category of electronic products, specifically on smartphones and notebooks, also limits the interpretation of results. Finally, given that the consumers studied are Brazilian, cultural issues may arise in the extrapolation of results to other contexts.

In addition, it is suggested that the effects of the dimensions of the FGC and UGC on the CBBE be investigated, in order to generate more insights into which characteristics of communications consumers consider most in building brand value. Similarly, it can be investigated which dimensions of CBBE are most influenced by FGC and UGC. In this work, the behavioral variable studied was the purchase intention. Other behavioral variables such as loyalty, intention to pay a premium price, among others, can be used and can generate different results.

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Ecological panels as an alternative for waste from mechanical processing of Amazonian species

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Abstract

The wood residues resulting from the operational phases in companies in the forestry market are normally considered by-products and, therefore, are discarded or reused for energy production, however, this material has a greater potential, such as the generation of new products through agglutination, which may generate a new segment in the wood industry, causing competition between products of native and planted species. This research aimed to develop agglomerated panels using residues of two tree species from the Amazon (Dinizia excelsa Ducke and Manilkara huberi (Ducke) Chevalier) and a mixture of commercial Amazonian species of high density, with the purpose of greater added value and a possible solution to reduce the negative environmental impacts of carbon emissions. The experimental design consisted of three treatments with five repetitions in each. Experimental panels were produced with a nominal density of 0.80 g/cm³, using castor oil-based resin with 10% percentages. The panels were pressed with a pressure of 10 MPa, temperature of 100ºC and with a pressing time of 10 minutes. The evaluations of the results obtained were compared with the ANSI A208.1 / 2009 standard and with the literature on agglomerated panels of tropical species. In physical properties, the panels showed compliance with the values found in the literature, however, they are outside the standard of the norm. Regarding the mechanical properties, the MOR values classify the panels in the medium to high density standard in accordance with the standard. The results of the MOE are superior to those of the existing literature, with emphasis on the perpendicular traction that presents values consistent with the literature. The machining evaluations carried out according to ASTM D 1666-11 / 2011, show a good quality in the finish. In general analysis and in compliance with the regulations, all panels have economic viability and potential for industrialization.

Keywords: chipboard panels, wood residues, tropical woods

1. INTRODUCTION

The Brazilian Amazon is one of the main tropical wood producing regions in the world and its growing stock contributes to more than 30% of the world's timber reserves [ITTO, 2014]. Despite presenting a significant amount of raw material, the activities carried out still predominantly develop in an

unsustainable manner, causing an enormous waste of forest resources in all stages of the production chain, from forest exploration to industrial processing in the sawmill [Araújo, 2013].

The average yield of Brazilian sawmills is around 60 to 80% [Batista, Silva & Corteletti, 2013]. However, in the Amazon region, the processing of native wood reaches a loss of 59% [Hummel *et al*., 2010], which causes an increase in the final price of the product and the volume of waste generated in saw dust and edge planks [Biasi & da Rocha, 2007].

Among the most explored native species we can mention the *Manilkara huberi* (Ducke) Chevalier (Maçaranduba) and *Dinizia excelsa* Ducke (Angelim Vermelho), sought mainly due to the multiple uses of their woods. In a study developed by [Melo *et al*., 2012], it was found that one log of *Manilkara huberi* (Ducke) Chevalier (2.90 m³) yields approximately 45% (1.30 m³) and the other 55% is waste, with 18.24 % of these residues (0.29 m³) being characterized as sawdust. While [Stragliotto, 2019] when studying the yield of sawn wood for export of the Dinizia *excelsa Ducke* species, a use of 40.18% with 59.82% of residues was observed.

This low yield can generate an increase in wood consumption, leading to a shortage of this raw material in the future. The yield in the processing or splitting of logs in the sawmill is an important issue that has an intrinsic relationship with sustainability in the use of forest resources, since the level of use of the raw material directly influences the area of explored forest necessary to meet the demand for wood [Iwakiri, 1990].

The necessary knowledge to solve these problems involves the characterization of the productive performance of these industries, the factors that generate waste, the volume and type of existing waste and the seasonality of its generation, in addition to the possible uses that can be given to this material [Brand *et al.,* 2002]. In addition, the prognosis of the stock and yield of the raw material processed at the sawmill is of paramount importance for businessmen in the forestry sector, enabling improvement in production planning, optimization and control [Iwakiri, 1990].

According to [Quirino, 2004], waste can be used energetically to produce heat, steam or electricity in thermoelectric plants. Another use is in the form of solid fuel, such as charcoal. Carbonization and combustion have been identified as alternatives to reduce waste from the timber industries, however, they generate impacts on the environment through the release of gases and derivatives [Fontes, 1994].

The use of residues for production in products with higher added value is a possible solution, not only to reduce the negative environmental impacts resulting from the emission of gases, but also to generate work and income [Rivela *et al*., 2006]. Thus, the objective of this work was to develop agglomerated panels using residues from two commonly used Amazonian tree species and a mixture of commercial high-density Amazonian species to enable the use of solid waste for panel production.

3. MATERIAL AND METHODS

3.1 Characterization of the study area and waste collection

The study was carried out at Instituto Nacional de Pesquisas da Amazônia (INPA) in partnership with the company Mil Madeiras Preciosas Ltda., linked to the Precious Wood Amazon (PWA) group,

located in the municipality of Itacoatiara about 227 km from the city of Manaus- AM (02° 43'S and 58° 31'-58° 57'O) [26].

The material from this study was obtained through a donation from the company linked to the project, where mechanical processing residues from the split of the logs identified as Massaranduba and Angelim Vermelho were donated.

The donated residues were transformed into chips, making wooden fillets for grinding in a mechanical grinder in a 60 mesh size. Later, with the crushed material, it was packed in a plastic bag for its accommodation.

3.2 Botanical identification

From the samples obtained in item 3.1, specimens oriented in the tangential and radial directions were made to be identified in the wood identification laboratory - LAIM of the Coordination of Technology and Innovation - COTEI of the National Institute for Research in the Amazon - INPA. The identifications were made based on the ABNT procedures and by comparing the samples cataloged in the xylotheque of this course coordination office.

3.3 Moisture content and bulk density

This property was determined by double weighing, weighing the residues on a precision scale after collection, and then they were placed in the oven at 105°C until they acquired a constant weight, to obtain the last weight for the calculation of humidity.–

The apparent density was determined by the stoichiometric method with wood moisture of 12%, being carried out in the Laboratory of Engineering and Wood Artifacts (LEAM), using digital caliper and precision scale.

3.4 Determination of ash and silica

The ash determination was carried out following the ASTM D1102-84 [ASTM, 2007] standard with 1 g of sawdust (60 mesh) and platinum crucibles with the use of a muffle furnace, with the quantification of silica performed according to [Vogel, 1981].

3.5 Fabrication of the panels

The methodology used for the production of the panels was in accordance with the specifications of NBR 14810-1 [ABNT, 2013] for medium density particle boards with adaptations. The desired formatting of the panels to be developed consisted of dimensions 400X400X15 (mm) with a density of 0.80g/cm3. The volume of matter to be used in production was calculated using the density equation.

The resin used in the manufacture was IMPERVEG AGT 1315 donated by the company IMPERVEG Polímeros Indústria e Comércio Ltda, with a composition based on vegetable polyurethane (originated from castor oil), formulated by the cold mixture of a prepolymer and a polyol. The applied experimental design produced three panels using 1632g of wood and 288g of resin, with 15 specimens removed from each panel for the tests. The panels were produced at the Physical-Chemical Testing Laboratory of the Faculty of Technology of Universidade Federal do Amazonas (UFAM), and the work

carried out by [Lima, 2012], [da Silva *et al.*, 2013] and [Silva, 2019] were adopted as methodological references.

3.6 Manufacture of panels

At first, the wood particles were weighed on a digital scale to separate the components the day before the preparation of the panels, which were accommodated in individual plastic packages. On the day the plates were made, the prepolymer and polyol components were weighed on a digital scale.

Then, the resins were mixed with the wood particles for a period of 10 minutes until the material was homogenized. Subsequently, this material was placed in a mold and compacted manually, being promptly placed in a hot press at a temperature of approximately 100°C, pressure of 10 MPa for 10 min.

After the pressing process, the plates were allowed to cure for 72 hours, where they received finishes and were cut for tests according to figure 1. Five specimens were removed from each plate with the following dimensions: 50X50 (mm) for the swelling and absorption tests (basic density), 50X200 (mm) for the elasticity module test and 50X80 (mm) for the rupture module being calculated through these also the perpendicular tensile strength.

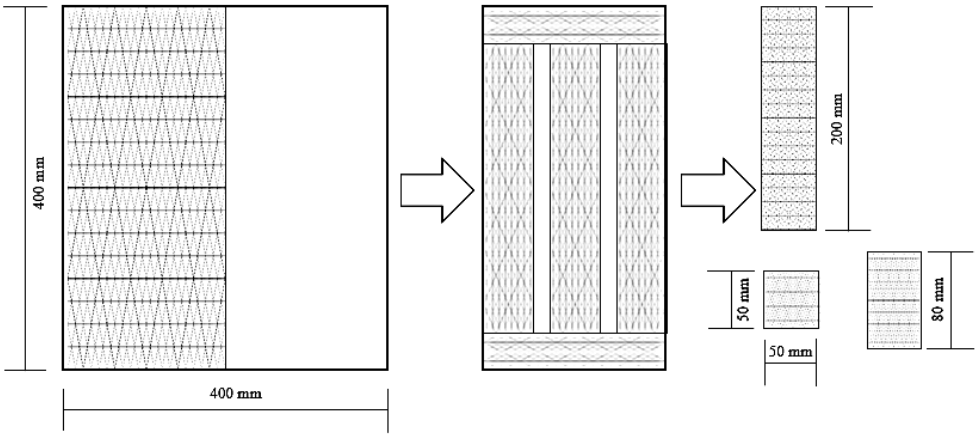

Figure 1. Squaring and cutting performed for sample removal

The apparent density of these panels was calculated according to item 3.5, and the swelling and absorption had their quantification according to NBR 14810-2 [ABNT, 2018], where it prescribes that they must be measured and weighed in 2 and 24 hours. The mechanical properties were calculated by the proposal by [Mesquita, 2013], and their evaluation was analyzed according to the ANSI A208.1 standard [CPA, 2009]. In addition, based on ASTM D 1666-11 [ASTM, 2011], tests were carried out for drilling and cracking by nails.

The drilling tests were performed with a vertical bench drill, using four helical drills of 6, 8 (high-speed steel), 10 and 12 mm in diameter with a sample perforation. The holes were drilled 20 mm apart and 10 mm from the edges. The parts were evaluated and classified according to the defects described in Table 1.

Table 1. Notes applied to part evaluations in machining tests

Note	Classification	Defects
1	Excellent	Absence of defects
2	Good	Presence of less than 50% of defects
3	Regular	Presence of 50% of defects
4	Poor	Presence of more than 50% of defects
5	Very poor	Presence of 100% of defects

Source: ASTM D-1666-11 [4].

In the nail cracking test, nails were inserted from the edges to the center of the pieces, 20 mm apart with the help of a hammer, using four types of gauge: 16X27, 14X21, 13X18 and 1x17 of the Gerdau brand. In this test, the presence of cracks or cracks was taken into account, with a classification as "accepts nails" (without cracks or in insignificant dimensions) and pieces that "do not accept nails" (with relevant cracks).

3.7 Statistical analysis

The assessment was made based on descriptive statistics (mean, standard deviation, median and quartile) in the criteria established by the standards that deal with wooden panels [ABNT, 2018]. The results of physical and mechanical properties were evaluated using the Kruskal-Wallis analysis of variance (ANOVA) (non-parametric) and the Nemenyi multiple comparison test when necessary.

4. Results and Discussion

The wood used in the production of the panels identified as *Massaranduba* (Manilkara huberi (Ducke) Chevalier), had red heartwood and light brown sapwood, with basic density ranging from 0.89 to 1.04 g / cm3, being classified as very heavy and with high natural durability. While the second red Angelim species (*Dinizia excelsa* Ducke) has reddish-brown heartwood and reddish-gray sapwood, with basic density ranging from 0.90 to 1.15 g / cm3, with the same classification as Massaranduba, with high natural durability. Both species have high commercial demand and produce a significant amount of waste around 70% per tree.

4.1 Ash and silica content

In the chemical analysis performed, an average ash content of 0.24% was found for both species (Table 2). In an individual panorama, the species *Manilkara huberi* (Ducke) Chevalier presented a value lower than that found by [Nobre *et al*., 2014], equivalent to 0.33%. When we compare the species *Dinizia excelsa* Ducke, it presented a value higher than that found by [Fortes, 2018], which expressed a value of approximately 0.18% and approximate to the value found by [Araújo, 2019] of 0.23%.

In a study developed by [Santana & Okino, 2007] where the ash content of 36 Amazonian woods was evaluated, there is a variation of this percentage from 0.2% to 2.3% based on the density of the wood. Other researchers, such as [Aquino, 2003] and [Numazawa, 1986], found values ranging from 0.43 to 1.76%. This variation can be related to the environmental conditions under which the tree grows [Fengel,

1989] and can also be influenced by its location and also by the discourse by [Collet, 1956], that the ash content after carbonization depends on the amount of inorganic compounds present in the wood.

Species	*Dinizia excelsa* Ducke			*Manilkara huberi* (Ducke) Chevalier	
	Ash Content		Silica content	Ash Content	Silica content
Samples	1	0.25	0.06	0.26	0.09
	2	0.22	0.07	0.22	0.10
Average	0.24		0.07	0.24	0.01

Table 2. Quantitative of inorganic compounds of the species

The average silica content found was different in each species, where Dinizia *excelsa* Ducke obtained a value of 0.07% and *Manilkarahuberi* (Ducke) Chevalier presented a content of 0.01% (Table 2).There is a scarcity of studies in the literature related to the amount of silica present in tropical woods, mainly due to the costly cost of its realization, however, in one of the few studies related to Amazonian woods, [Santana *et al*., 2013] working with 36 species quantifies a variation between 0.07% to 1.6% of this inorganic compound.

Despite not measuring the species *Dinizia excelsa* Ducke, it was possible to observe a similar value working with the species *Diplotropis purpurea* (Rich.)Amshoff from the same botanical family. However, when analyzing the species *Manilkara huberi* (Ducke) Chevalier, no silica was found, which diverges from the result found in this work. This fact may have occurred mainly due to the different methodologies applied.

4.2 Visual analysis of the panels produced

In a succinct way the panels *of Dinizia excelsa* Ducke *and Manilkara* huberi (Ducke) Chevalier had better homogenization with resin than the mixture of Amazonian species. In the visual analysis performed, no defects were found, where the surfaces were flat and without roughness (Figure 2). The plates proved to be resistant to small manual efforts and with some depressions in the corners.

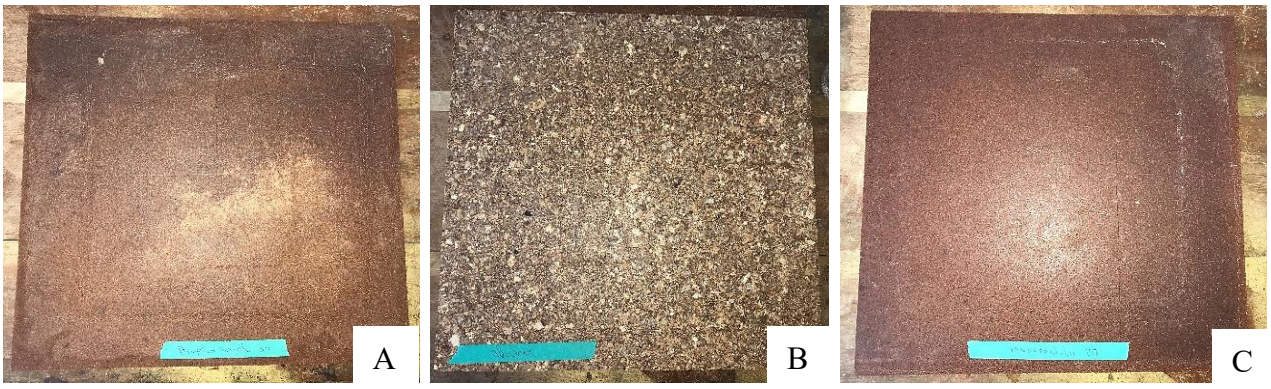

Figure 2. Wood waste boards: A) Dinizia *excelsa* Ducke; B) Mixture of high-density commercial Amazonian species; C) Manilkara *huberi (* Ducke) Chevalier.

4.3 Physical properties of the panels

The average values of the specific mass of the particle boards varied between 0.93g / cm³ to 1.20g / cm³ (Table 3), being higher than the established specific nominal density. According to the parameters of the ANSI A208.1 standard [CPA, 2009], these panels are characterized as panels of high density particles, as they presented values above 0.80 g/cm³.There was no effect of the treatment on the initial density (X^2 (2) = 5.82; p> 0.05), however, this effect was noticed after two hours of immersion (X^2 (2) = 11.16; p < 0.05), being highlighted by the differentiation between treatment with *Dinizia excelsa* Ducke and treatment with a mixture of commercial Amazonian species of high density (p0.05).

After twenty-four hours of immersion, an effect of the treatment on the density was also observed (X^2 (2) = 9.91; p <0.05), however this difference was noted between the treatment with *Manilkara huberi* (Ducke) Chevalier and treatment with a mixture of commercial Amazonian species of high density (p0.05).

Table 3. Average values of the apparent density of the panels

Species	SM (g)	2H	24H
Dinizia excelsa Ducke	1.03 (0.05)	1.39 (0.04)	1.42 (0.04)
Manilkara huberi (Ducke) Chevalier	1.20 (0.12)	1.25 (0.11)	1.44 (0.06)
NI	0.93 (0.21)	1.02 (0.16)	1.17 (0.17)

ME = specific mass; 2H = 2 hours after immersion; 24H = percentage 24 hours after immersion; NI = Mixture of high-density commercial Amazonian species. Values in parentheses refer to the standard deviation.

Absorption and Swelling

The average values of absorption and swelling for the particle boards after two and twenty-four hours of immersion, for each treatment, are shown in Table 4. In the analysis of variation performed for swelling, no effects were found on the treatments of two hours (X^2 (2) = 5.66; p> 0.05) and twenty-four hours (X^2 (2) = 3.92; p> 0.05). However, it is possible to notice an effect on absorption (X^2 (2) = 10.58; p <0.05) after a period of two hours, highlighting this factor between the Manilkara huberi (Ducke) Chevalier treatments and the mixed treatment of high-density commercial Amazonian species (p0.05). In the evaluation carried out in the twenty-four hour period, there was no effect on the treatments and the absorption of the panels (X^2 (2) = 5.84; p> 0.05).

The ANSI A208.1 standard [CPA, 2009] does not present values for the physical property of absorption, therefore, the comparison between values found in the literature with compatible panels is adopted. The absorption found by [Negrão *et al*., 2014] working with agglomerated panels with mixtures of tropical wood particles was an average absorption of 6.44% for two hours and 20.07% for twenty-four hours.

[Surdi, Bortoletto Junior & Castro, 2018] when working with agglomerated panels of residues of Amazonian species, obtain values of 10.55% to 37.80% for two hours and 27.64% to 53.69% for twenty-four hours. The values obtained in this work are between 4.08% to 43.54% for two hours and 20.23% to 48.31% for twenty-four hours, being within the observed value range.

For swelling, the values found in this study are between 3.10% to 6.19% for two hours and 9.10% to 11.26% for twenty-four hours. [Negrão *et al*., 2014] obtains an average of 3.46% for two hours and

9.35% for twenty-four hours, while [Iwakiri *et al*., 2016] working with agglomerated panels of Amazonian species presents values ranging from 2.67% to 7.67% for two hours and 8.44% to 18.50% for twenty-four hours.

The ANSI A208.1 standard [CPA, 2009] does not specify values for the thickness property of the swelling in the classification corresponding to the panels, thus stipulating the maximum 8% used for panels used on *decks*, where the composite panels of *Dinizia excelsa* Ducke and the mixture of commercial Amazonian species of high density would not present conformity, however, the composite panel of *Manilkara huberi* (Ducke) Chevalier presented a value close to the requirement.

Species	AA (%)		IE (%)	
	Two hours	Twenty-four hours	Two hours	Twenty-four hours
Dinizia excelsa Ducke	32.95 (4.07)	35.50 (3.69)	6.19 (1.98)	11.18 (1.33)
Manilkara huberi (Ducke) Chevalier	4.08 (1.25)	20.23 (8.87)	3.10 (1.15)	9.10 (1.86)
NI	11.94 (10.82)	28.22 (14.44)	5.47 (2.68)	11.26 (4.82)

Table 4. Average values of water absorption and thickness swelling

AA = Water absorption; IE = Thickness swelling; NI = Mixture of high-density commercial Amazonian species; Values in parentheses refer to the standard deviation.

4.5 Mechanical properties

The results of the mechanical properties for each panel are shown in Table 5, where in the analyzes of variance performed, no significant differences were found between treatments. It is observed that the values of rupture modulus (MOR) vary from 14.17MPa (*Manilkara huberi* (Ducke) Chevalier) to 20.73MPa (NI), the deformation of the panels with the individual species was in the range of 4 to 5mm, while the treatment with a mixture of commercial species that remained between 5 to 8 mm.

This value by the ANSI A208.1 standard [CPA, 2009] would classify them as medium to high density panels, with the commercial to industrial range as employability. [Negrão *et al*., 2014] in his study finds an average value of 1581MPa while [Longo *et al*., 2015] observes average values of MOE ranging from 552.14MPa to 935.62MPa for particulate panels produced from processing residue from five commercial tropical species.

The mean values of modulus of elasticity (MOE) ranged from 1522.76MPa (*Dinizia excelsa* Ducke) to 4185.74MPa (*Manilkarahuberi* (Ducke) Chevalier), with a variation of deformation in the range of 4 to 5mm, with only the exception of the treatment with mix of commercial species, ranging from 5 to 8mm. Only one panel fit the standardization made by ANSI A208.1 [CPA, 2009], this being the Manilkara huberi (Ducke) Chevalier panel, the others presented lower values based on density and the minimum elasticity module corresponding to 1725MPa.

[Negrão *et al*., 2014] in his study finds an average value of 1581MPa while [Longo *et al*., 2015] observes average values of MOE ranging from 552.14MPa to 935.62MPa for particulate panels produced

from processing residue from five commercial tropical species. Therefore, the values obtained in this study are higher than the values found for mixtures of tropical species.

Regarding the results presented, the perpendicular tensile strength varied between 0.63MPa (NI) to 0.95MPa (*Diniziaexcelsa* Ducke, 85%), thus meeting the minimum requirement of ANSI A208.1 [CPA, 2009] and classifying them as a utility in an industrial environment. [Negrão *et al.*, 2014] in their study finds an average value of 1.17MPa, while [Iwakiri *et al.*, 2016] that addresses values of 0.75Mpa to 0.90MPa. Despite this, these values are lower than those found by [Surdi, Bortoletto Junior & Castro, 2018] of 1.16MPa and 1.61MPa.

Table 5. Average values of rupture modulus (MOR), elastic modulus (MOE) and tensile strength perpendicular to the surface.

Species	MOR (MPa)	MOE (MPa)	TP (MPa)
Dinizia excelsa Ducke	18.55 (1.74)	1670.39 (254.22)	0.95 (0.17)
Manilkara huberi (Ducke) Chevalier	14.17 (5.26)	4185.74 (4301.76)	0.77 (0.16)
NI	20.73 (9.63)	1522.76 (633.03)	0.63 (0.25)

NI = Mixture of high-density commercial Amazonian species; Values in parentheses refer to the standard deviation.

4.6 Machining test

The performance of the specimens and their evaluation were based on the observation made by the responsible technician of the sawmill of the Laboratory of Engineering and Wood Artifacts (Table 6) at the time of the tests, the samples had on one side performed the drilling test while on the other the nail cracking test.

According to the analyzes, it was possible to conclude that none of the specimens presented difficulties or imperfections for the drilling test (Figure 3), however, for the analyzes carried out by nail cracking, the majority showed cracks when drilled at a distance of 10mm from the edge with the exception of the sample with high density mixtures (Figure 4), this performance may have occurred due to a bad uniformity of the edge of the panels because the same specimens did not show this behavior when pierced further to the center of the sample.

Table 6. Results of sample evaluations after machining tests.

Species	Drilling test		Nail splitting
	Sample	Note	Classification
Dinizia excelsa Ducke	1	1	Accepts nails*
Manilkara huberi (Ducke) Chevalier	1	1	Accepts nails
NI	1	1	Accepts nails

NI = Mixture of high-density commercial Amazonian species; * Particularities found

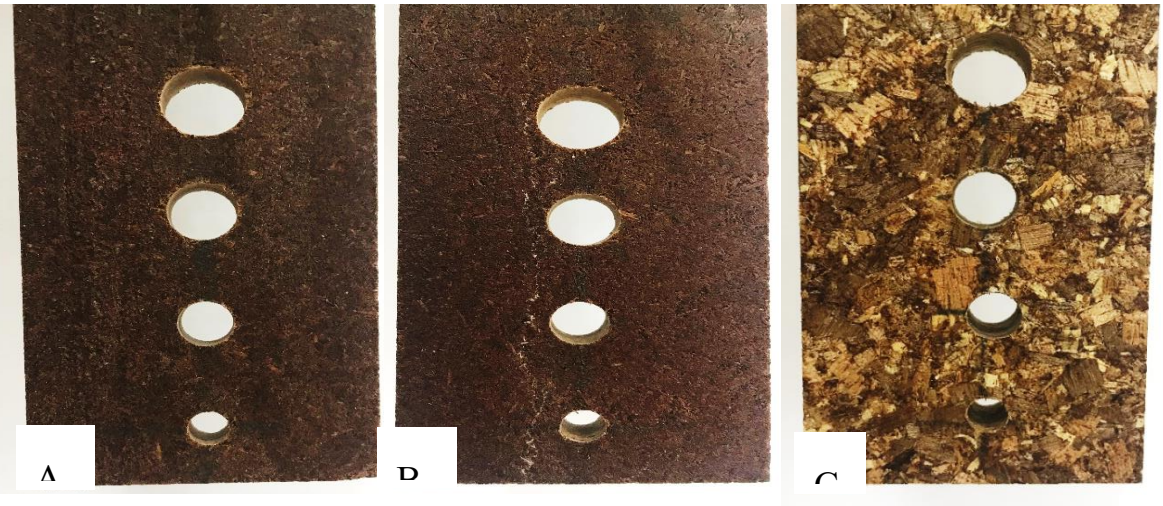

Figure 3. A) *Dinizia excelsa* Ducke; B) *Manilkara huberi* (Ducke) Chevalier; C) Mixture of species with high density

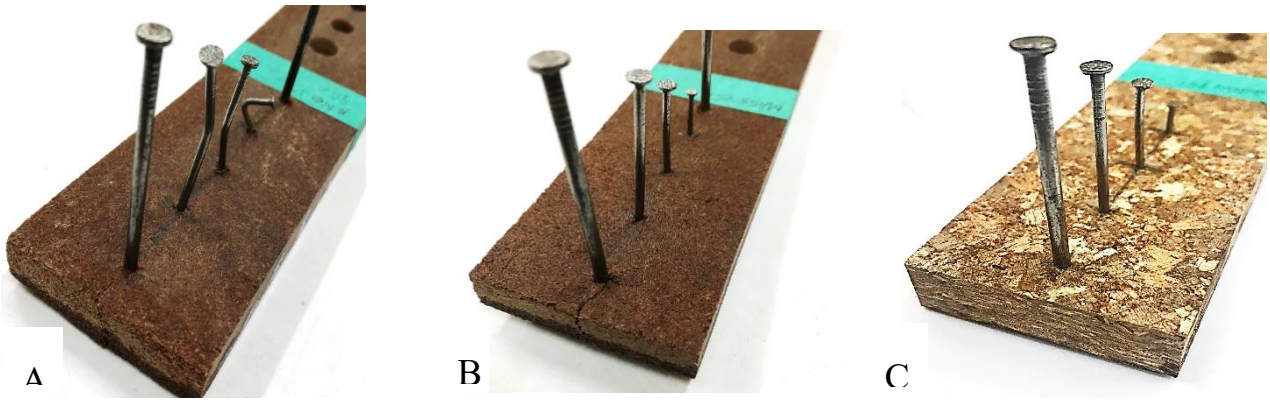

Figure 4. A) *Dinizia excelsa* Ducke; B) *Manilkara huberi* (Ducke) Chevalier; C) Mixture of species with high density

However, they obtained greater resistance as they approached the center of the piece, including the deformation of some nails (Figure 5). According to [Taques & de Arruda, 2016] the basic knowledge of the properties during the machining process provides adequate use, contributing to the better use of the raw material, consequently in less waste.

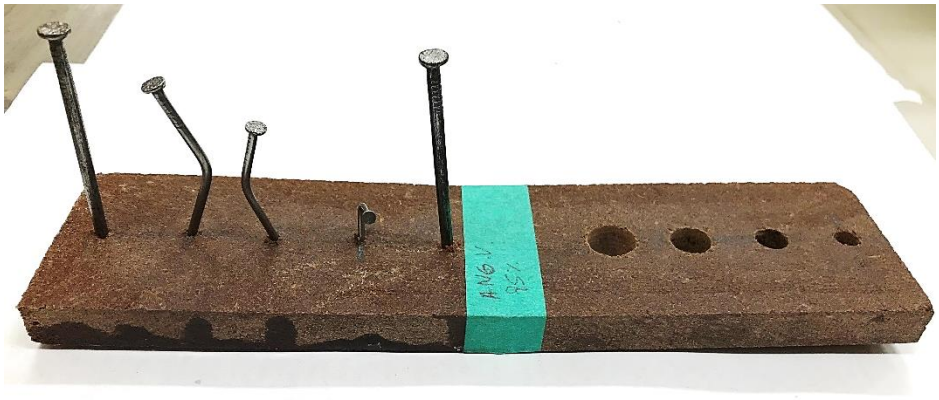

Figure 5. Nail deformities in the test specimen treatment of Dinizia *excelsa* Ducke (85%)

4.7 Analysis of production and use of panels

The panels produced have essential characteristics to be used in making different products. Considering that for every 9 tons of waste generated during the mechanical processing of the logs until the final product sold by the company, the amount of raw material used in each panel would produce 4500 panels, contributing to the environment and the insertion of a new line in the productive chain of the wood industry. Analyzing all the qualities of the panels, as well as the amount of raw material used, the possibility of large-scale production is envisaged in the future if any company is interested in selling.

5. CONCLUSION

The wood agglomerated panels of Amazonian species presented results similar to those found in the literature for physical and mechanical properties, with their highlight in the value of modulus of elasticity superior to the other studies.

The *Manilkarahuberi* (Ducke) Chevalier panel showed the highest viability of employability in the industry, however, the use of the other panels is also valid given its diversity of suitability of uses.

The residues of Amazonian species in the production of agglomerated panels enable a new product on the market, which will provide competitiveness to agglomerated panels generated by planted species, fostering a new market for the residues of the timber industry in the Amazon.

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Use of Physical Education Classes as a Didactic Laboratory for Teaching Mathematics: An Example with a Quadratic Function

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Abstract

The research objective of this study was to evaluate the use of Physical Education classes as didactic laboratory for lessons in Mathematics, presenting an alternative way to conduct classes, mainly of quadratic functions, illustrating basic concepts such as graphs plotting and determination coefficients, analyze if such use achieves some of the goals of using a Didactic Laboratory in addition to research ways to interdisciplinary with Physics. Discusses an action in which students work in groups to solve problems proposed based on empirical data obtained through play activities and measures of athletics values practiced by the students allowing may have the opportunity to produce arguments and more meaningful answers, which would improve the overall learning. The athletics and recreational activities are then used as problematic objects both empirically and qualitatively. As a result, it was observed that some of the objectives of a Didactic Laboratory are achieved when using the Physical Education classes and it appears that this feature is much more available in public schools than they are equipped with a science laboratory.

Keywords: Teaching of Mathematics, Physics Education, Didactic Laboratory, Physical Education, Interdisciplinary.

1. Introduction

Many teachers in Brazil have experienced difficulties in teaching mathematics and as a result seek alternative methods in order to present new teaching resources aimed at stimulate the student and show the concepts in a way that has less difficulties in the teaching and learning process. Thus, the need for innovation and the use of methods alternatives has become a trend in recent years (BORGES, 2002).

One of these trends is mathematical modeling that uses empirical data. So the teacher provides an environment in which students can problematize and investigate, through exercises mathematical, more real and concrete situations, making it possible to analyze the dimension discourse of science teaching and learning processes in real situations in the classroom (VILLANI AND NASCIMENTO, 2003). The traditional Didactic Laboratory seeks to identify within routine activities, such as athletics exercises and other recreational activities, the concepts mathematicians involved in them.

The use of the traditional Didactic Laboratory is a subject that has been widely studied by researchers in science education in Brazil, even without a specific space for such (GRANDINI AND GRANDINI, 2008). For a country where a considerable fraction of students have never had the opportunity to entering a science laboratory, it may seem absurd to question the validity of classes practices, especially as in most schools they simply do not exist (BORGES, 2002). One should try to offer students an alternative to the traditional didactic laboratory through routine activities, such as physical education classes. Like this, this proposal aims to identify within athletics and other activities playful concepts of quadratic function (IEZZI AND MARAKAMI, 1993; LIMA, 2013) involved in them and analyze not only quantitatively, but also in a conceptual way the exercises of Physical Education through Mathematical concepts.

2. Methodology

The research was carried out in stages at a Public School in the city of Belém – State of Pará - Brazil. In the first, we tried to determine the objectives of the didactic laboratory, which according to GRANDINI and GRANDINI (2008) are: 1) illustrate content taught in theoretical classes; 2) use experimental data to solve specific problems; 3) stimulate and maintain the student's interest in the study of mathematics and 4) help to bridge the gap between theory and practice. Such search consisted of a research based on materials involved by other researchers in the use of the Didactic Laboratory and the use of recreational activities (VILLATORRE et al., 2008), seeking to establish modeling processes in Mathematics classes. This research showed the importance of the Didactic Laboratory in the training of high school students (GRANDINI, GRANDINI, 2008).

In the second part of the work, a discussion was developed about the space and time quantities and their units of measurement, an initially theoretical view. Then a series of measurements is made, which were performed with tape measure and measuring tape to determine the size of the objects and some sizes of linear trajectories. It was interesting to note how the size perception of measurement units such as the meter and centimeter was flawed. During the measurements taken by the students, the concept of significant algharisms without the use of annotations was discussed and it was later verified that this resource seen in practice, even without it have been noticed by the students, was better absorbed than those taught in the classroom, since the students gave it greater meaning.

To paraphrase the comment of one of the students in the class seems to me to be very relevant to the situation. "As I was holding the measuring tape and making the size measurements it was easier for me to learn". This shows that the use of the senses is very important in learning scientific concepts.

Then, competition groups were formed, dividing 38 students into four groups, two groups containing 9 students and two groups containing 10 students. These groups were engaged in two kind of competition.

The first competition was related to the athletics dispute and the second competition was related to the precision of the measurements of the times and distances referring to the athletics dispute. Each team would then have to choose their athletes who would participate in the activity athletics, in this case, the shot put was chosen.

Each team chosen an athlete to compete in shot put and the other team members were tasked with measuring the distance of the shot from all groups. There was no computerized equipment to measure the distance of the pitches, so students' measurements were compared between themselves. Table 1 shows the measurements recorded by each team.

Table 1 – The distance measurements recorded by each team in the shot-put activity.

Athlete	**Distance measurements recorded by each team (m)**			
	Team 1	Team 2	Team 3	Team 4
Team 4	13,04	13,05	13,04	13,02
Team 2	12,68	12,68	12,67	12,67
Team 3	11,53	11,54	11,54	11,53
Team 1	10,40	10,42	10,41	10,42

In each shot put, it was assumed that there was an angle of about 45 degrees to the vertical axis. Thus, the following question was asked: With an angle of 45 degrees at the launch and considering the height of the athlete as initial height of the object (weight), what was the initial velocity of shot put?

This situation created several inquiries by the students who questioned the way the launch angle was chosen, but as we did not have the equipment to carry out this measure, the value was accepted (with reservations).

In this case, it was observed that even one or two "assigned" parameters without taking the necessary measures creates a lot of doubt and, therefore, difficulty in assimilating the concepts involved.

A playful activity was also carried out with the ball tossing among the students. To analyze the movement of the thrown ball, each team selects three students to be the experimenters and the rest of the team to be for data collection and analysis. While two students throw a handball ball from one to the other, a third student performs motion filming. In this activity, each team produced several videos. With the videos in hand, the students responsible for analyzing the movements chose one of the videos made. The data collected from the chosen video was used to assemble Table 2 with information relevant to the description of the movement, such as time of movement and maximum height. The reach of the movement remained fixed between the teams since the position of the students who were making the shots were previously established. The heights were determined using the equation:

$$h = \frac{g.t^2}{2}$$

where t is the ascent time obtained by the timing given by the videos made by the students and g is the gravity acceleration.

Table 2 - Time measurements collected in ball launch activity

	Collected data			
	Team 1	Team 2	Team 3	Team 4
Total time (s)	1,83	2,08	1,96	1,92
Ascent time(s)	0,92	1,04	0,98	0,96
Maximum height(m)	4,2	5,4	4,8	4,6

3. Questioning the collected data Problems developed from the recorded data

The following is a collection of some of the problems proposed to students in the classroom regarding the empirical data collected during physical education classes. The obtained tables were organized in small handouts and distributed to students before each series of exercises. The construction of the graphs by the students was done with a more modern tool, in this case, GeoGebra (dynamic mathematics software).

3.1. Shot put problems

The following problems will use the data in Table 1. The resolutions will be show for the data collected by Team 1.

3.1.1. Problem 1

Considering the shop put made by the students from an angle of $\alpha = 45º$, determine the velocity of the launch using the reach value measured by your team. Considere: $g = 10\ m/s^2$ and $A = \frac{V_0^2 \sin(2\alpha)}{g}$ (reach).

Resolution:

It will be shown the resolution for the data recorded by team 1. Since $\alpha = 45º$, then $sin(2\alpha) = 1$, so the launching velocity can be determined by:

$$V_0 = \sqrt{gA}\ .$$

Hence the velocities per team will be: Team 1: $V_0 = 10{,}20m/s$; Team 2: $V_0 = 11{,}26m/s$; Team 3: $V_0 = 10{,}74m/s$; Team 4: $V_0 = 11{,}42m/s$.

3.1.2. Problem 2

Using the trajectory equation:

$$f(x) = \tan(\alpha)x - \frac{gx^2}{2(V_0\cos(\alpha))^2},$$

write the function that represents the trajectory of the weight thrown by your team, considering $\alpha = 45º$ and the velocity value determined in the previous question. $(g = 10m/s^2)$.

Resolution:

The winning team launching velocity, that is the Team 4, will be presented in this solution, but every team made your resolution. With $V_0 = 11{,}42m/s$ and $\alpha = 45º$, we will have $cos^2(\alpha) = (cos45)^2 = (0{,}71)^2 = 0{,}5$ and $tan(45) = 1$, we get

$$f(x) = x - 0{,}076x^2$$

3.1.3. Problem 3

Determine the roots of the equation obtained in the previous question.

Resolution:

We get

$$x - 0{,}0767x^2 = 0$$
$$x(1 - 0{,}0767x) = 0$$

Therefore, $x_1 = 0 \; and \; x_2 = \frac{1}{0{,}0767} = 13{,}04$. Note that the value of x_2 is equal to the launch reach.

3.1.4. Problem 4

Determine the vertex of the parabola given by the equation obtained in the Problem 2.

Resolution:

We have

$$V = \left(\frac{-b}{2a}, \frac{-\Delta}{4a} \right),$$

with $a = -0{,}0767$, $b = 1$ and $\Delta = 1$. Thus,

$$x_v = \frac{-b}{2a} = 6{,}52 \text{ and } y_v = \frac{-\Delta}{4a} = 3{,}26$$

Note that the value of x_v is the midpoint of the roots obtained, and that the value of y_v corresponds to the maximum height of the weight's trajectory.

3.1.5. Problem 5

Sketch graph the function obtained in the Problem 2.

Resolution:

The function being given by:

$$f(x) = -0{,}0767x^2 + x,$$

the roots are $x_1 = 0 \; and \; x_2 = 13{,}04$ and the vertex the point (6.52; 3.26), we can Sketch the graph as shown in Figure 1.

3.2 Problems with ball launch

The following problems use the data in Table 2.

3.2.1. Problem 1

Considering the launches made by students under an angle of $\alpha = 60º$, determine the launch velocity using the ascent time value measured by your team. Use $g = 10\ m/s^2$ $g = 10m/s^2$ and $t_s = \frac{V_0 \sin(\alpha)}{g}$.

Resolution:

Como $\alpha = 60º$, então $sen\alpha = 0{,}866$, then the launch velocity can be obtained by:

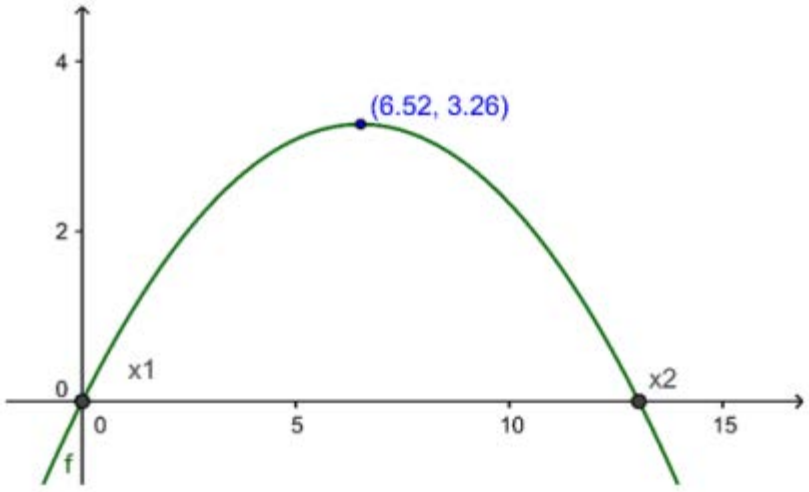
$$V_0 = \frac{g.t_s}{0{,}866}.$$

Hence the speeds per team will be: Team 1: $V_0 = 10{,}62m/s$, Team 2: $V_0 = 12{,}01m/s$, Team 3: $V_0 = 11{,}32m/s$, Team 4: $V_0 = 11{,}08m/s$.

Figure 1 - Graph of the quadratic function of the shot-put team 4 with data recorded by team 1.

3.2.2. Problem 2

Using the trajectory equation:



$$f(x) = \tan(\alpha)x - \frac{gx^2}{2(V_0\cos(\alpha))^2},$$

Write the function that represents the trajectory of the ball launch by your team, considere $\alpha = 60º$ and the speed value determined in the previous question, $(g = 10m/s^2)$.

Resolution:

We consider the launch velocity of team 2 with $V_0 = 12{,}01m/s$. With $\alpha = 60º$, we will have $cos^2(\alpha) = (cos60º)^2 = (0{,}5)^2 = 0{,}25$ and $tan(\alpha) = 1{,}73$, so

$$f(x) = 1{,}73x - \frac{10x^2}{2(12{,}01)^2 0{,}25}$$

$$f(x) = -0{,}139x^2 + 1{,}73x$$

3.2.3. Problem 3

Determine the roots of the equation obtained in Problem 2.

Resolution:

We have

$$x(1{,}73 - 0{,}139x) = 0\,.$$

Therefore,

$$x_1 = 0 \; and \; x_2 = \frac{-1{,}73}{-0{,}139} = 12{,}45\ .$$

3.2.4 Problem 4

Determine the vertex of the parabola given by the equation obtained in Problem 2.

Resolution:

We have

$$V = \left(\frac{-b}{2a}, \frac{-\Delta}{4a} \right),$$

with: $a = -0{,}139, b = 1{,}73$ $a = -0{,}139,\ b = 1{,}73$ and $\Delta = 2{,}99$. Thus,

$$x_v = \frac{-b}{2a} = 6{,}22 \text{ and } y_v = \frac{-\Delta}{4a} = 5{,}28\,.$$

Note that the value of x_v, is the midpoint of the roots obtained, and that the value of y_v corresponds to the maximum height of the body's trajectory.

3.2.5. Sketch graph the function obtained in the Problem 2.

Resolution:

The function being given by:

$$f(x) = -0{,}139x^2 + 1{,}73x,$$

the roots are $x_1 = 0$ and $x_2 = 12{,}45$ and the vertex the point $(6{,}22;\ 5{,}38)$, we can Sketch the graph as shown in Figure 2.

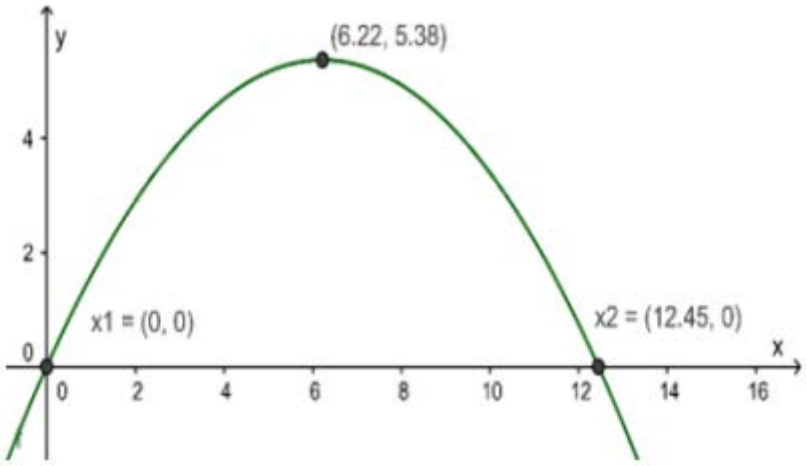


Figure 2 - Graph of the quadratic function of the launch ball with data recorded by team 2.

4. Considerações finais

It was possible to observe with this research that Physical Education classes work with a great tool, including reaching the objectives of a Didactic Laboratory and also serving to arouse the interest of students in learning.

At the end of the process, students in the class where the research was carried out were asked to complete a short questionnaire related to the activities and students' opinions regarding the validity of the proposed process. The questionnaires used, shown in Table 3, were based on previous research on the subject. (GRANDINI, GRANDINI, 2008). In question 1 the student could choose only one of the two options while in questions 2 and 3 he could choose more than one option.

Table 3 – Student Point of view

Questionnaire	%
1. What is a Didactic Laboratory for you?	
1.1. It is a place where activities are developed to illustrate the content taught in theoretical classes;	42%
1.2. It is a set of practical activities incorporated into Science Education.	58%
2. For which reasons should practical activities be part of high school math classes?	
2.1. They encourage the student to know, understand and apply the theory in practice;	92%
2.2. They teach content not included in theoretical classes;	62%
2.3. They train students in the interpretation of experimental data;	81%
2.4. They teach principles and attitudes in experimental work;	86%
3. Among the objectives below, check the one that you believe is most important for the use of Didactic Laboratory.	
3.1. Helping to bridge the gap between theory and practice;	88%

3.2. Stimulate and maintain interest in the study of Mathematics;	96%
3.3. Solve math exercises;	64%
3.4. Develop basic practical skills.	78%

When analyzing the answers to the first question, where 42% of the students still consider the Didactic Laboratory just a place where practical activities can be carried out, we noticed that even for a class that had activities carried out in several places, the notion of "reserved" space the activities experimental is very firm.

In the second question, students could choose more than one option and it became evident that the use of the didactic laboratory greatly encourages learning, showing ways for the student to experience situations where the theory is applied. The answers given to question 3 only reinforce this notion of stimulating students' interest in the learning process.

The activities proposed to students in the classroom, after the practical classes, served to illustrate in a more interesting way to the student the concepts of quadratic functions worked in the first year of high school. It is also noteworthy that the practical classes directly influenced the students' arguments, which allowed them to make a more concrete analogy of the contents taught with phenomena observed and performed by themselves.

Finally, it is possible to observe the need for prior planning of the classes taught, to provide attractive tools in order to provide students with more instruments that they can use to form a solid argument based on athletics and other recreational activities.

In addition to the first questionnaire, which aims mainly to get an idea of the students 'motivations, a second questionnaire, shown in Figure 6, was proposed, in which it seeks to verify the extent to which the objectives of the didactic laboratory were achieved in the students' view.

We note that most students agree that the objectives of the Didactic laboratory were achieved satisfactorily when using Physical Education classes, being important to provide experimental data for the solution of problems and mainly to stimulate students in the study of Mathematics.

Even though the students' opinion about the process is important, but it is still the verification of the results obtained by the students of the class that participated in the process. While the average grades of students in other classes of the first year of the school was 5.7; the average grades of students in the class where the survey was conducted was 6.8; an average grade 19.3% above the average of other classes.

Mathematics taboos regarding their learning difficulties can be countered with activities that encourage students to think for themselves by developing more solid forms of argument through routine experiments.

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Analysis Of Strategic Cost Management Assisting In Decision Making: A Case Study Of A Company That Provides Cleaning, Conservation And Sanitation Services

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Abstract

This work presents a study on the cost formation process of a third-party service provider from the Federal Public Administration to draw a parallel with the strategic cost management using the absorption and variable costing methods. As a methodology, a qualitative-quantitative research strategy, of an applied nature, was used, through a case study in a company that provides cleaning, conservation, and sanitation services. Data on 13 types of inputs (the highest values) were analyzed over six months. The values were highlighted referring the input data of the Bidding Notice that led to the contracting of the service provider company, the inputs consumed by the client, and the inputs purchased by the company. The results of the study indicate that the company bought twice as much (119%) than the amount foreseen in the notice on the analyzed period. Using the precepts of Strategic Cost Management, in parallel with the absorption and variable costing methods, it can be observed that in terms of making managerial decisions, the second (variable costing) forwards more critical information to the manager than the first (absorption costing), resulting from the concern of complying with Brazilian tax legislation, without considering the inherent tax costs (not only) in the operational structure of the type of service object in this study.

Keywords: Strategic Cost Management; Absorption Costing; Variable Costing; Decision Making;

1. Introduction

Nowadays, the search for greater competitiveness has been emphasized as a great challenge for organizations, which rely on information with more quality to assist the decision-making process. Managers need to be more and more aware of good cost management practices to ensure organizations survive, and this survival is the result of the relationship between cost, productivity, and quality of products and/or services.

(Berts & Kock, 1995) reinforced by (Megliorini, 2012) and (Piva & Caraffini, 2018) portray that the expansion of competition in the business environment has had an impact on the service sector, reflecting on greater importance in the use of accounting information, especially in information referring to planning, control, costs and decision making and complement that the type of company does not matter, but that knowledge of the industry and having good management are fundamental factors for the success of the

business and in what concerns to a competitive market about the need to manage, control and calculate costs.

In this sense, (Martins, 2018) clarifies that cost accounting is no longer a mere inventory cost assessor and has become a significant instrument in supporting managerial decision-making because, with greater competition, organizations no longer reach their goals. prices just considering the costs and yes, adding the wishes of the market. (Raupp & Michels, 2015) add that for a company to have cost management it is critical to manage, know, and control the expenses of products and/or services.

Regarding the provision of services, concerning outsourcing, in Brazil, this had a significant increase, mainly in the late 1960s with the advent of Decree-Law No. 200, of February 25, 1967.

(Fernandes, 2002) corroborated by (Almeida, 2018) cite that the Public Administration used the concept of outsourcing to become more flexible, to provide the downsizing of the administrative machine and reduce unemployment in the country, in addition to reinforcing the idea that the Public Administration should focus on its main activity and reduce its costs, with a redirection of its activities.

Previous studies such as (Boas, 1998; Backes, Souza & Silva, 2008; Filho, Peixe, Passos & Peixe, 2016; Castro, Oliveira, Cisne & Bezerra, 2018; Nunes & Ferrari, 2019) emphasize the importance about the thematic of the study, using Strategic Cost Management as a tool to assist in managerial decision-making, relying on administration, control, and analysis of costs to foster management strategies.

In this sense, the objective of this work is to present a study on the cost formation process of a third-party service provider from the Federal Public Administration to draw a parallel with strategic cost management using absorption and variable costing methods.

The work is structured in 05 (five) parts: After the introduction, the theoretical framework is presented dealing with Strategic Cost Management and Costing Methods in the literature. Then, the methodology applied in conducting the research and the results of the study are described. Finally, the final considerations about the study are presented, followed by the references used.

2. Theoretical framework

The theoretical framework will deal with Strategic Cost Management, 02 (two) costing methods, and outsourcing.

2.1 Strategic Cost Management

Strategic cost management is an analysis of these through a more comprehensive prism, which gives a more sophisticated look to the organization seeking to obtain competitive benefits. Costs are collected to contribute to the development of strategies aimed to obtaining competitive advantages. Furthermore, in competitive environments, it is primarily sought to obtain high-quality products and/or services, productively and efficiently (Shank & Govindarajan, 1997; Piva & Carafinni, 2018; Martins, 2018).

When it comes to data related to costs, (Carmo, Lima, Martins, Pereira & Soares, 2013) corroborate that the number of companies that use electronic spreadsheets for data formation and as used for the elaboration of decision making is significant. In this sense, (Colpo, Medeiros, Amorin & Weise, 2015) reinforce that good management of an organization is a determining factor in the goals it intends to achieve, highlighting

the importance of the manager in detecting and pointing out limitations and the number of available resources.

Following this bias, strategic cost management supports the implementation of management instruments, providing solid bases for management decision making and in the planning process. Also, the organization can structure itself more efficiently, enabling better results through the cost system, acquiring advantages in the market through better use of resources and ensuring responses with greater relevance for management (Megliorini, 2007; Reis & Santana, 2012; Moura & Lima, 2016; Martins, 2018).

In this sense, (Lima & Cunha, 2016), state that costs can have multiple positions depending on the scenario in which they are employed. (Bruni & Famá, 2009) point out the difference in the view of costs between a consumer and a company. While the former sees the cost in several ways - opportunity, accounting, financial, among others, the latter sees the cost more rigidly - the monetary value to be disbursed.

The difference between costs and expenses must also be highlighted. Costs are consumption related to the production of other products or services. Expenses are consumption directly linked to administrative expenses, that is, they seek the generation of revenue (Bruni & Famá, 2012; Ribeiro, 2017; Martins, 2018).

Complementing this thought, Cost Accounting brings several terminologies about other concepts that are commonly confused (or put as synonyms) in the organizational environment, but that it is necessary to make a distinction as shown in Table 1

Table 1 - Cost Terminologies

Expenses	**It is a generalized term for expenditure. It translates financial sacrifices that the company makes to obtain a product or service;**
Disbursement	Payments arising from the purchase of a good or service;
Investments	Expenses activated due to attributable gains in the future;
Cost	Expenses related to goods or services made for the production of other goods and services;
Expense	Values of goods or services consumed directly or indirectly to obtain revenue;
Loss	Values of goods or services consumed exceptionally and involuntarily, treated as non-operational, not constituting part of the production costs.

Source: Adapted from Martins, 2018.

2.2 Costing Methods

Costing methods support the determination of cost objects, which can be a department, an operation, a product or a service, that is, when thinking about identifying costs in activities, departments, operations or products and services, it is used some costing method (Megliorini, 2012; Martins, 2018; Vieira, Holanda & Souza, 2018). In this work, 02 (two) costing methods very common in the literature will be addressed: Absorption Costing and Variable Costing.

Absorption Costing is the costing method in which all costs, whether fixed or variable, direct or indirect, are appropriated to the costs of products or services (Maher, 2001; Reis, 2005; Megliorini, 2012; Martins, 2018). Variable costing is also known as direct costing. In this type of cost, only variable costs are allocated to products or services, whether direct or indirect, and fixed costs are therefore considered expenses for the

year (Dias & Padoveze, 2007; Backes, Souza & Silva, 2008; Martins, 2018; Vieira, Holanda & Souza, 2018). In Table 2 there is a comparison between the methods with their advantages and disadvantages.

Table 2 - Comparison between Absorption Cost x Variable Cost

Costing Method	Advantages	Disadvantages
Absorption	Assistance to tax authorities, a survey of the total cost of products, as both direct and indirect costs as well as fixed and variable costs are attributed to products and compliance with the principle of competence (Wernke, 2005; Backs, Souza & SILVA, 2008; Martins, 2018).	The method is criticized when it comes to decision making, for prioritizing compliance with legislation and not the managerial scope and for causing distortions in the apportionment, mainly of fixed costs, using arbitrariness and subjectivity to allocate them (Pamplona, 1993; Motta, 2000; Wernke, 2005; Castro, Oliveira, Cisne & Bezerra, 2018; Martins, 2018).
Variable	The mitigation of the arbitrariness of the apportionment method, mainly, but not only, of those related to fixed costs, since this method assumes little relevance for managerial observation. The emergence of the concept of contribution margin, that is, it is a method focused on managerial decision making (Souza, Clemente, Kreuz & Rosseto, 2003; Abbas, Gonçalves & Leoncine, 2012; Martins, 2018).	The injury of the Accounting Standards for not complying with the principle of competence, the non-acceptance by the tax legislation for external audit and the fact that in practice, the distinction between fixed and variable costs is not so clear (Viceconti & Neves, 1995; Souza et al, 2003; Gnisci, 2010; Castro et al, 2018; Martins, 2018).

Source: Prepared by the authors (2020).

2.3 Outsourcing in the Public Service

(Almeida, 2018) states that outsourcing is used in industries, companies or institutions, to hire another company, industry, or organization to provide a certain service, the practice of which operates in both public and private services.

He adds that the outsourced service is deficient and that there is more intense exploitation of the worker, under the justification that a higher quality in the provision of the service and the mitigation of unemployment.

Still (Almeida, 2018) shows that, from the perspective of the Brazilian market, Public Administration is one of the prevalent employers, in all 03 (three) spheres. In this sense, (Vieese, 2012) adds that the public sector acts in the fight against unemployment, which may cause the extension or retraction of the so-called public services and, consequently, causing certain privatization as a strategy from outsourcing.

In this bias, the contract for the outsourcing of public service is made through a public notice that is known and accessible to the public. There is, therefore, a need to demonstrate public interest in contracting this service, that is, it must have a lower cost, a better profit and be essential and justifiable, since the Administration itself should perform it (Valente, 2009; Silva, 2016; Almeida, 2018).

3. Methodology

A qualitative-quantitative research strategy was applied that is based on the use of two types of data, also called mixed data, to provide a better understanding of a particular research problem (Creswell & Clark, 2015; CRESWELL, 2017), of an applied nature, which is the research produce knowledge for applicability and the solution of practical characteristic problems (Silva & Menezes, 2005; Domingues, 2017).

To operationalize the study, a case study was carried out in a company that provides cleaning, conservation, and sanitation services. As explained by (Yin, 2015), the case study is applied because it is a meticulous method of research, through a systemic and sociological approach, being treated as a considerable methodological strategy, allowing a focus concerning the object to be studied, or better, a practical investigation of a phenomenon within the context of real-life (Yin, 2015).

The methodology of the theoretical framework was to preferably adopt the search results between 2016 to 2020, focusing on research in English, the database was Google Scholar, using CAPES journals as support. The keywords were: strategic cost management, costing method, absorption costing, variable costing, and outsourcing. The criterion used for the selection and filtering of articles was the degree of relevance of the information. Other external articles from this range were added to serve as a foundation for theoretical concepts.

To analyze the data in the composition and valuation of the inputs more fluently, the systematic was limited to 13 (thirteen) items of Notice XXX/201X (whose object was the contracting of continuous cleaning, conservation and sanitation services, with a the supply of materials needed under contract) which are the ones with the greatest quantities and value: common toilet paper, interleaved paper towels, bleach, hypochlorite, disinfectant, detergent, liquid soap, glass cleaner, multipurpose, flavoring, a plastic bag of 30 liters, a plastic bag of 50 liters and a plastic bag of 100 liters. Besides, the analysis period from July to December 2018 and the 5 (five) customer supply sectors, hereinafter referred to as sector 1 to sector 5, was limited.

The units were consolidated into “standardized units” to compare the consumption measures provided for in the Public Notice, which were consumed by the customer and the measures that were purchased by the company, in addition to scaling the bid adjustment to a monthly amount for the item comparability, dividing the amount of the notice (annual) by 12 (twelve) months.

The data were processed using Microsoft Office Excel 2016® software and was based on input data provided by the Public Notice, input data consumed by the customer, input data purchased by the company and its value implications in module 3 and module 5 since modules 1, 2 and 4 have little or no variability due to legal obligations or collective agreements.

Table 3 - Parameters used for data analysis

Parameters
IN 05 Cost Spreadsheet for employee pricing
Quantity of Public Notices x Quantity of Input Consumed
Quantity Input Notice x Quantity Input Purchased
Amount Input Consumed x Amount Input Purchased
Edict Profit Margin x Profit Margin Quantity Consumed
Edict Profit Margin x Profit Margin Quantity Purchased
Indirect Costs Margin Notice x Indirect Costs Margin Quantity Consumed
Indirect Costs Margin Notice x Indirect Costs Margin Quantity Purchased
Absorption Costing x Variable Costing

Source: Prepared by the authors (2020).

4. Analysis and Results

The hiring of a third party by the Public Administration is preceded by a bidding process. This process is divided into 05 (five) sequential steps - Preliminary bidding phase, Internal bidding phase, External bidding phase, Contractual phase, and Post-contracting phase, as shown in Figure 1. For analysis of the proposed work, consideration the stage External phase of the bidding, from the perspective of the service provider company.

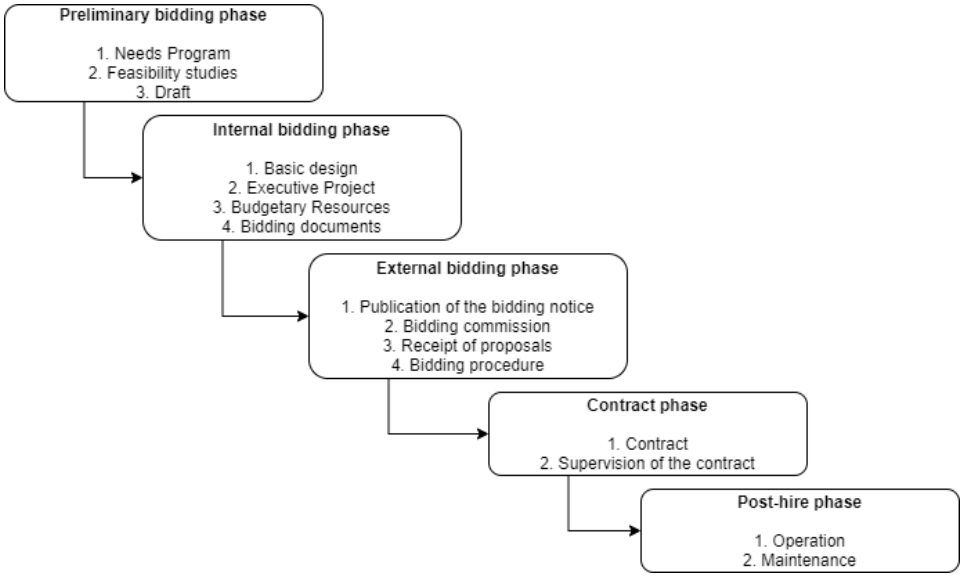

Figure 1 - Flowchart of the Bidding Process

Source: Adapted from TCU (2014).

From the publication of the bidding notice, the company conducts several internal analyzes to find out if it can participate in the bidding. Starting with the financial-economic analysis up to the analysis of the activities according to the National Classification of Economic Activities - CNAE, in addition to verifying that the notice is following the laws in force in all applicable aspects. If the company's CNAE does not

meet the need for the notice, the company is not qualified to participate in the bidding process. Figure 2 shows the flowchart of the bidding process from the company's perspective.

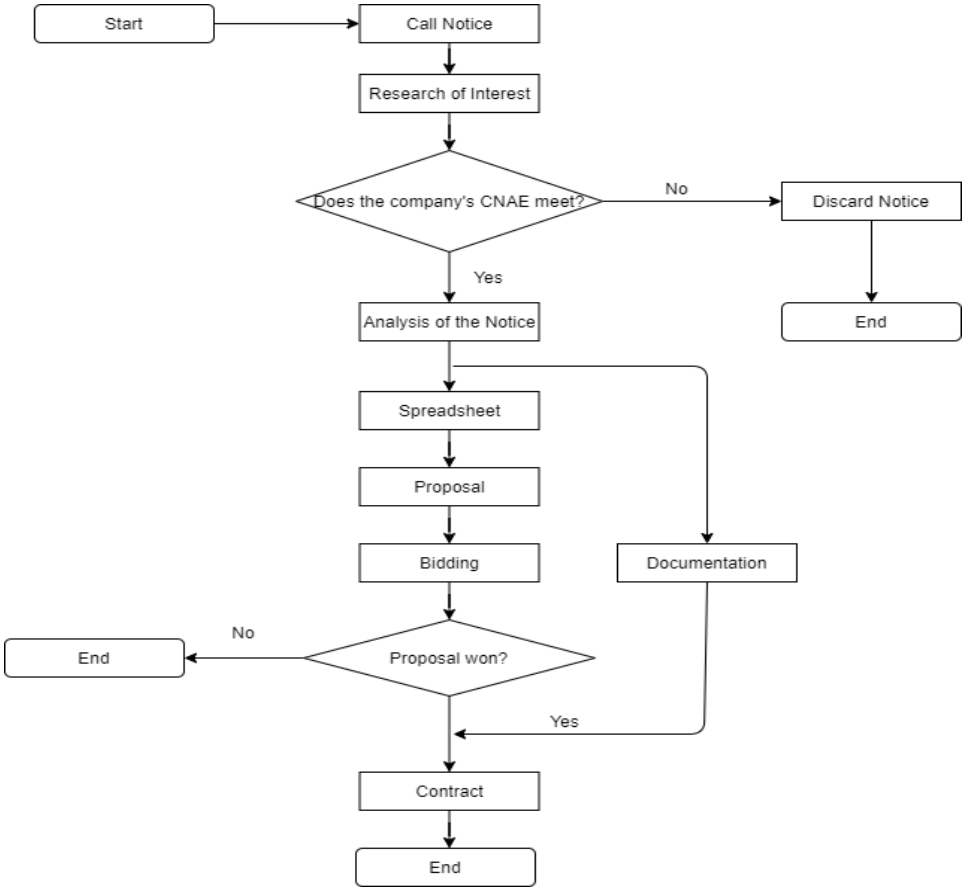

Figure 2 - Flowchart of the Public Notice from the Company's perspective
Source: Prepared by the authors (2020).

Being able to participate in the Bidding and after analyzing the public notice, the company will compose the cost spreadsheet according to the characteristics contained therein. Then, there is the phase of proposals and bids, in which the company aims to provide the lowest value, and then, it wins, according to the rules of the bidding process. The profit margin and subjective cost reduction can occur at this stage.

It should be noted that there are two types of bidding: face-to-face or electronic. In the face-to-face auction, it takes place in traditional bids, in the physical presence of the auctioneer. In the electronic auction, bidders register on the public procurement website, in the case of the Federal Government, Comprasnet, for a specific offer that interests them.

The locus company in the study acts as a provider of cleaning and outsourcing services to public institutions. It has 13 years in the market and arose from the need for a company in the cleaning market with clarity and commitment to the customer and its employees. Its client portfolio includes medium and large organizations in the government, federal and private sectors having a high commitment its values and the satisfaction of the client and our employees in general.

To operationalize the study, the proposal submitted to a Public Institution of the Federal Government of Brazil (notice XXX/201X) was selected, the whose estimated value for contracting continued cleaning, conservation and sanitation services, with the supply of necessary materials under contract, it was up to R$

7,547,127.61 per year. The company submitted a bid with a value of R$ 6,940,712.15 per year, being declared the winner of the contest. Figure 3 shows the comparison between the estimated value and the company's bid.

Also, the study is based on the specifications provided for the announcement under the company's economic-financial view, since it is where there is the greatest influence of strategic cost management on the possible room for maneuver on the composition of its commercial proposal to be presented with the bidding agency, that is, the perspective of the work will be to present the impact on a possible result if the company already employed strategic cost management when participating in the bidding process.

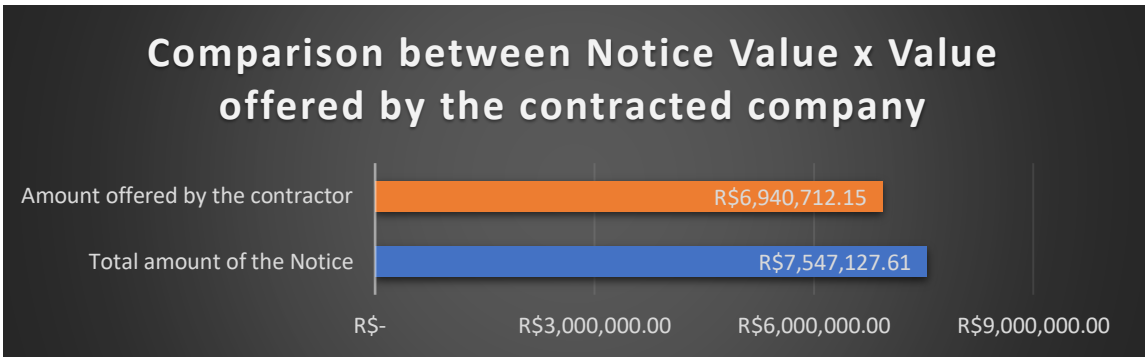

Figure 3 - Comparison of the bid notice x value offered by the contracted company
Source: Prepared by the authors (2020).

In this sense, the present work carried out an analysis of the value of R $ 6,940,712.15 (which is equivalent to 92% of the maximum value of the bid), which made the company win the bidding process and drew a comparison with the values that would be possible if the company adopted strategic cost management.

Initially, it should be noted that this amount, as well as the maximum amount proposed by the notice, is detailed by a cost spreadsheet whose legal basis is Normative Instruction 05 of May 26, 2017, of the Ministry of Planning, Development, and Management that governs the hiring of the Federal Public Administration. Such spreadsheet is composed of 05 (five) modules, which are: Module 1 - Compensation Composition; Module 2 - Monthly and daily benefits; Module 3 - Miscellaneous Inputs; Module 4 - Social and Labor Charges; and Module 5 - Indirect Costs, Taxes, and Profits, which are summarized in Table 4.

Table 4 - Summary table of cost per employee

SUMMARY TABLE OF COST PER EMPLOYEE		
Labor linked to contractual execution (value per employee)		**Percentages and Reference Values**
A	Module 1 - Composition of Remuneration	-
B	Module 2 - Monthly and Daily Benefits	-
C	Module 3 - Miscellaneous Supplies	-
D	Module 4 - Social and Labor Charges	-
E	Module 5 - Indirect Costs, Taxes and Profit	-
TOTAL AMOUNT PER EMPLOYEE		-

Source: Prepared by the authors from IN 05/2017 (2020).

Following this bias, Modules 1, 2 and 4 are the same for companies in the same industry, as they are items that are governed by the CLT, Collective Labor Agreements, such as labor rights (transportation, food, health assistance, etc.), social security charges and FGTS, 13th salary, provisions for termination, among others. However, Modules 3 and 5 (Miscellaneous Inputs and Indirect Costs, Taxes, and Profit) that will be the object of analysis, since strategic cost management is more relevant to their composition. Module 3 deals with Raw Materials, Uniforms and Maintenance / Depreciation (CIF's), and module 5 on other indirect manufacturing costs, profit, and federal taxes that will make up the cost of the service provided.

The analysis started from module 3 (Miscellaneous Inputs) which is divided into 03 (three) items: Uniforms, Materials (Inputs), and Maintenance and Depreciation. Of the 03 items, Materials represent 87.76% of the total of Miscellaneous Inputs and that was where the analysis was directed. Table 5 shows the details of module 3.

Table 5 - Module 3 - Miscellaneous Inputs

MODULE 3 - MISCELLANEOUS SUPPLIES		**Percentages and Reference Values**	
A	Uniforms	9.55%	R$ 45.15
B	Materials	87.76%	R$ 415.05
C	Maintenance and depreciation	2.69%	R$ 12.73
TOTAL MISCELLANEOUS INPUTS		**100%**	**R$ 472.93**

Source: Research data (2020).

It was structured from the form of acquisition of inputs to the form of transfer to the customer and its internal distribution. Figure 4 exemplifies the flowchart of this process.

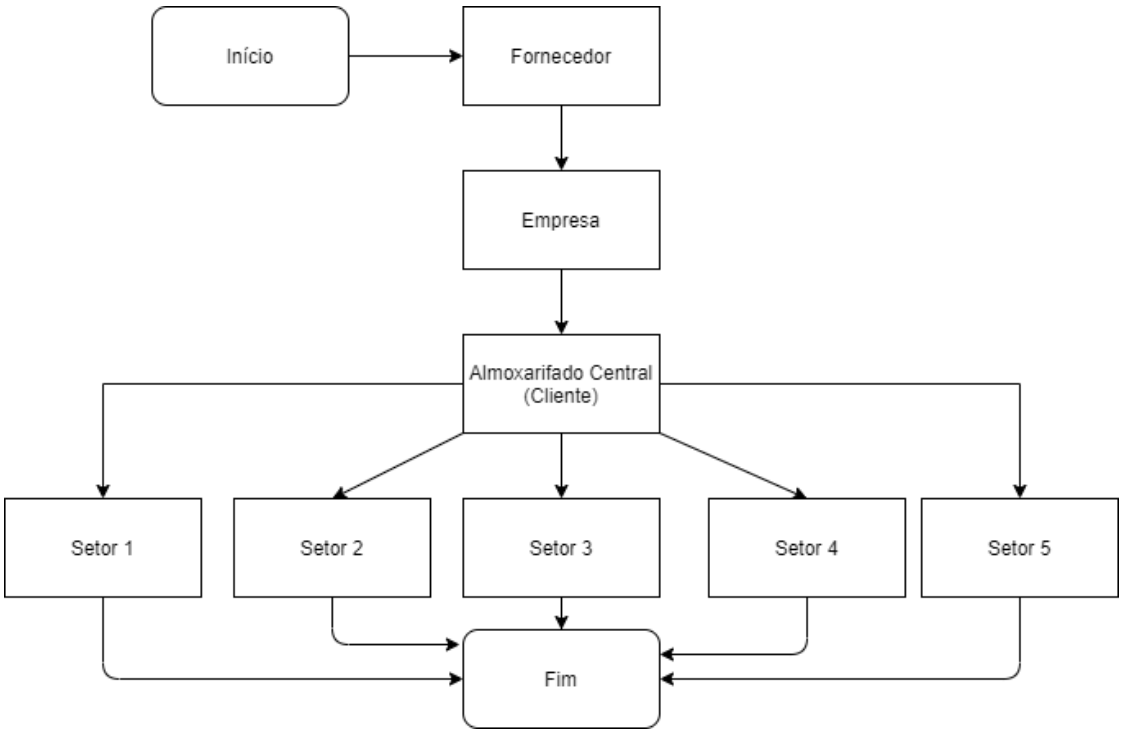

Figure 4 - Input Distribution Flowchart

Source: Prepared by the authors (2020).

According to Figure 4, the company requests a certain amount of material from the supplier, which delivers it to the company in its central warehouse that is at the customer, and from there it distributes to the demanding sectors, which have sub- stocks. It is noteworthy that the period of data collection and analysis of the values was 6 (six) months - July to December 2018.

Initially, it was found that the company did not carry out any inventory control method. Purchases were made based on the average consumption of the last few months and all customer requests for replacement of inputs were promptly answered even if there was no need to verify the contract. Then, it was determined that an initial inventory was made for data collection, and later so that the method for control called the periodic inventory control method could be implemented , which is the company does not continuously control its inventories, but it does so for a period (weekly, monthly, etc.). In addition, a physical inventory count, called balance sheet, is necessary (Montoto, 2015).

Throughout the analysis, the values required by the notice, the values that the company bought and delivered to the customer, and the values that the customer consumed were taken as a parameter.

Mathematical standardizations were carried out so the units contained in the public notice served as a parameter for the values purchased and the values consumed. Besides, 13 input items were worked on, which are those that had the greatest volume or financial impact during the analysis. Table 6 summarizes the stock generated by the company (inputs acquired) in the final 6 (six) months of 2018 by sector, a period that was used for data analysis.

Table 6 - Inputs purchased in the second half of 2018

MATERIAL PURCHASED IN THE SEMESTER									
MATERIAL	STOCK						FINANCIAL		Percent
	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total	R$ Unitary	R$ Total	
Common hygienic role	1,850	1,800	1,800	1,500	1,650	8,600	R$ 27.05	R$ 232,630.00	45.95%
Interleaved paper towel	3,950	3,955	3,515	2,848	4,500	18,768	R$ 9.90	R$ 185,803.20	36.70%
Sanitary water	1,350	1,830	1,830	1,430	850	7,290	R$ 1.80	R$ 13,122.00	2.59%
Hypochlorite	1,200	800	800	200	150	3,150	R$ 2.00	R$ 6,300.00	1.24%
Disinfectant	480	480	480	200	150	1,790	R$ 3.10	R$ 5,549.00	1.10%
Detergent	300	300	300	100	100	1,100	R$ 3.40	R$ 3,740.00	0.74%
Liquid soap	840	840	840	300	200	3,020	R$ 3.90	R$ 11,778.00	2.33%
Glass Cleaner	900	800	750	400	300	3,150	R$ 2.60	R$ 8,190.00	1.62%
Multipurpose	300	225	235	160	140	1,060	R$ 3.80	R$ 4,028.00	0.80%
Flavoring	540	480	450	250	150	1,870	R$ 3.20	R$ 5,984.00	1.18%
Plastic Bag of 30 liters	50,000	13,800	4,000	5,500	13,000	86,300	R$ 0.05	R$ 4,487.60	0.89%
Plastic Bag of 50 liters	35,000	30,000	25,000	8,000	4,000	102,000	R$ 0.08	R$ 7,854.00	1.55%
Plastic Bag of 100 liters	39,500	29,100	1,000	8,000	18,100	95,700	R$ 0.18	R$ 16,795.35	3.32%
TOTAL								**R$ 506,261.15**	**100.00%**

Source: Research data (2020).

It appears that 45.95% of the amount disbursed was for the purchase of common toilet paper and interfaced paper towels with 36.70% of disbursement in the period. The remaining items represented 17.35% of the disbursement. Table 7 shows the customer's actual consumption by sector, that is, his actual need for inputs.

Table 7 - Inputs consumed in the second half of 2018

REAL CONSUMED MATERIAL IN THE SEMESTER - CONSUMPTION									
MATERIAL	STOCK						FINANCIAL		Percent
	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total	R$ Unitary	R$ Total	
Common hygienic role	1,850	1,650	1,680	1,050	1,038	7,268	R$ 27.05	R$ 196,599.40	65.66%
Interleaved paper towel	2,350	2,450	163	35	310	5,308	R$ 9.90	R$ 52,549.20	17.55%
Sanitary water	1,150	1,630	83	20	48	2,931	R$ 1.80	R$ 5,275.80	1.76%
Hypochlorite	850	650	680	186	135	2,501	R$ 2.00	R$ 5,002.00	1.67%
Disinfectant	330	430	385	188	139	1,472	R$ 3.10	R$ 4,563.20	1.52%
Detergent	185	285	275	96	89	930	R$ 3.40	R$ 3,162.00	1.06%
Liquid soap	750	660	790	275	195	2,670	R$ 3.90	R$ 10,413.00	3.48%
Glass Cleaner	760	80	85	79	74	1,078	R$ 2.60	R$ 2,802.80	0.94%
Multipurpose	280	102	196	58	36	672	R$ 3.80	R$ 2,553.60	0.85%
Flavoring	410	380	370	135	91	1,386	R$ 3.20	R$ 4,435.20	1.48%
Plastic Bag of 30 liters	10,500	10,800	3,770	4,800	5,500	35,370	R$ 0.05	R$ 1,839.24	0.61%
Plastic Bag of 50 liters	11,800	4,300	5,560	2,500	170	24,330	R$ 0.08	R$ 1,873.41	0.63%
Plastic Bag of 100 liters	9,900	10,500	13,000	7,800	6,500	47,700	R$ 0.18	R$ 8,371.35	2.80%
TOTAL								**R$ 299,440.20**	**100.00%**

Source: Research data (2020).

Analogously to the previous table, the highest percentages of inputs consumed are common toilet paper and interleaved paper towels, however, their percentages were changed, to 65.66% and 17.55%, respectively. And the rest of the materials, representing 16.80%. Table 8 shows the amounts in quantity and financially by the terms of the notice.

Table 8 - Inputs provided according to the quantities established in the Notice XXX / 201X for 06 months

INPUTS PROVIDED ACCORDING TO THE QUANTITIES ESTABLISHED IN THE NOTICE XXX/201X FOR 06 MOUNTHS				
MATERIAL	NOTICE	FINANCIAL		Percent
	Semester Quantity	R$ Unitary	R$ Total	
Common hygienic role	1,173	R$ 27.05	R$ 31,729.65	13.77%
Interleaved paper towel	18,768	R$ 9.90	R$ 185,803.20	80.62%
Sanitary water	117	R$ 1.80	R$ 211.14	0.09%
Hypochlorite	783	R$ 2.00	R$ 1,565.00	0.68%
Disinfectant	235	R$ 3.10	R$ 727.26	0.32%
Detergent	313	R$ 3.40	R$ 1,064.20	0.46%
Liquid soap	782	R$ 3.90	R$ 3,049.80	1.32%
Glass Cleaner	1,251	R$ 2.60	R$ 3,252.60	1.41%
Multipurpose	469	R$ 3.80	R$ 1,782.20	0.77%
Flavoring	375	R$ 3.20	R$ 1,201.12	0.52%
Plastic Bag of 30 liters	313	R$ 0.05	R$ 16.28	0.01%
Plastic Bag of 50 liters	313	R$ 0.08	R$ 24.10	0.01%
Plastic Bag of 100 liters	313	R$ 0.18	R$ 54.93	0.02%
TOTAL			**R$ 230,481.48**	**100.00%**

Source: Research data (2020).

The estimates provided for in Notice XXX/201X specify that the inputs of common toilet paper and interleaved paper towels are the most important financial material. However, according to the size of the public notice, the largest consumption would be paper towels (80.62%) and not common toilet paper (13.77%). The other inputs represent only 5.62% of the amount that should be disbursed by the winning company.

The results of the analysis indicate that the amount consumed by the customer is 29.92% higher than the quantity dimensioned in the Public Notice, that is, if the company provided only what was foreseen in the Public Notice, there would be a shortage or rationalization of inputs, as the expected consumption is lower than actual consumption, as shown in Figure 5.

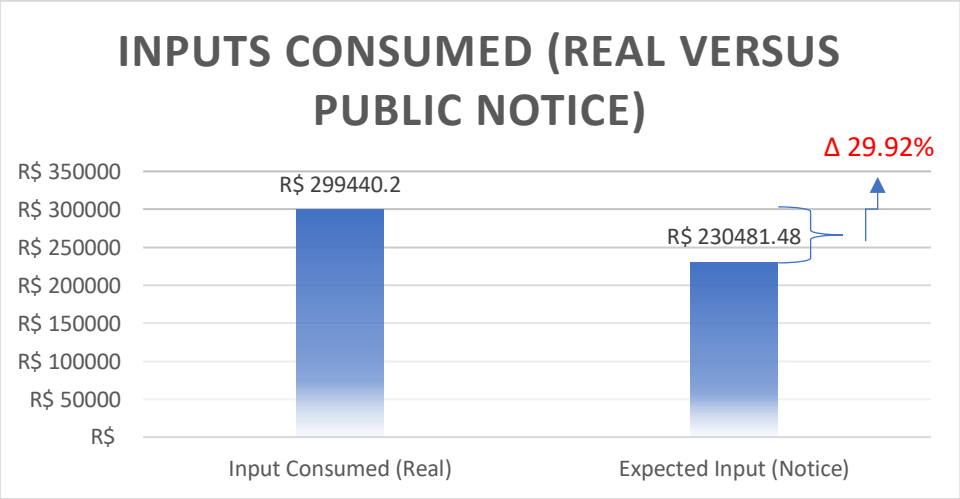

Figure 5 - Inputs Consumed (Real versus Public Notice)
Source: Research data, 2020.

Analyzing the quantities consumed with the quantities purchased by the company, the difference percentage suffers a greater increase, becoming 69.07%, that is, purchases based on the monthly history, aligned with a consumption need greater than budgeted in the public notice. on the part of the client, sub-inventories without carrying out an inventory and without methods of control and the fulfillment of requests made by the client without contractual analysis made the company acquire almost twice as many inputs in 06 (six) months as the client would arrive to consume, as shown in Figure 6.

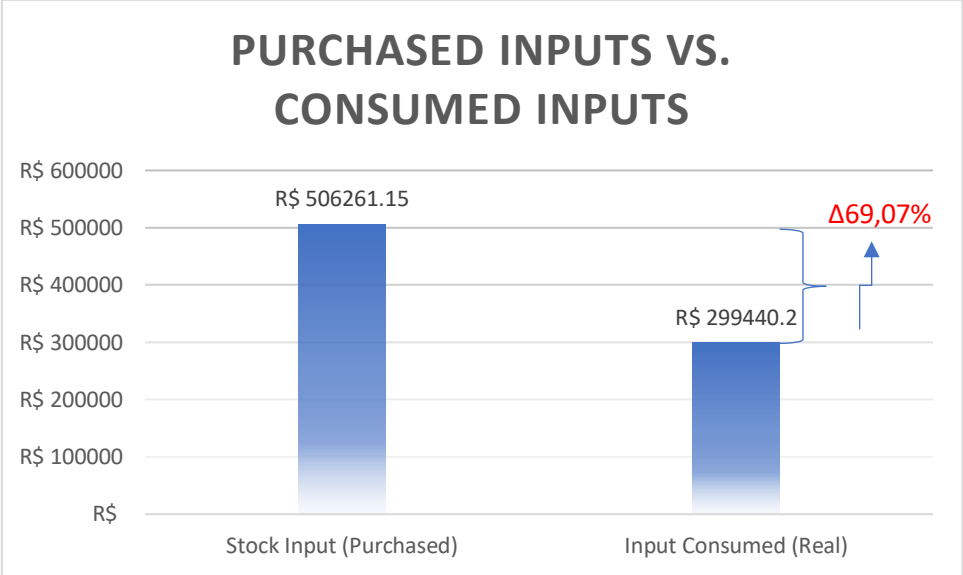

Figure 6 - Purchased Inputs vs. Consumed Inputs
Source: Research data, 2020.

When comparing the quantity purchased and the quantity provided for in the Notice, the difference is even more exacerbated, becoming 119.65%, that is, in 6 months, the company had already acquired more than 2 times the amount provided for in the Notice, in financial terms, as shown in Figure 7.

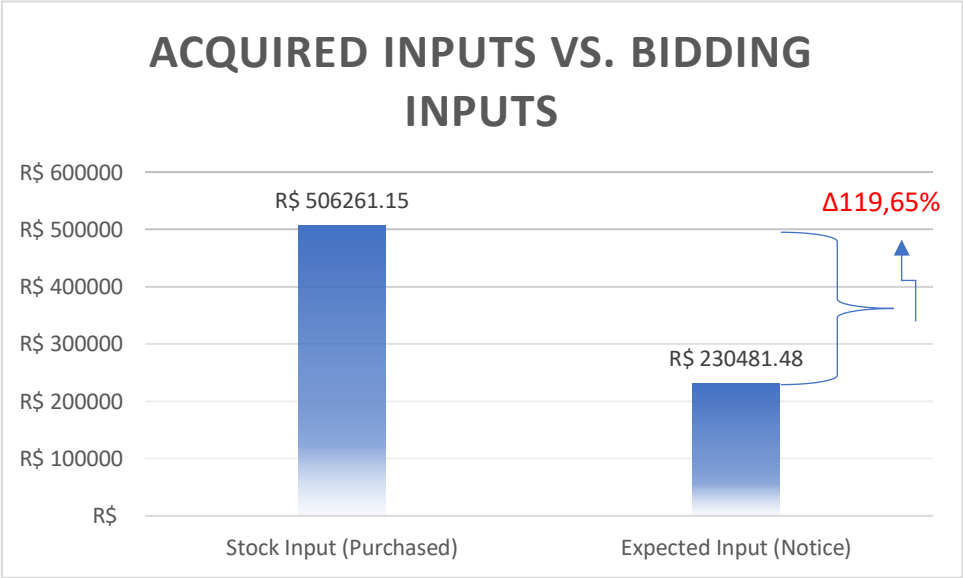

Figure 7 - Acquired Inputs vs. Bidding Inputs
Source: Research data, 2020.

In module 5 (Indirect Costs, Taxes, and Profits) it is divided into 03 (three) items: Indirect Costs, Profit, and Taxes. This, in turn, is subdivided into 04 (four) sub-items: Federal Taxes (PIS and COFINS), State Taxes (specify), Municipal Taxes (ISS), and Other Taxes (specify). Of these items, Indirect Costs and Profits are subject to percentage change. Taxes are legal requirements, no. Table 9 summarizes the items and sub-items according to the terms of the Notice.

Table 9 - Module 5 - Indirect Costs, Taxes, and Profit

MODULE 5: INDIRECT COSTS, TAXES AND PROFIT		Percentages and Reference Values	
A	Indirect costs	3.00%	R$ 64.34
B	Profit	6.79%	R$ 150.00
C	Taxes	8.65%	R$ 2,582.50
C.1	Federal Taxes (PIS and COFINS)	3.65%	R$ 94.26
C.2	State Taxes (specify)		
C.3	Municipal Taxes (ISS)	5.00%	R$ 129.13
C.4	Other taxes (specify)		
GROUP "E" Total		**18.44%**	**R$ 437.73**

Source: Research data, 2020.

Module 5, presented a percentage of 3% for the item Indirect Costs that reflect the administrative expenses of the company, expenses with gasoline, expenses with office, among others. Its value is composed of the percentage applied to the sum of the values of modules 1, 2, 3, and 4. For the item Profit, the percentage was 6.79% and its value is found in a similar way to the item Indirect Costs with the addition of Indirect Costs.

Regarding the item Taxes, its composition is made by the sub-items Federal Taxes and Municipal Taxes. The company, by adopting an income tax taxation regime called Presumed Profit, is supported by to adopt the cumulative incidence regime for PIS and CONFINS, hence the 3.65% rate. And the ISS, according to Complementary Law 116/2003, establishes 5% for this type of service, totaling 8.65%. Its value is calculated on the sum of modules 1, 2, 3, and 4 and the items Indirect Costs and Profit. R $ 2,582.50 is the amount referring to the cost of an employee, according to Table 10, a summary of the cost per employee.

Table 10 - Summary Table of Cost per Employee

SUMMARY TABLE OF COST PER EMPLOYEE			
Labor linked to contractual execution (value per employee)		**Percentages and Reference Values**	**Public Notice**
A	Module 1 - Composition of Remuneration	29.43%	R$ 760.00
B	Module 2 - Monthly and Daily Benefits	13.12%	R$ 338.74
C	Module 3 - Miscellaneous Supplies	18.31%	R$ 472.93
D	Module 4 - Social and Labor Charges	22.19%	R$ 573.10
E	Module 5 - Indirect Costs, Taxes and Profit	16.95%	R$ 437.73
TOTAL AMOUNT PER EMPLOYEE		**100.00%**	**R$ 2,582.50**

Source: Research data, 2020.

Table 11 summarizes the room for maneuver on Indirect Costs and Profit items. It is noteworthy that the percentage values of these items over the total of the module in their sum represent less than 50% of the module, that is, 48.97% of the total. 51.03% are tax obligations imposed by law. Also, Indirect Costs (administrative expenses in general) represent 2.49% of an employee's total value. And the profit, 5.81%, making a sum of 8.3% of range for the company to maneuver in eventual losses.

Table 11 - Comparative table of item / module and item / total percentage

MODULE 5: INDIRECT COSTS, TAXES AND PROFIT		% Item/Module 5	% Item/Total
A	Indirect costs	14.70%	2.49%
B	Profit	34.27%	5.81%
C	Taxes	51.03%	8.65%
C.1	Federal Taxes (PIS and COFINS)	21.53%	3.65%
C.2	State Taxes (specify)		
C.3	Municipal Taxes (ISS)	29.50%	5.00%
C.4	Other taxes (specify)		
GROUP "E" Total		**100.00%**	**16.95%**

Source: Research data, 2020.

Keeping all other fixed costs and using the variation of inputs as a parameter due to consumption and what was purchased by the company, Table 12 was obtained, which shows a loss of 4.81% for the first case (inputs consumed by the customer) and 19.23% for the second case (inputs purchased by the company).

Table 12 - Comparison between value per employee Notice x Consumed x Purchased

SUMMARY TABLE OF COST PER EMPLOYEE				
Labor linked to contractual execution (value per employee)		**Public Notice**	**Value Consumed**	**Purchased Value**
A	Module 1 - Composition of Remuneration	R$ 760.00	R$ 760.00	R$ 760.00
B	Module 2 - Monthly and Daily Benefits	R$ 338.74	R$ 338.74	R$ 338.74
C	Module 3 - Miscellaneous Supplies	R$ 472.93	R$ 597.11	R$ 969.55
D	Module 4 - Social and Labor Charges	R$ 573.10	R$ 573.10	R$ 573.10
E	Module 5 - Indirect Costs, Taxes and Profit	R$ 437.73	R$ 437.73	R$ 437.73
TOTAL AMOUNT PER EMPLOYEE		**R$ 2,582.50**	**R$ 2,706.68**	**R$ 3,079.12**
Percentage differences in relation to the Public Notice			**-4.81%**	**-19.23%**

Source: Research data, 2020.

By reducing the profit margin by 5.29%, from 6.79% to 1.50%, the loss obtained by the company due to the value of input consumed by the customer is zeroed, with a profit of 0.15 % about the values of the notice. However, in the case of the value of inputs purchased by the company, even if it uses the entire percentage range of maneuver both for Profit and Indirect Costs, the company still has a loss of 10.93% concerning the values of the notice, as shown in Table 13.

Table 13 - Comparison between value per employee Notice x Consumed x Purchased with a change in margins

SUMMARY TABLE OF COST PER EMPLOYEE				
Labor linked to contractual execution (value per employee)		Public Notice	Value Consumed	Purchased Value
A	Module 1 - Composition of Remuneration	R$ 760.00	R$ 760.00	R$ 760.00
B	Module 2 - Monthly and Daily Benefits	R$ 338.74	R$ 338.74	R$ 338.74
C	Module 3 - Miscellaneous Supplies	R$ 472.93	R$ 597.11	R$ 969.55
D	Module 4 - Social and Labor Charges	R$ 573.10	R$ 573.10	R$ 573.10
E	Module 5 - Indirect Costs, Taxes and Profit	R$ 437.73	R$ 309.80	R$ 223.39
TOTAL AMOUNT PER EMPLOYEE		**R$ 2,582.50**	**R$ 2,578.75**	**R$ 2,864.78**
Percentage differences in relation to the Public Notice			**0.15%**	**-10.93%**

Source: Research data, 2020.

Corroborating with the analysis, the absorption costing method, which includes both fixed and variable costs in the composition of the cost of the service provided, shows that the value of the Costs of Services provided is equivalent to 83.05% of the price value of sales. However, variable costing, whose values allocated to the composition of costs are only variable costs, shows that only 17.82% of costs about the sale price are related to variable costs, that is, for this type of specific activity, the cost of operating the activity amounts to 65.23%, according to Table 14.

Table 14 - Absorption Cost versus Variable Cost

Statement of Income for the Year	Absorption Costing	%	Variable Costing	%
SALES OF PRODUCTS, GOODS AND SERVICES	**R$ 2,582.50**	**100.00%**	**R$2,582.50**	**100.00%**
Sales of Products, Goods and Services	R$ 2,582.50	100.00%	R$ 2,582.50	100.00%
(-) Deductions from taxes, rebates and returns	R$ 223.39	8.65%	R$ 223.39	8.65%
(=) NET REVENUE	**R$ 2,359.11**	**91.35%**	**R$2,359.11**	**91.35%**
(-) COST OF SALES	**R$ 2,144.77**	**83.05%**	**R$ 460.20**	**17.82%**
Cost of Products, Goods and Services	R$ 2,144.77	83.05%	R$ 460.20	17.82%
(=) GROSS PROFIT	**R$ 214.34**	**8.30%**	**R$1,898.91**	**73.53%**
(-) OPERATIONAL EXPENSES	R$ 64.34	2.49%	R$ 1,748.91	67.72%
(=) Net Income	**R$ 150.00**	**5.81%**	**R$ 150.00**	**5.81%**

Source: Research data, 2020.

In this sense, the use of the absorption costing method and mainly the variable costing method reinforces the little room for maneuver that the decision-maker has to correct the course of operations without compromising its indirect costs or profit margin, either legal obligations or the specificity of the activity, which increases the percentage of operating costs and suppresses variable costs.

5. Final Considerations

This paper presents a study on the cost formation process of an outsourced Federal Public Administration service provider to draw a parallel with strategic cost management using the absorption and variable costing methods.

Under the academic prism, Strategic Cost Management, as a tool in assisting managerial decision-making, can be used in the process of cost formation in companies providing outsourced service to the Federal Public Administration of Brazil, providing subsidies for managers in the process decision-making.

In this sense, outsourcing in the Public Sector, due to its nature, preserves bureaucratic processes as portrayed at work, which brings limitations to the company and its managers, as there are legal obligations, mandatory obligations arising from collective work agreements and contractual ties that must be fulfilled. Even so, with the applicability of Strategic Cost Management, it was possible to analyze the process in a detailed manner and with the leeway that is not linked to the subsequent legal and procedural issues of the public administration.

The results of the analysis show that due to the cost spreadsheet arising from IN 05/2017 (mandatory legal norm), modules 1, 2, and 4 do not have a range of values, as they are legal obligations or collective agreements that are imposed on all companies. companies in the business. However, modules 3 and 5, despite being linked to the Public Notice and consequently to a contract, have greater flexibility, allowing the manager to make compensation adjustments if necessary.

Furthermore, as analyzed in the paper, even though there is room for course correction maneuvers, the percentage is limited, either by the 16.07% of the inputs that are allocated in module 3 or by 8.30% of the Indirect Costs plus the Profit that they are in module 5. It appears, therefore, that the company and its managers have less than 25% for route adjustments due to the specificity of the activity in question.

Using the precepts of Strategic Cost Management, in parallel with the absorption and variable costing methods, it can be observed that in terms of making managerial decisions, the second (variable costing) forwards more critical information to the manager than the first (absorption costing). This is mainly because it is concerned with complying to the tax legislation while the objective is to demonstrate the value that the service provider has without considering the fixed costs that are inherent (not only) in the operational structure of this type of service.

In this vein, variable costing presented a percentage of 17.82% of costs of services provided, something close to the value of the inputs from the IN 05 table, denoting that for this specific activity, the small margin of adjustments that can be made for increasing profitability. In the case of absorption costing, the costs of services are 83.05%, which limits the profit of the said company according to the limitations arising from the Brazilian administrative bureaucracy.

The work also presents a holistic view of the process to the manager and reinforces the points to be adjusted to allow a financial survival for the company without prejudice the initial conditions established by the Notice and the contract.

In this sense, this work suggests, as future work, the analysis of data on the value chain mapping prism to support greater possibilities of adjustments for purchasing process and the use of inputs, since that is where the highest percentage exists. of maneuver in which the company holds the power of the expense, without prejudice the legal procedures.

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Evaluation of the potential toxicity of haloperidol, clozapine and a new putative antipsychotic molecule, PT-31, in an alternative toxicity model, *C. elegans*

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Abstract

Schizophrenia is a disabling mental illness that affects approximately 1% of the world population. The treatment of this disorder is based on two generations of substances, typical antipsychotics, such as haloperidol, and atypical antipsychotics, such as clozapine, which can cause severe adverse effects. Therefore, the development of novel molecules that are safe and efficacious to treat the disease is crucial. PT-31 is a putative α2-adrenoceptor agonist effective against schizophrenia positive and cognitive symptoms in mice. C. elegans is an alternative model that has been successfully used to investigate the toxicity of a variety of substances. The present study aimed to evaluate the potential toxicity of the new molecule PT-31 and the antipsychotics haloperidol and clozapine in C. elegans. The evaluation was carried out based on toxicity endpoint tests, survival, developmental and behavioral assays. The antipsychotics haloperidol and clozapine decreased nematode survival by 30 and 40%, respectively, exposing the potential toxicity of these substances whereas PT-31 was safer based on this parameter. Similar results were obtained in the nematode developmental assay: haloperidol and clozapine significantly reduced nematode body length and area, whereas PT-31 preserved the normal development of the nematodes. The behavioral assessment was based on the frequency of body bends; none of the antipsychotics affected the locomotion rate of the nematodes, and PT-31 also did not compromise this parameter, demonstrating the safety of this new compound and reinforcing the recognized toxicity of antipsychotics.

Keywords: PT-31; C. elegans; alternative model, toxicity evaluation.

1. INTRODUCTION

Schizophrenia is a complex syndrome that affects approximately 21 million people worldwide [1, 2]. The illness presents a diversity of symptoms categorised as positive (hallucinations and delusions), negative (incapacity to feel pleasure) and cognitive (impaired working memory, altered perception). It is one of the most debilitating diseases, being associated with low employment rates and difficulties in daily life that compromise the patient's autonomy [3].

The pathophysiology of schizophrenia is not well understood. The underlying neurochemical mechanisms hypothesized are the dopaminergic and the glutamatergic; however, it is known that other neurotransmitters are also involved [4]. Most pharmacological treatments for schizophrenia are based on selective dopamine blockade, the mechanism of action of typical antipsychotics, such as haloperidol. Due to their selectivity, these antipsychotics improve only the positive symptoms of the disease, but they fail to treat the negative and cognitive symptoms [5] in addition to triggering extrapyramidal effects, drug-induced Parkinsonism, prolactin elevation, and other less frequent effects, such as hypogonadism leading to sexual dysfunction in men and galactorrhea in women [6, 7]. The second-generation antipsychotics, or atypical antipsychotics, have clozapine as their main representative, a substance also approved for the treatment of resistant schizophrenia [8]. Clozapine targets multiple receptors also causes several adverse effects, such as weight gain, cardiovascular diseases, endocrine disturbances and more serious effects, such as hematological alterations [9, 10, 11].

The noradrenergic system has shown to be a promising target for the development of new neuroleptics. Evidence suggests that norepinephrine plays an important role in cognitive functions in the prefrontal cortex [12]. In this perspective, the Therapeutic Innovation Research Group, from the Federal University of Pernambuco, developed an imidazolidine derivative 3-(2-chloro-6-fluorobenzyl)-imidazolidine-2,4-dione, PT-31 (Figure 1), a putative agonist of alpha-2A adrenergic receptors [13].

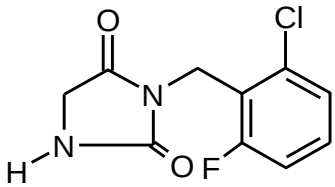


Figure 1. Chemical structure of PT-31.

Studies of the group have demonstrated the potential antipsychotic activity of PT-31 in animal models with positive, cognitive and attentional dysfunction symptoms, without the induction of adverse effects, such as sedation and extrapyramidal symptoms [14]. This molecule also presented neuroprotective effect, demonstrated in an excitotoxicity model [14].

To further contribute to the toxicological evaluation of this molecule, the use of an alternative testing model is of main relevance. *Caenorhabditis elegans* is an alternative model that respects the “three Rs” (reduce, refine and replace) [15] and is widely used for toxicity studies, since this nematode worm provides data representative from a complete animal with fully functioning and metabolically active systems [16]. In addition, its easy maintenance, reproduction and experimentation make it an excellent experimental model. It is also worth mentioning that *C. elegans* has a well-characterized nervous system, presenting the

same neurotransmitters as vertebrates, including acetylcholine, glutamate, γ-amino-butyric acid (GABA), dopamine and serotonin [17, 18].

Within this context, the objective of the present study was to evaluate the potential toxicity of PT-31, as well as the antipsychotics available in the clinic, haloperidol and clozapine, in the alternative model *C. elegans*.

2. Material and Methods

2.1 C. elegans, culture and synchronization

The nematode strain N2 (wild type) was obtained from Caenorhabditis Genetics Center (CGC). The nematodes were maintained on nematode growth medium (NGM) plates seeded with *Escherichia coli* OP50 as food source and kept in a BOD incubator at constant temperature of 20°C [19, 20]. Synchronization, a process to obtain the nematode eggs, was achieved by washing off the gravid nematodes with water from the plates to conical tubes and centrifuging the tubes. Later, the bleaching solution was added: mixture of sodium hypochlorite/ sodium hydroxide (10 M) and water, which was agitated constantly and vigorously for 6 minutes to lyse the worm cuticle. Then, the eggs were separated from the bacterial debris using a 30% sucrose gradient. The eggs obtained were maintained in a BOB® incubator in NGM plates without bacteria to allow hatching overnight (between 13-14 hours all worms were synchronized in larval stage L1) [21, 22].

2.2 Treatment of the nematodes

The antipsychotics haloperidol and clozapine were acquired from Tocris Bioscience®. The molecule PT-31, 3-(2-chloro-6-fluorobenzyl)-imidazolidine-2,4-dione, was synthetized by the Department of Research in Therapeutic Innovation from the Federal University of Pernambuco.

For the treatment of the nematodes, stock solutions containing 10 mM of each compound were prepared in 100% dimethyl sulfoxide (DMSO). From these solutions, the following concentrations were prepared: 80, 160 e 320 μM. Serial dilution from the highest concentration (320 μM) was used to obtain the remaining solutions. A control was prepared containing the highest concentration of DMSO present in the dilutions. 1,500 nematodes synchronized at larval stage L1 were treated for 1 hour in homogenizer with the aforementioned concentrations of haloperidol, clozapine and PT-31, and subsequently seeded onto plates. All assays were conducted in two replicates and repeated in three independent experiments.

2.3 Lethality assay

After 48 hours, the nematodes were counted under dissecting microscope to evaluate the number of live worms per treatment in comparison to control (without treatment). This evaluation aimed to assess the median lethal dose (LD_{50}), which is the dose lethal to 50% of the nematode population, in order to draw a dose-response curve in case of significant mortality [19].

2.4 Developmental assay

After 48 hours of treatment, images of 10 nematodes were taken with help of a dissecting microscope

coupled to a camera. Nematode body length and area were measured using the software ImageJ® [22].

2.5 Behavioral assay

Forty-eight hours after treatment, six nematodes in larval stage L4 of each assayed concentration were transferred to fresh NGM agar plates without E. coli OP50 and kept at 20°C. Nematode locomotion rate was quantified based on the frequency of body bends, the sinusoidal movement of the worm. Each nematode was acclimated for 1 minute, and subsequently, the number of body bends was monitored for 1 minute [23].

2.6 Data analysis

Statistical analysis was carried out on Sigma Stat® using analysis of variance (ANOVA) with post-hoc Student-Newman-Keuls if significant difference, considering $P < 0.05$.

3. Results

Nematode survival rates following treatment with increasing concentrations of haloperidol, clozapine and PT-31 are shown in Figure 2. Clozapine and haloperidol at highest concentration decreased significantly nematode survival rate when compared to control, whereas PT-31 did not impact survival rate. Therefore, the LD_{50} could not be determined.

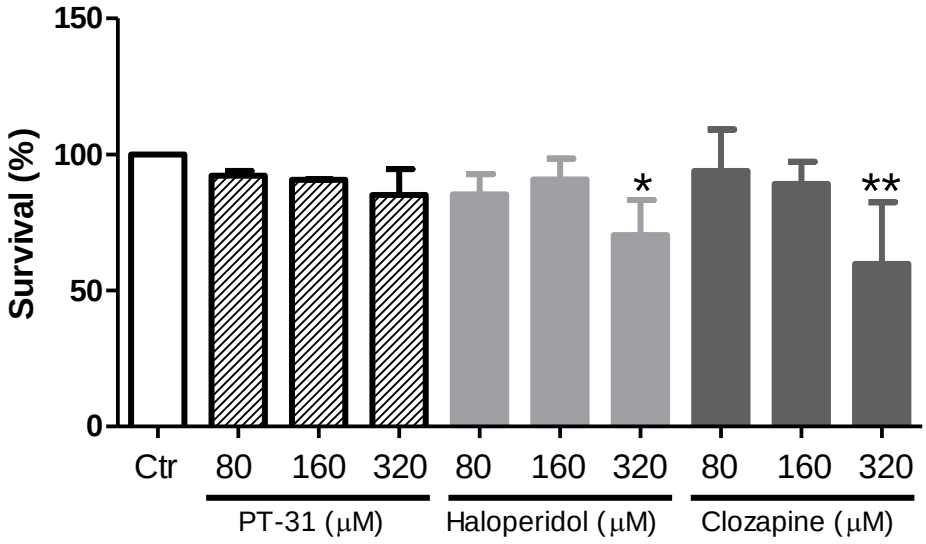
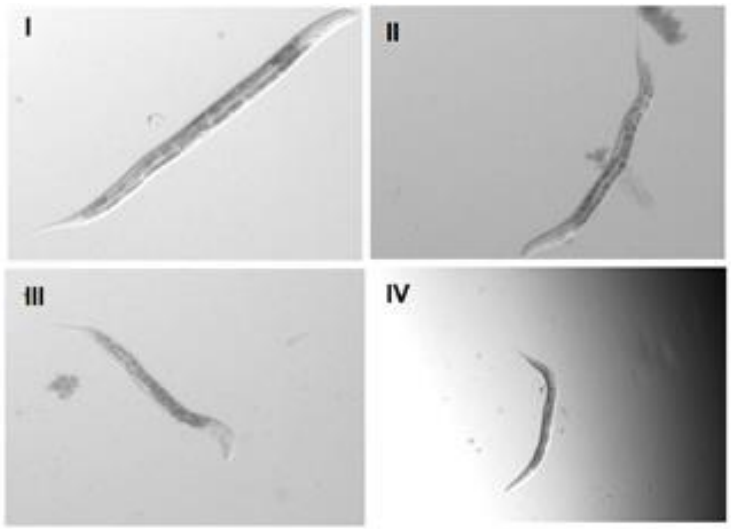


Figure 2. Survival rates of nematodes treated with control (Ctr), PT-31, Haloperidol and Clozapine at concentrations 80, 160 and 320 μM (n = 2 – 4). Data are expressed as mean + S.D. ANOVA with post-hoc Student-Newman-Keuls. F (9,31) = 3.910; P = 0.004. Different from control * P < 0.05.

The development of the nematodes was evaluated based on body length and area. Exposure to increasing concentrations of haloperidol and clozapine reduced significantly nematode length (Figure 3A) and area (Figure 3B) when compared to control; PT-31 did not affect these parameters. Images of *C. elegans*

exposed to the highest concentration (320 μM) of each substance are also presented in Figure 3.



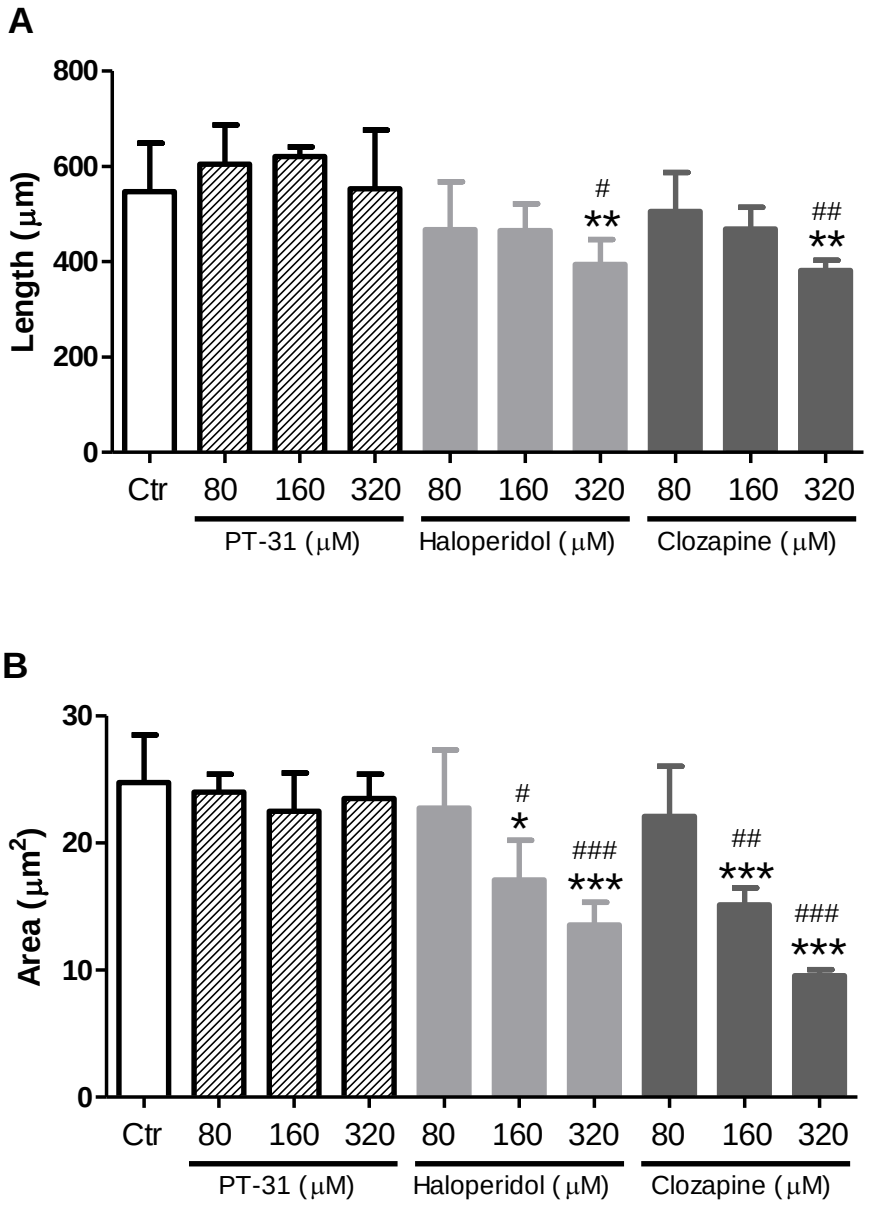


Figure 3. Microscope images of nematodes treated with control (I), haloperidol 320 μM (II), clozapine 320 μM (III) and PT-31 320 μM (IV). Development parameters (A) body length and (B) area of nematodes treated with control (Ctr), PT-31, Haloperidol and Clozapine at concentrations 80, 160 and 320 μM. Data are expressed as mean + S.D. ANOVA with post-hoc Student-Newman-Keuls. $F(9,57) = 5.520$; $P < 0.001$ and $F(9,39) = 13.76$; $P < 0.0001$. Different from control ** $P < 0.01$. Different from PT-31 at the same concentration $^{\#}P<0.05$; $^{\#\#}P<0.01$; $^{\#\#\#}P<0.001$.

Nematode behavior was monitored based on the frequency of body bends. Following treatment of the nematodes with increasing concentrations of haloperidol, clozapine and PT-31, the usual locomotion behavior was not affected when compared to control (Figure 4).

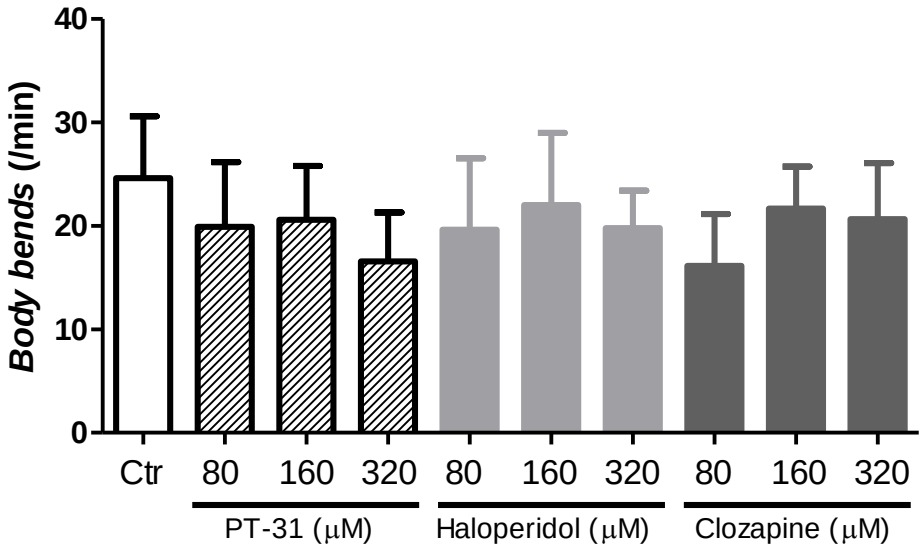


Figure 4. Behavior (body bend frequency) of nematodes treated with control (Ctr), PT-31, Haloperidol and Clozapine at concentrations 80, 160 and 320 μM. Data are expressed as mean + S.D. ANOVA with post-hoc Student-Newman-Keuls. F (9,123) = 2.207; P = 0.023.

4. Discussion

Due to the adverse effects caused by the antipsychotics currently available, it is necessary to develop new drugs with antipsychotic activity, capable of improving the symptoms of schizophrenia with more safety and less side effects. The present study evaluated the toxicity of a new putative antipsychotic molecule, PT-31, and the typical and atypical antipsychotics haloperidol and clozapine in the alternative toxicity testing model *C. elegans*. Based on the evaluations conducted, behavioral, developmental and lethality assays, known as toxicity endpoint tests or toxicity endpoints, it was demonstrated that the antipsychotics haloperidol and clozapine disrupted the normal development and survival of nematodes in the highest concentration tested. In contrast, PT-31 did not compromise these parameters.

Another toxicity endpoint studied was drug-induced lethality, widely assessed to determine the LD_{50} (lethal dose to 50% of test population) of substances through a dose-response curve [24, 22]. Similarly to the present study, Jacques *et al.* [24] and Charão *et al.* [22] also failed to establish an LD_{50}, but assessed the toxicity of different compounds based on nematode survival rate. Charão *et al.* [22] observed a 30% mortality rate in nematodes exposed to paraquat (0.5 mM), suggesting toxicity of this herbicide. Jacques *et al.* [24] demonstrated the toxicity of a solid lipid nanoparticle, which reduced nematode survival rate by 50%. The mortality rates observed in the present study were respectively 30 and 40% following treatment with 320 μM haloperidol or clozapine. By comparison to the aforementioned results of other authors, our data indicated toxicity of the antipsychotics at high concentrations. Contrastingly, PT-31 decreased the survival rate by only 15%, being safer considering this parameter and suggesting absence of toxicity.

The safety of PT-31 was reinforced in the developmental assay, as even the highest concentration of the substance did not reduce significantly nematode body length (552.7 ± 123.5) and area (23.5 ± 1.91) when

compared control (length: 546.9 ± 102.0; area: 24.75 ± 3.77). In contrast, haloperidol and clozapine (320 μM) decreased nematode body length by 28% (394.1 ± 52.93) and 30% (381.3 ± 21.62), respectively. In addition, haloperidol and clozapine respectively decreased nematode body area by 31% (17.10 ± 3.10) and 38% (15.13 ± 1.33) following treatment with 160 μM, and 45% (13.58 ± 1.77) and 61% (9.55 ± 0.48) following treatment with 320 μM. Donohoe *et al.* [25] also observed disruption of development induced by haloperidol and clozapine, with reduction of nematode body area by 45% and 42%, respectively, reinforcing the potential toxicity of these antipsychotics. It is important to highlight that the effects observed by Donohoe *et al.* [25] also occurred at the concentration 160 μM, which impacted nematode body area in the present study.

C. elegans is a testing model that can also be used to evaluate the toxicity of other compounds, such as metals and nanomaterials. Wu *et al.* [26] and Moon et al. [27] evaluated the toxicity of metals based on the length of *C. elegans* worms, showing decrease of 7% in the measurements after nematode treatment with ZnO nanoparticles (50 μg/L) [26] and 22% following treatment with silver nanomaterials [27], therefore suggesting toxicity of these compounds.

Tepper *et al.* [28] proposed that the development of nematodes, assessed through the body length, is related to a conservative genetic regulation pathway. DAF-16 is a transcription factor that activates or inactivates gene regulation. Under normal conditions, DAF-16 allows nematode growth and development; however, stress conditions trigger a modification in DAF-16 generating a stress response that impairs worm development. PT-31 seems to be safer than haloperidol and clozapine, as it did not affect the length and area of the worms in comparison to control.

Another hypothesis raised by Donohoe *et al.* [25] suggests that haloperidol, a D2 dopaminergic antagonist, could compromise worm development through dopaminergic mechanisms. As clozapine does not present preferential inhibition of dopamine, the development of *C. elegans* would be less affected. However, in the present study both antipsychotics disrupted the nematode development to the same extent. The dopaminergic hypothesis is probably based on the fact that the behavior of *C. elegans* is regulated by several neurotransmitters, such as dopamine, serotonin, acetylcholine, glutamate and GABA [29]. Dopamine is responsible for several behavioral functions including locomotion, assessed by means of the frequency of body bends. In addition to dopamine, GABA and acetylcholine are also involved in locomotion: the dorsal and ventral muscles of the worm receive inhibitory GABAergic stimuli for relaxation, as well as excitatory cholinergic stimuli for contraction, creating the “S” movements that drive the worm forward [30].

In the present study, the antipsychotics haloperidol, clozapine and PT-31 did not affect nematode behavior in any tested concentration, suggesting absence of neurotoxicity. Contrastingly, Monte *et al.* [23] observed neurotoxicity following exposure of *C. elegans* to clozapine and haloperidol, with significant reduction of locomotion rate. The referred study was also conducted with wild N2 strains, but the acute exposure assay comprised different concentrations of haloperidol and clozapine: 133 and 459 μM; these concentrations reduced the number of body bends by 15 and 30%, respectively.

The results of our study reinforce the safety of PT-31, based on the first toxicity assessment carried out in this alternative model. This data contrasts with the evidence of toxicity induced by the antipsychotics haloperidol and clozapine, which impacted nematode development and survival in a dose-dependent

manner. In addition to previous studies conducted by the group showing antipsychotic activity of PT-31 in animal models [14], the present study corroborates with the assessment of the safety and efficacy of this molecule.

5. Conclusion

This work reports the first toxicity assessment of PT-31, a new molecule with promising antipsychotic activity, in an alternative animal model, *C. elegans*. PT-31 proved to be non-toxic and safer than haloperidol and clozapine, antipsychotics available in clinical practice, reinforcing the current data available on this molecule for the potential development of a new, safe and effective antipsychotic.

6. Acknowledgements

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Smart Cities: A Systematic Mapping on an Academic Basis

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Abstract

Smart Cities belong to a multidisciplinary research area, which does not yet have a formal definition and may have different meanings depending on the context. In view of this, the objective of this work is to map the term "Smart City" in the scientific field. For such, the scientific publications present in Scopus' data base, accessed by the Periodicals portal of the Coordination for the Improvement of Higher Level Personnel (CAPES), were researched. As results, 61,435 publications were found, which after the inclusion criteria, 632 publications remained to be analyzed. China was the country that presented the largest number of publications with a total of 94 documents. The analysis of annual publications showed that there was an increase in the number of publications over the years, especially between 2018 and 2019. The main contributions of this work were the provision of a knowledge base that can be used by both scientists and researchers and developers of the organizations, identifying gaps and opportunities to be explored.

Keywords: Intellectual Property; Smart City; Innovation.

1. Introduction

Smart Cities (SC) is a theme that began in academia and spread to the business environment. It is a term that does not yet have a formal definition, as it depends on the context to make sense [1].

Therefore, an Smart City, in fact, is a group of people with intelligence who form a large cluster of people called the city. According to [2], An Smart City is to put people at the center of everything, and through technologies, especially Information and Communication Technologies (ICT) [3], foster a governance that uses collaborative planning and citizen for the creative, integrated and sustainable development of innovations that favor competitiveness, entrepreneurship, resilience and constant improvement of quality of life.

The objective of Smart Cities is to make better use of resources, increasing the quality of services offered to citizens [1]. According to a report presented by [4], 68% of the world's population will live in urban areas, cities, by 2050.

Thus, given the various definitions and the relevance of the theme Smart Cities, this work aims to map the term "Smart City" in the scientific field. This type of research is, according to [5], a type of systematic review that aims to delineate an area that has a more comprehensive scope and wants to gather, through research questions, as much information as possible about a particular area of knowledge or topic.

The main motivation for this research is to form a knowledge base that offers in a single work resources to support the development of other research and developments in the area of Smart Cities, promoting innovation.

This document is organized as follows. Section 2 presents the methodology used in the research. Section 3 presents the results. Section 4, the threats to validity. Finally, the final considerations are presented in Section 5.

2. Methodology

The Systematic Mapping protocol (MS) defined by [6] was used to conduct this article. The Scientific Mapping (SC) process was applied, as it was a review of original primary works in an international database of peer-reviewed scientific research.

Because it is a subject that covers many areas of research, multidisciplinary. The publications database [7] was selected. This database was defined due to the great relevance of its publications to the scientific community and society [8]. It is also the largest multidisciplinary database of abstracts, citations and full texts of the world's revised scientific literature, covering publications since 1960, with more than 18,500 titles from approximately 5,000 international publishers, with daily updates [7].

For the analysis of the results, the spreadsheet publishing software produced by Microsoft, Microsoft Excel [9] together with the VOS viewer collaboration network software [10] were used.

2.1 Research Questions

The research questions were defined from the mapping objective. In order to situate researchers and those interested in the subject on the relevance and scope of publications on Smart Cities. Thus, the following research questions were created to guide the conduct of this work:

- - Q1 - Which country or territory presents the most publications?
- - Q2 - How are the publications distributed over the years?
- - Q3 - Which research areas have the most publications?
- - Q4 - Which author publishes the most?
- - Q5 - Which institution promotes the most publications?

2.2 Search Strategy

The searches were carried out in January 2020 and the base search process began with conducting pilot searches with the keywords, described in Table 1, through the Periodical Portal of the Coordination for the Improvement of Higher Education Personnel (CAPES) [11]. These pilot searches consisted of a combination of keywords and related synonyms, all in English, due to the characteristics of the searched databases. Only publications made until 2019 were taken into account.

Table 1 **- Keywords used to form the search strategy**

Key Word	Synonym in English
Smart City	*smart city, intelligent city*

Source: Prepared by the authors (2020).

After adaptation through pilot searches, a Search String was defined to conduct the mapping on the defined bases, as shown in Table 2.

Table 2 **- Search string set to search in SCOPUS bases**

(("smart cit*") OR ("smartcit*") OR ("intelligent cit*") OR ("intelligentcit*"))*

Source: Prepared by the authors (2020).

2.3 Inclusion/Exclusion Criteria

With the string formed, the Inclusion Criteria (IC) were used to determine the relevance of publications in the research bases, the Inclusion Criteria defined for the bases were:

I. Have one of the key words in the "Title" field of the publication;
II. Be published as "Open Access";
III. Be of the type "Article";
IV. Be in the languages: "Portuguese", "English" or "Spanish".

To be applied in the analysis of the titles, keywords, abstracts and conclusions, the following Exclusion Criteria were defined to ensure the quality of the work:

I. Duplicate Publications;
II. Repeated Studies;
III. Publications that are not available in full;
IV. Publications that are no longer available in the bases.

With the definition of the Inclusion/Exclusion Criteria a specific string was created for the base and then searches were made in [7]. As will be presented in the next sessions.

3. Results and Discussion

The following section will present the results of the systematic mapping process of publications from the researched bases and a brief analysis.

3.1 General Information

The search string with the search terms was used in the base [7] and returned the quantity of primary works described in Table 3.

Table 3 - ***Criteria used and results in the Scopus base***

Inclusion Criteria	Results
All fields (No inclusion criteria)	61.435
Have one of the keywords in the "Title" field of the publication	6.662
Being published as "Open Access"	1.051
Be of the "Article" type	645
Be in the languages: "Portuguese", "English" or "Spanish".	632

Source: Prepared by the authors (2020).

This search resulted in the base specific search string [7], shown in Table 4

Table 4 **- Specific and Quantitative Search String of publications returned at Scopus**

Search string	Publications
TITLE ((("smart* cit*") OR ("smartcit*") OR ("intelligent cit*") OR ("intelligentcit*"))) AND (LIMIT-TO (ACCESSTYPE(OA))) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Spanish") OR LIMIT-TO (LANGUAGE , "Portuguese"))	632

Source: Prepared by the authors (2020).

A total of 632 publications were returned from the base after using the Inclusion/Exclusion Criteria.
The relationship between the key words of the publications can be seen in the heat map, presented in Figure 1, formed by 210 single words divided into 6 clusters. The key words "smart city" in the center and "internet of things", "big data", "human", among others, to the surroundings are highlighted.

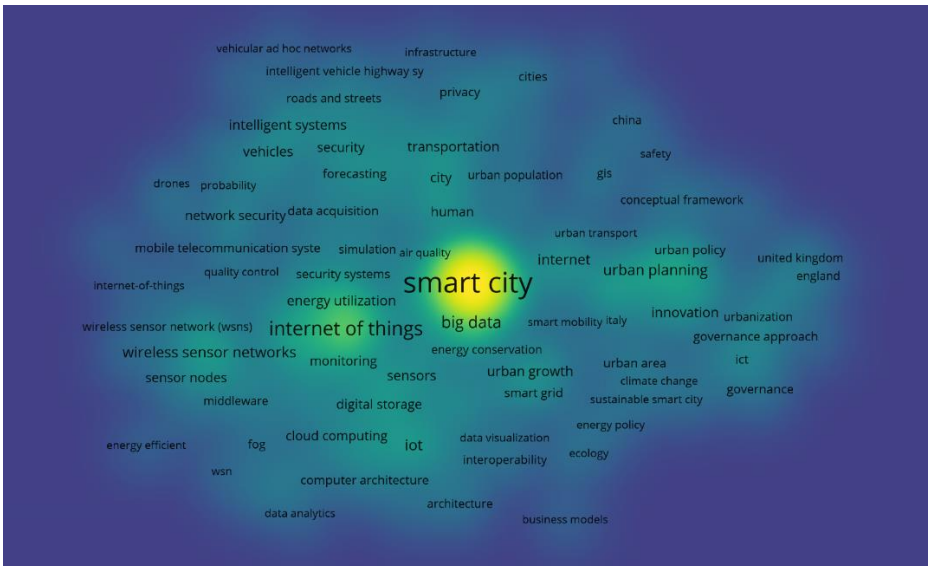

Figure 1 - Representation of the collaboration network between the keywords

Source: Prepared by the authors (2020).

3.2 Answers to Research Questions

This section will show the results from the systematic mapping in order to answer the Research Questions of this study.

Q1. Which country or territory has the most publications?

The country or territory that presented the most publications was China with 94 occurrences. Then came Spain with 80 and the United States with 71 publications. Brazil presented a total of 18 publications on the theme Smart Cities. As shown in Figure 2.

Regarding the co-authorship network, presented in Figure 3, it is formed by 14 clusters with a total of 73 single countries or territories interconnected according to the joint participation in publications. The countries that stood out most were China, United States, Spain, United Kingdom, Italy, India and South Korea. The others are represented by cluster center linkages.

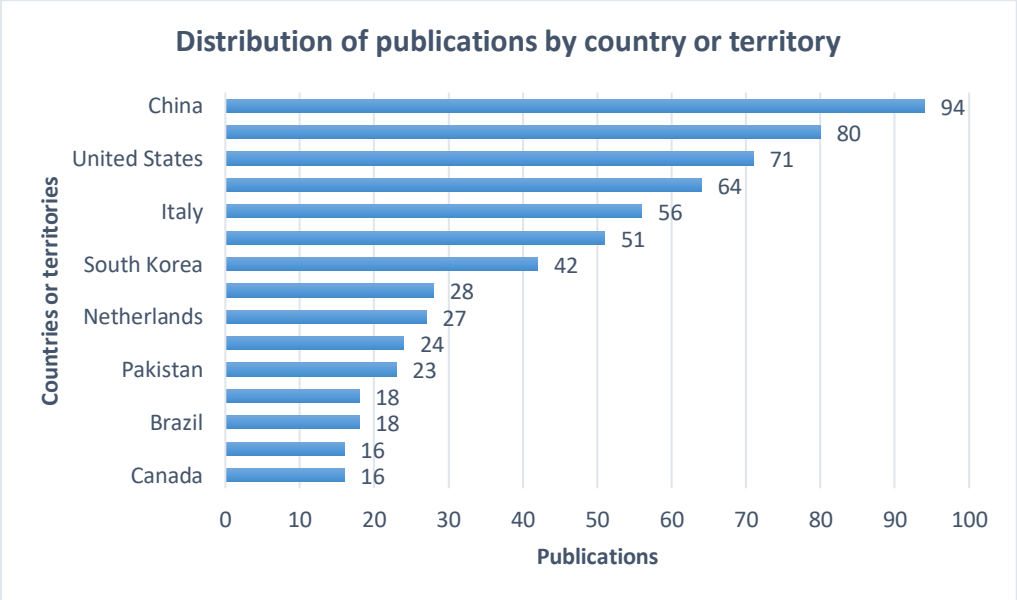

Figure 2 - Distribution of publications by country or territory

Source: Prepared by the authors (2020).

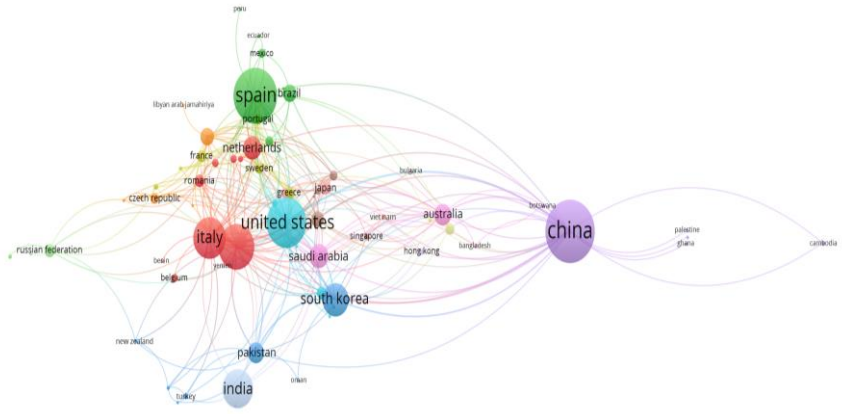

Figure 3 - Representation of the network of collaboration between the countries

Source: Prepared by the authors (2020).

Q2. How is the distribution of publications over the years presented?

Analyzing the publications over time at the base, an increase in the number of works between all years, from 2011 onwards, is highlighted. With a more significant increase of 103 between the years 2018 (144) and 2019 (247). Presented in Figure 4.

Also, the work [1], is the most cited publication over the years, with a total of 2357 citations. As can be seen in Figure 5, which presents the network of collaboration between publications over the years. The network is composed of all works that have had citations over time (310) grouped into 43 clusters.

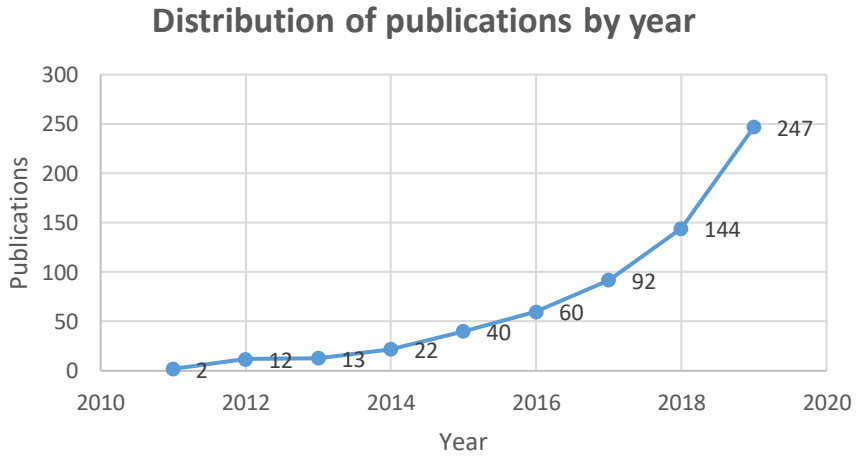

Figure 4 - Distribution of publications by year

Source: Prepared by the authors (2020).

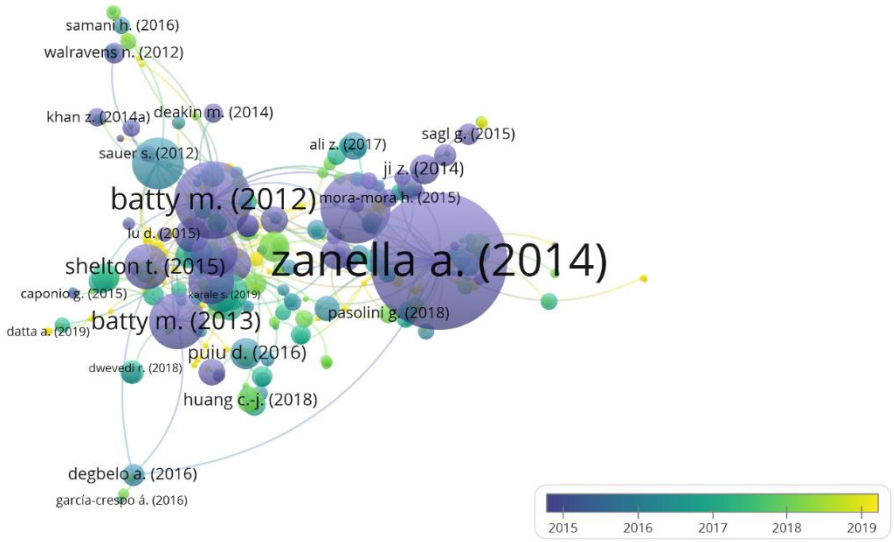

Figure 5 - Representation of the collaborative network of publication citations over the years

Source: Prepared by the authors (2020).

Q3. Which research areas have the most publications?

Regarding the research areas of the works published, in the base [7], the Engineering area stands out with a total of 354 publications, followed by Computer Science with 274, in second place, and in third place the Social Sciences area, with 167. As presented in Figure 6. Such characteristic may be due to the subject being of a multidisciplinary scope, involving several branches of research.

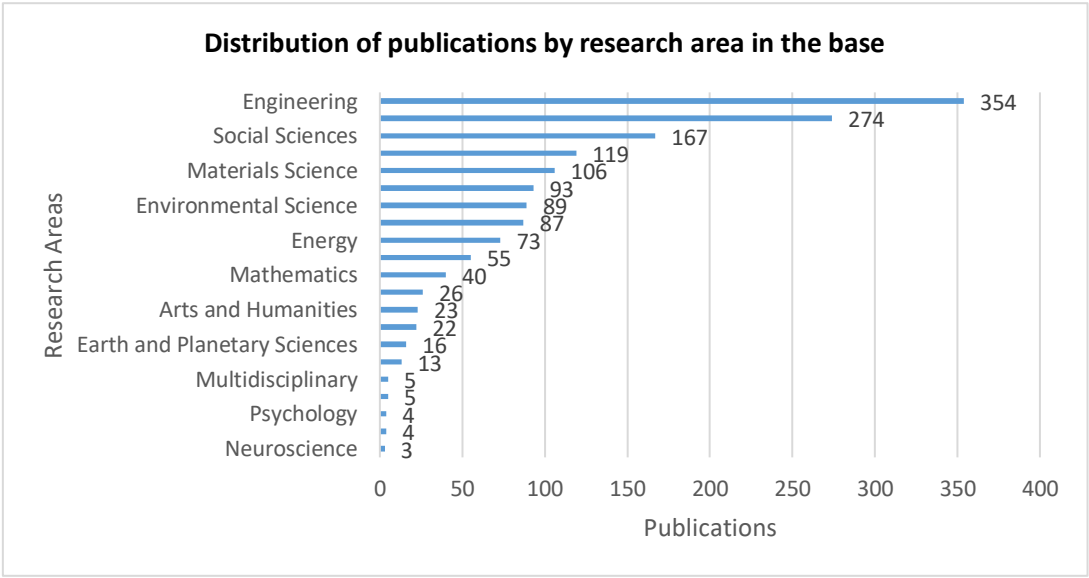

Figure 6 - Distribution of publications by research area in the base

Source: Prepared by the authors (2020).

Q4. Which author publishes the most?

Analyzing the authorship of the publications, the author with the greatest number of publications is "Muñoz, L." with 7 documents. The other authors can be verified in Figure 7.

Also, a network of co-authors is presented in Figure 8, composed of 228 authors forming 22 clusters. The

authors who most co-publish are "Wu j"., Zhang y., Wang h. Zhang x. , Liu y. Kantarci b.

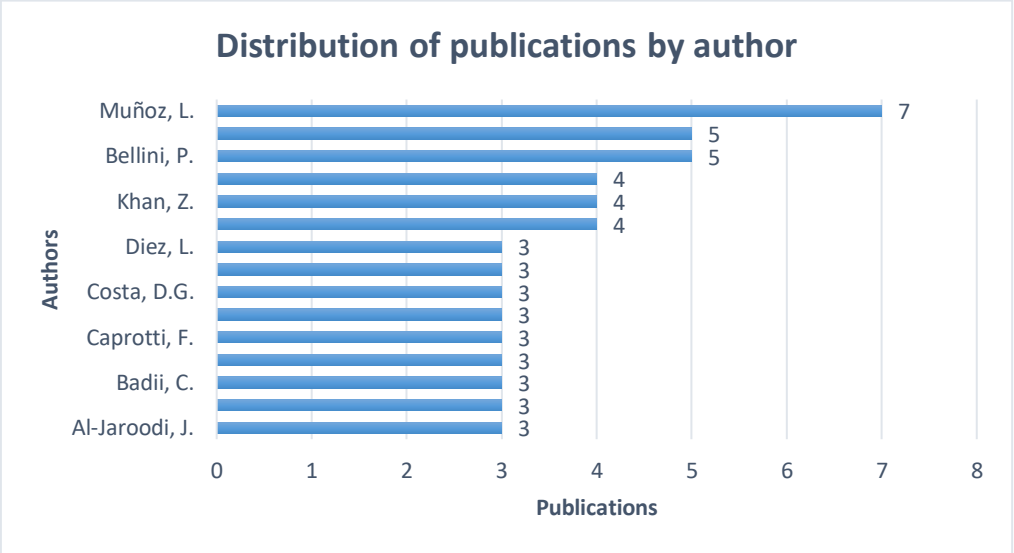

Figure 7 - Distribution of publications by author

Source: Prepared by the authors (2020).

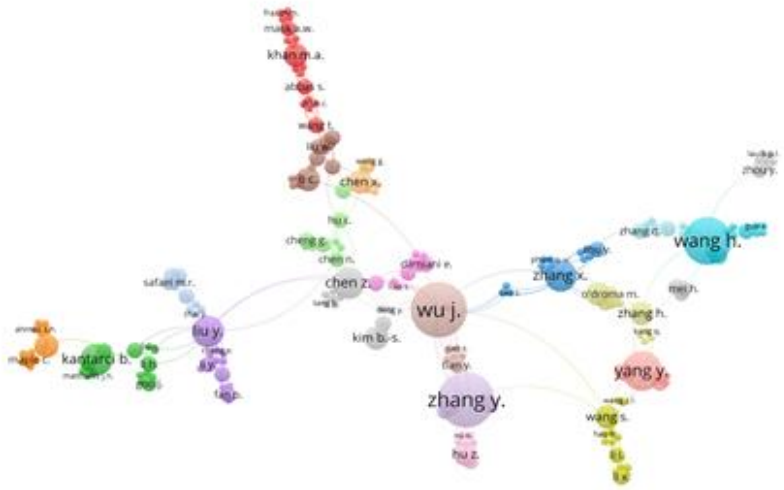

Figure 8 - Representation of the collaboration network between authors/co-authorships

Source: Prepared by the authors (2020).

Q5. Which institution promotes the most publications?

Regarding the analysis of institutions and their publications, "Wuhan University" and "King Saud University" stand out as the institutions with the highest number of published works, with 9 works each. The other main ones can be seen in the graph represented in Figure 9.

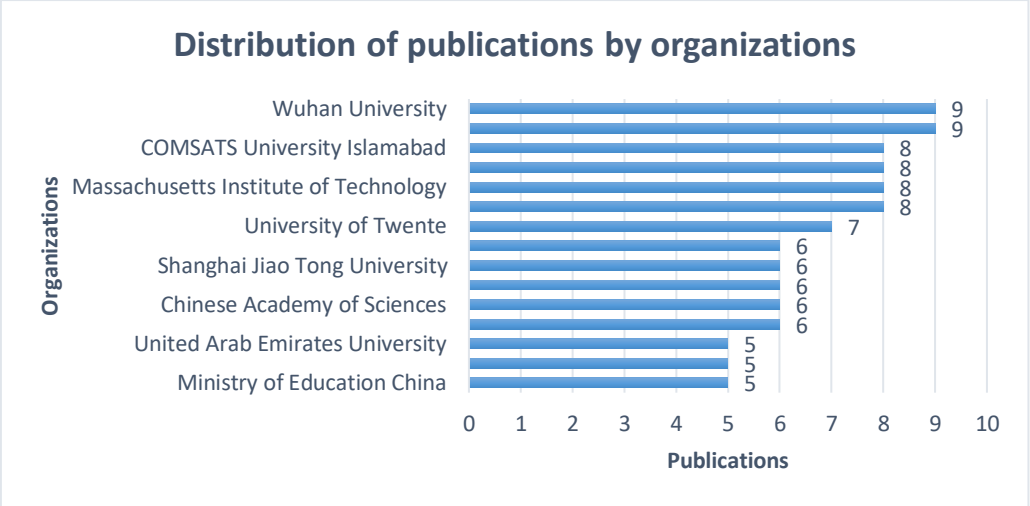

Figure 9 - Distribution of publications by organizations

Source: Prepared by the authors (2020).

Figure 10 shows the collaborative network between the institutions that have had publications in the database. Only one cluster was formed with 12 institutions that published in co-authorship.

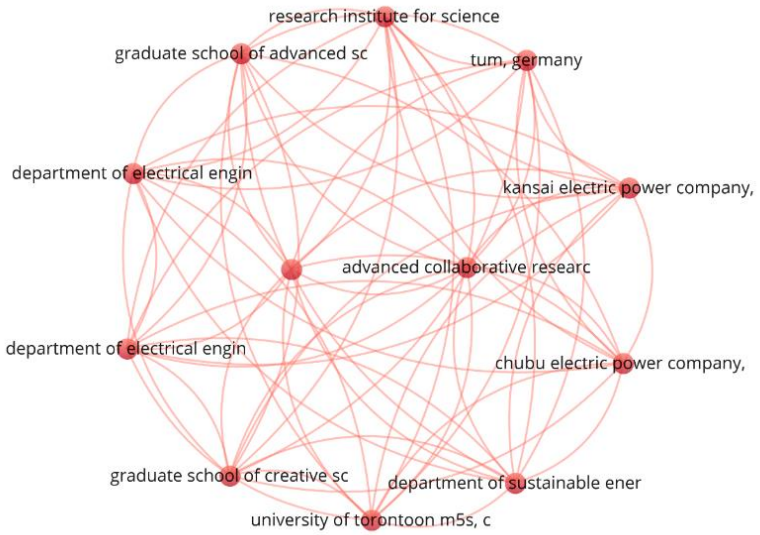

Figure 10 - Distribution of publications by organizations

Source: Prepared by the authors (2020).

4. Threats to Validity

The validation of the Systematic Mapping protocol was carried out by a researcher in the area of Computing who develops research on Smart Cities, however, there was no validation or participation of a group of people in the selection and extraction of data from the works, this being a threat to the validity of this research due to the possible presence of bias.

Another threat is linked to the number of works analyzed in the entirety (632) in a short period of time,

which required great effort and may have caused fatigue in the process.

Regarding the selection of works, only a database using a string was used, which represented the search terms. Soon there may be other works in other bases and that may have other keywords and synonyms of search. To mitigate this threat the string was made according to the main theme and the database has a large number of publications in common with other large databases and this has relevance on multidisciplinary works that is the focus of this search.

5. Final Considerations

The systematic mapping presented in this work identified 632 publications on the theme of Smart Cities, published between 2011 and 2019, presenting a growing number of works that may be an indication of a current and relevant theme that is growing in the interests of the scientific and business communities.

It was also possible to notice that China is the country with the most publications with a total of 94 occurrences and that the "Wuhan University" is the institution that most promotes the works in this area. Brazil presented 18 publications on the subject.

Also, the areas that stood out the most were Engineering, Computer Science and Social Sciences, respectively.

Muñoz, L. was highlighted as the author who published the most on the subject.

The main contributions of this work were:

To map and analyze in a systematic way the scientific researches about Smart Cities, providing an initial knowledge base that can be used by both scientists of the academy and researchers and developers of the organizations. Besides presenting gaps and opportunities that can be explored in future work.

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IN SILICO EVALUATION OF POTASSIUM USNATE: A COMPOSITE PROMISER IN THE COVID-19 COMBAT

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ABSTRACT

A new coronavirus appears in China in December 2019, subsequently threatening the world, it was identified as Covid-19. Its main symptomatic characteristic is directly linked to acute respiratory failure, however there are asymptomatic cases of the disease, mainly in the group not considered at risk. For the treatment of the disease a variety ofantiviral drugs have been tested, with conflicting results. The use of computer-assisted drugs is essential for the development of new therapeutic alternatives for various diseases, once they reduce the time consumed in the initial screening tests, in addition to determining the possible mechanisms of action and reducing toxicity. In our study, we evaluated the interaction of viral components of the coronavirus with potassium usnate, salt derived from lichenic origin and with proven antimicrobial and antitumor activities. Derived from ussic acid, potassium usnate showed low energy for complex formation, this interaction occurs between the usnate salt and the structures of proteinase 3CLpro and enzyme Mpro, all key parts of Covid-19. In addition, in order to prove in silico the use of potassium usnate, they were tested and compared with other approved drugs and candidates for clinical trials to combat the new coronavirus.

Keyword: Covid-19; potassium usnate; antivirals, molecular docking.

INTRODUCTION

At the end of 2019, China comes to know a new coronavirus, identified from Covid-19, an invisible enemy to the eye, but with a great mortality power, and that a time later, the world started to be affected by it. There are three types of coronavirus in humans: they are human coronavirus 229E (HCoV-229E), HCoV-OC43 and coronavirus associated with severe acute respiratory syndrome (SARS) (SARS-CoV) [1, 2].

The main feature of Covid-19 is related to acute respiratory infections (ARI), the disease in its severe condition causes death of the alveoli and consequently respiratory failure [2,3].

This virus has non-segmented and enveloped positive RNA, which is widely disseminated in humans and other mammals [4]. Although most people who are infected do not show symptoms, the coronavirus is considered a pandemic responsible for syndromes of severe acute respiratory diseases [4-6].

Covid-19 has two important structures: the protease M^{pro}, an enzyme that mediates replication and virus transition [8-9] and the non-structural proteinase of polyprotein or $3CL^{pro}$, responsible for controlling the activities of the replication process of the Covid-19 [23].

The present time, with the discovery of this new Covid-19 coronavirus, there is no definitive pharmacological treatment for combat it. Using molecular modeling together with artificial intelligence is the initial step to combat the coronavirus. Many antiviral drugs that are already familiar are being tested to combat Covid-19, but with no concrete results.

A possible drug acyclovir is an example that can be used to against viral infections, being specific to the genus Simplexvirus, among the antimicrobial actions, intracellular half-life of one hour, decreases viral activity, increases healing kinetics and prevents appearance of new injuries [12-15].

Another drug widely advocated for the fight against Covid-19 is hydroxychloroquine, a medicine used to combat malaria and which has had pharmacological therapy against rheumatic diseases, such as lupus [16-17].

Also used as a test, remdesevir is another antiviral used to fight infections caused by RNA viruses, and which presented a mechanism of action against covid-19 [24].

Polypyrrole is another compound used in silico tests to combat covid-29, this polymer has been studied in several therapies, its electrical and biocompatible characteristics can be useful against the virus [25].

A promising one for the proposed covid-19 fight is potassium usnate, a compound derived from ussic acid, this acid that is present in lichens, organisms inhabit large vulnerable geographic areas and found mainly in bark, tree trunks, rocks and soils [18-20].

Ussic acid is widely used in the pharmaceutical, chemical and cosmetic industries, being one of the active ingredients for the production of medicines, being the most active and most important compound produced by the secondary metabolism of lichens [5, 6]. Starting from ussic acid, the derived compound, potassium usnate, in the form of salt, has less toxicity and is easily synthesized.

The binders used for silico evaluation were the antivirals acyclovir, hydroxychloroquine and remdesevir, in addition to the polypyrrole polymer, compared with potassium usnate, a promising possible to combat covid-19 (figure 1). Potassium usnate showed in silico an antiviral potential in combating the new coronavirus.

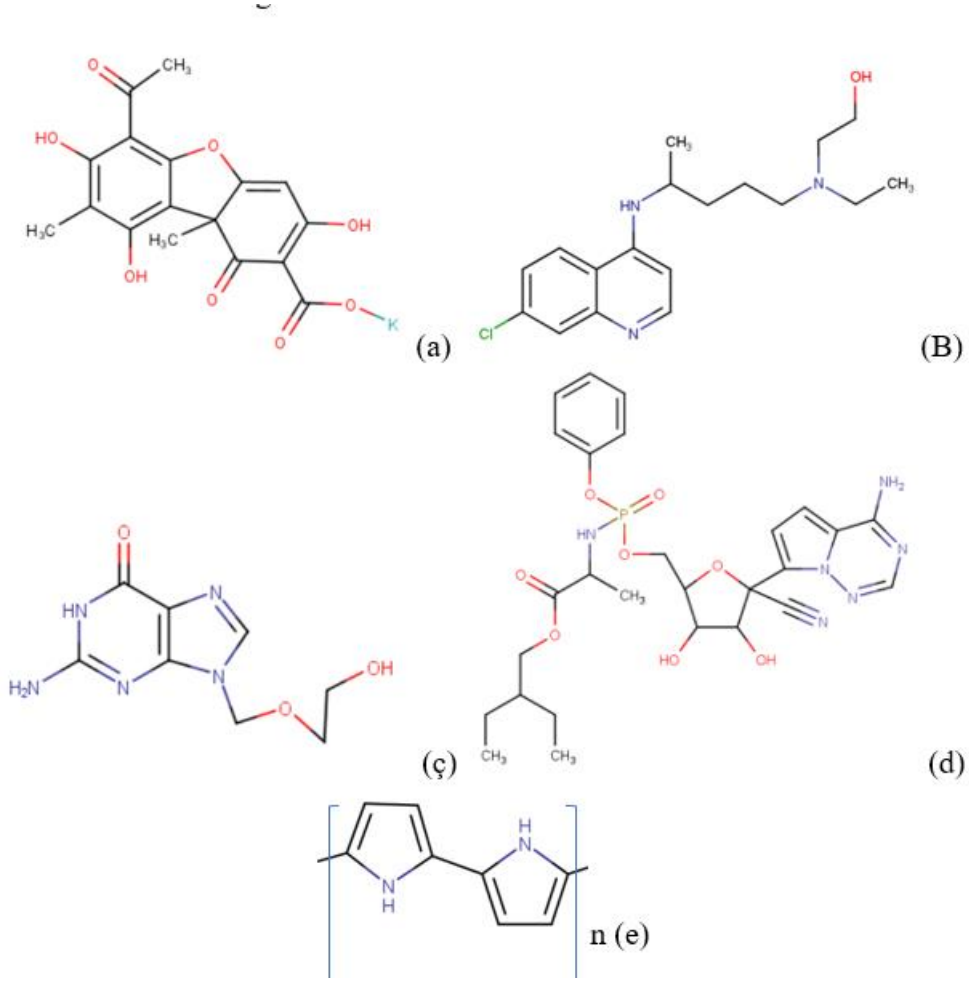


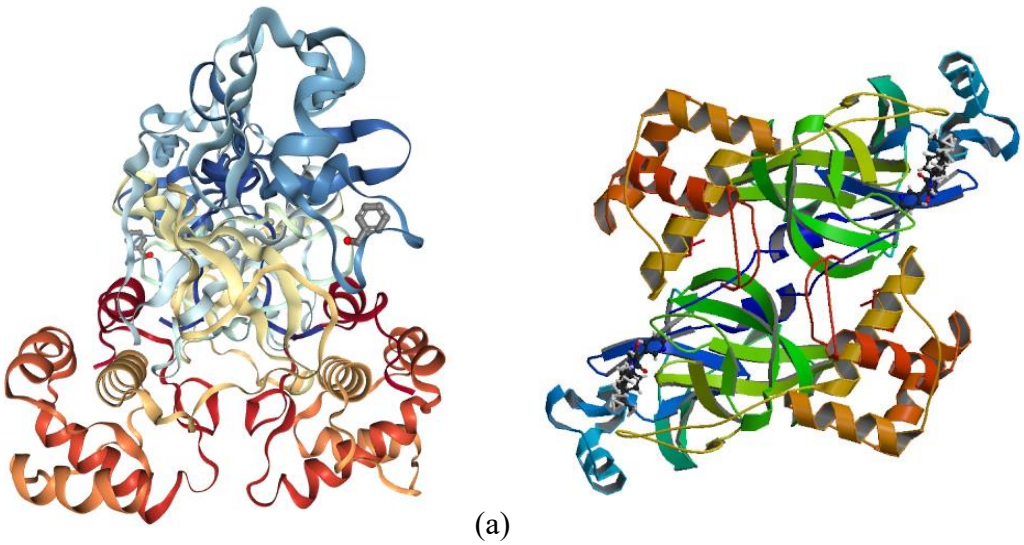
Figure 1. Potassium usnate (a), hydroxychloroquine (b), acyclovir (c) and remdesevir (d), polypyrrole (ppy) (e), respectively.

MATERIALS AND METHODS

For the design of the molecules, the MarvinSketch extension was used, part of ChemAxon's JChem package (https://www.chemaxon.com/). The software allows the construction of drug structures, such as potassium usnate, which were designed in the program and had their energies calculated according to the standardization configuration.

DOCKING FOR MPRO PROTEASE AND 3CL PROTEINASE

The crystal structure of the Covid-19 M^{pro} protease (PDB ID 6LU7) and the Covid-19 $3CL^{pro}$ polyprotein non-structural proteinase structure (PDB ID 6W63) were downloaded from the Protein Data Bank (http://www.rcsb.org/pdb/home/home.do), (figure 2).



(a) (b)

Figure 2. Secondary structure of M^{pro} protease (a) and non-structural polyprotein proteinase $3CL^{pro}$ (b) from Covid-19.

The molecular structures were submitted to molecular fitting using the Molegro Virtual Docker, v. 6.0.1 (MVD) [10]. All water molecules were excluded from viral structures and compounds that were prepared using the same standard parameter settings in the software package (scoring function: MolDock score; ligand evaluation: internal ES, internal HBond, Sp2-Sp2 twists , all verified; number of executions: 10; search algorithm: MolDock SE; maximum interactions: 1500; maximum population size: 50; maximum steps: 300; distance factor from neighbor: 1.00; and maximum number of poses returned. The coupling procedure was performed using a GRID of 10Å radius and 0.20 resolution to cover the ligand binding site of the structure in question.

RESULTS AND DISCUSSION

Potassium usnate, polypyrrole, acyclovir, hydroxychloroquine and remdesevir were incorporated into the crystalline structures of the M^{pro} protease and the $3CL^{pro}$ proteinase involved in the antiviral mechanism. The results are shown in tables 1 and 2 and indicate that potassium usnate shows greater affinity in the two structures of the coronavirus, when compared to the hydroxychloroquine ligand, acyclovir and polypyrrole, which are possible ligands to combat Covid-19. Two compounds showed excellent affinities for potassium usnate for the two structures and showed interaction only with the protease M^{pro}.

Binders	Binding energy
Hydroxychloroquine	-97.4764
Potassium usnate	-112.2900
Acyclovir	-89.8323
Polypyrrole	-78.3817
Remdesevir	-127.8850

Table 1: MolDock Score energies for the ligands in the mechanism of antiviral action, being potassium usnate and remdesevir with the best interaction for M^{pro} protease.

Binders	Binding energy
Hydroxychloroquine	-86.6906
Potassium usnate	-99.8391
Acyclovir	-90,114
Remdesevir	3.9727
Polypyrrole	-66.0040

Table 2: MolDock Score energies for ligands in the mechanism of antiviral action, potassium usnate with better interaction of $3CL^{pro}$ proteinase.

The potassium usnate interacts with amino acids through hydrogen bonds (blue lines) and electrostatic interactions (red lines), figure 3.

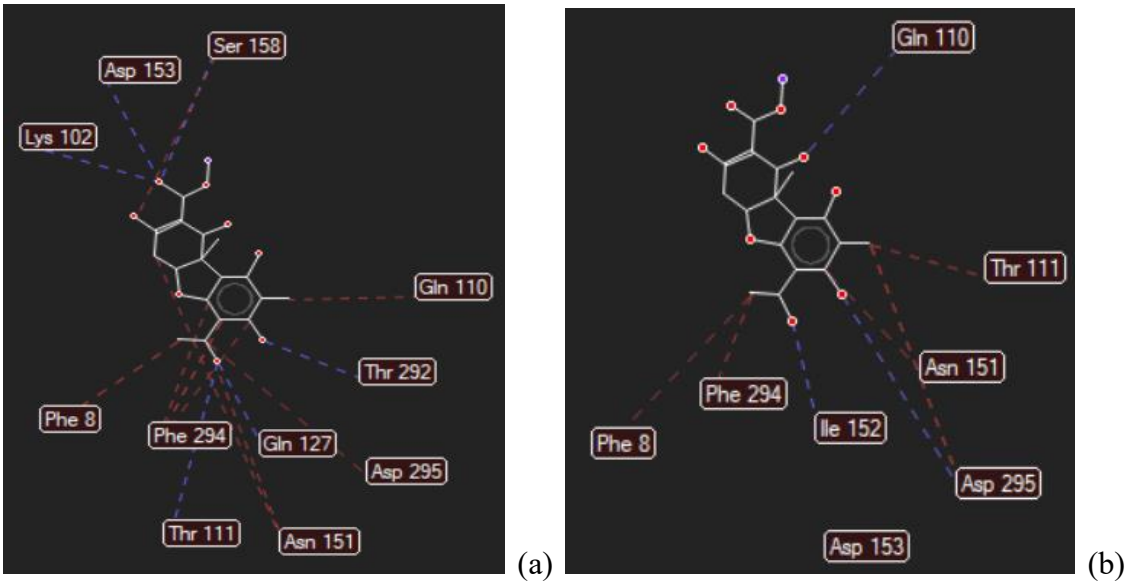


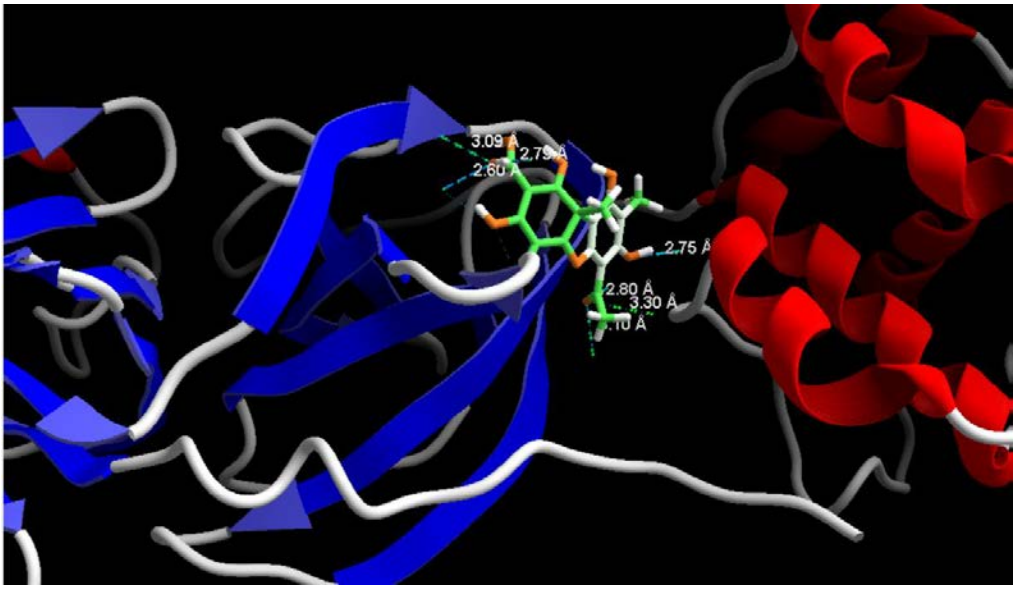
Figure 3. Intermolecular attractions by hydrogen bonds and electrostatic interactions of potassium usnate in the crystalline structures of the M^{pro} protease (a) and in the $3CL^{pro}$ proteinase (b).

Potassium usnate interacts by hydrogen bonds with the M^{pro} protease the amino acids threonine (111), lysine (102), serine (158) and aspartic (153), and with proteinase $3CL^{pro}$ the isoleucine (295) and aspartic (152).

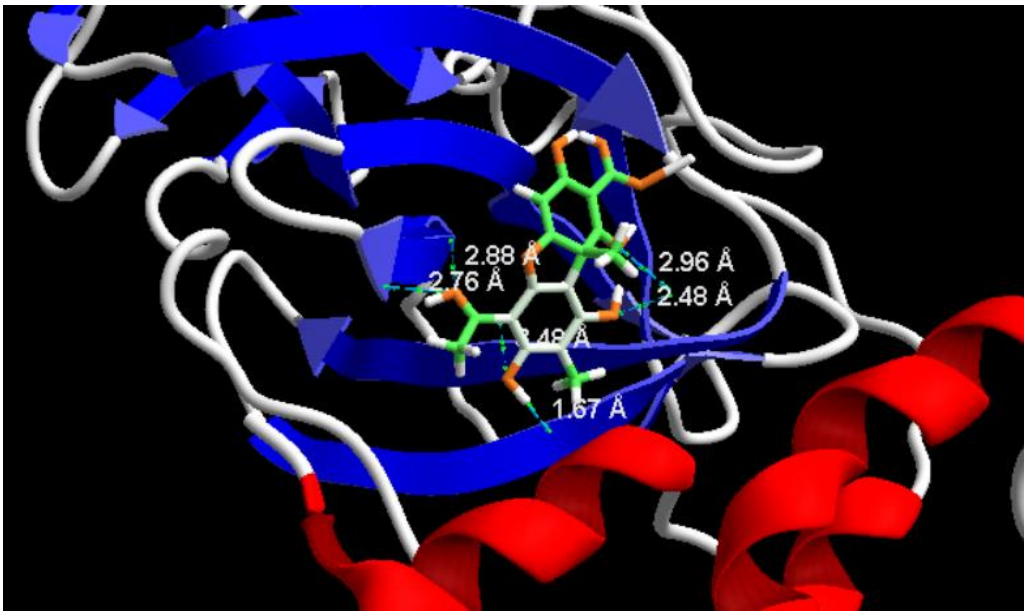
For electrostatic attractions there were interactions with the M^{pro} protease, the amino acids serine (158), phenylalanines (8 and 294), glutamic (110 and 127), asparagine (151), aspartic (295) and with the $3CL^{pro}$ proteinase the phenylalanine amino acids (8 and 294), aspartic (153 and 295), asparagine (151), threonine (111) and glutamine (110).

The interactions of these intermolecular forces by hydrogen and electrostatics highlight the potential for conformational stabilizations, that is, it induces the interaction of ligands with their targets.

In figure 4 it shows the interaction distances of the connections between the potassium usnate and the ligands, protease M^{pro} and proteinase $3CL^{pro}$, this recommends in which of the conformations are closest to the active site of the targets and the ligand.



(a)



(b)

Figure 4. Distances of interactions of potassium usnate with protease M^{pro} (a) and proteinase $3CL^{pro}$ (b).

CONCLUSION

This study compared the use of hydroxychloroquine, remdesevir and acyclovir to combat Covid-19 and potassium usnate as a substitute for the drugs in question.

Therefore, it is concluded that potassium usnate showed antiviral activity in silico with interaction energy, between the target molecules and the ligand, much lower when compared with hydroxychloroquine.

Despite presenting a slightly higher interaction energy than remdesevir in the protease Mpro, potassium usnate is a low toxicity salt and has low energy in both structures.

Thus, potassium usnate becomes promising for vitro test achievements in the against.

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Active Teaching-Learning Methodologies in an Undergraduate Course of Medicine with a Traditional Curriculum: Students' Perception

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Abstract

The current technological configuration added to the present social demands in health make it necessary to review the teaching-learning methodologies applied during the graduation of the medical professional. Those necessities are addressed by the National Curricular Guidelines, which preconize the adoption of methodologies that stimulate the student's autonomy and put the faculty in compliance with the current situation. To obtain a panorama about the medical students' perception in a college of a inland city of the São Paulo state in relation to the Active Teaching-LearningMethodologies (ATLM) this cross-sectional, descriptive-exploratory, quantitative analysis was carried out where the participants were students of the Medical School of São José do Rio Preto - FAMERP in 2017. Through a mixed questionnaire, that is, with open and closed questions, data were collected necessary to reach the objective. A total of 364 students participated, of whom 70.9% agreed they would like to use ATLM more often. Regarding the role of the student: 80.7% agreed that ATLM stimulate the study; 73.3% agreed that group activities support learning; 44.2% disagreed that students are not prepared for ATLM due to lack of maturity and 51.1% agreed that they are unprepared to use ATLM for being accustomed to traditional teaching methods. Data show that, even though they do not attend classes with ATLM frequently, the students can be very interested in execute them. Emphasis is given to his intense perception of learning in these moments. The student profile that compares with the ATLM is the one that knows them, that is, those who have had contact with such methodologies want to use them more frequently. In addition, students consider that the teachers' role should be that of a learning facilitator, who guides the studies so that the academic goals are achieved.

Keywords: Medical education; Active learning; Perception; Students;

1. Introduction

Active Teaching-LearningMethodologies (ATLM) are understood to be the set of strategies used in the teaching-learning process of learners which place them as protagonists of their own training, being based on a significant theoretical principle: autonomy (Freire, 2002).

The application of the outline of the first methods of active and significant Teaching-Learningdates from a few centuries before Christ, but its systematization and application in higher education in the health area only occurred from the second half of the 20th century, for example, the Problem-Based Learning (PBL), applied in Canada in the 1960s (Barbosa & Moura, 2013).

The pressing need to rediscuss the teaching-learning processes in the health area of undergraduate courses is contemporary and is based on several causes, which in turn originate from the current technological configuration and population demands in health.

In terms of technology, we can address, for example, the production of knowledge at very high speed, which makes the professional responsible for his own updating. Therefore, it is interesting that the professional "learns to learn" in his graduation (Mitre *et al.*, 2008). Regarding the social issue, we must pay attention to the National Curriculum Guidelines (NCG), regulated in 2001 and updated in 2014, which emphasize the importance of the critical reflection and creativity skills of the professional inserted in the

Unified Health System (UHS), in addition to recommending the use of methodologies that privilege the student's active participation in the construction of knowledge and integrate the learned content (Mello *et al.*, 2014). The Brazilian population aging, for example, requires a professional attentive to the integrality of the individual, with a biopsychosocial look at the health-disease process, and not with only a biological approach (Xavier & Koifman, 2011). The interdisciplinarity and teamwork recommended by the ATLM, to the detriment of passive information acquisition, appear as possible tools to obtain this skill.

Given these circumstances, we are invited to abandon old ways of storing and reproducing knowledge and to opt for the use of tools that better explore the student's criticism, creativity and dynamics (Ponciano *et al.*, 2017). These tools, grouped under the name of "active Teaching-Learningmethodologies" (ATLM), are based on three main interfaces to meet current demands: promoting learner's autonomy, the concept of school as a community and promoting pluralism (Puig, 1998; Berbel, 2011; Paiva *et al.*, 2016). Among the existing ATLM, they stand out for their effectiveness and frequency of use: PBL / ProblBL (problem-based learning), ProjBL / ABProj (project-based learning), Team Based Learning (TBL), portfolio, peer instruction, just-in- time teaching and role play.

When considering the learning context, it is essential to understand the way students perceive these contexts and understand how these perceptions influence students' approaches in their studies. The perceptions of students largely contribute to their experiences in higher education. These perceptions are closely linked to their expectations. Concerning encouraging the involvement of students with learning through any methodology, we should discuss their expectations more deeply. Being more attentive to expectations throughout a program can help us to better understand their subsequent perceptions and approaches to learning. (Tudor *et al.*, 2015).

Compared to this range of active methodologies, this work sought to obtain an overview of the perception, performance and degree of affinity of learners of a medical course regarding the ATLM. Such an approach allows us to: define the learners' profile which complies with the ATLM; analyze the adaptation of the subjects of institution regarding the ATLM from the learner's point of view; and generate curiosity and reflection in the learners on the issue.

2. Method and procedures

2.1 Design Study

This is an observational, cross-sectional analytical study, of descriptive-exploratory nature, for which quantitative methods of primary data collection were used (Hochman *et al*., 2005; Bordalo, 2006; Rodrigues, 2007) regarding the perception that participants have on Active Teaching-LearningMethodologies (ATLM). The information was obtained through a structured questionnaire specifically formulated for this purpose, according to guidelines issued by Marconi & Lakatos (2003) and Dalfovo *et al.* (2008).

2.2 Data collection and Study participants

Data were collected from medical school learners at the Medical School of São José do Rio Preto - FAMERP. Students enrolled in the aforementioned institution during the year 2017 aged 18 years or over were included as participants in the research. Students who refused to participate or did not complete the

questionnaire were excluded.

The questionnaires were applied to learners in their academic environment, such as theoretical classrooms and laboratories. First of all, students from the 1st, 2nd and 6th grades of 2017 answered, followed by students from the 3rd, 4th and 5th grades.

2.3 Survey instruments

The questionnaire was composed of three parts, with open and closed questions. The first part referred to the identification of the participant; the second inquired about the knowledge about the ATLM; and the third dealt with the learners' perception compared to the same methodologies. Among the closed questions, we had some of them elaborated according to the Likert Scale, which allows the participant to express his position in relation to a statement, checking one of the following options: totally agree, partially agree, indifferent, partially disagree and totally disagree (Amaro *et al*., 2005).

2.4 Data analysis

The exploratory analysis of the data included mean, median, standard deviation and variation for continuous variables and number and proportion for categorical variables. Correlation analysis statements were performed using test t Student and Pearson's correlation coefficient. Statistical analysis was performed using IBM-SPSS Statistics version 24 (IBM Corporation, NY, USA). All tests were two-tailed and P values <0.05 were considered significant.

2.5 Ethical considerations

The participants were informed about the importance of this research and the contribution it can bring to the medical-academic environment; after that, they were presented with the Free and Informed Consent Term – FICT, which they were able to sign before answering the questionnaire. Study approved by the Research Ethics Committee of the Medical School of São José do Rio Preto - CEP / FAMERP under number CAAE: 66603517.7.0000.5415.

3. Results

Considering the inclusion and exclusion criteria, as well as the learners' interest in participating in the study, the number of 364 participants was reached, about 80% of the total enrolled in the year 2017.

3.1 Identification of participants

From the first part of the questionnaire, with regard to the identification of the participants, an average age of 22 was obtained, distributed by age groups and grade as shown in Table 1. Regarding gender, 53% reported female gender and 46 , 4%, male; two participants (0.6%) did not declare.

Table 1. Analysis by age and course grade (n = 364; 2017)

AGE (years)	ABSOLUTE VALUES	%	GRADE	ABSOLUTE VALUES	%
18 - 21	127	34.9	**1st.**	76	20.9
22 - 25	176	48.4	**2nd.**	68	18.7
26 - 30	46	12.6	**3rd.**	60	16.5
> 30	3	0.8	**4th.**	55	15.1
Did not answer	11	3.0	**5th.**	52	14.3
			6th.	53	14.5

3.2 Participants' knowledge of ATLM

Given the question "How do you evaluate your knowledge about ATLM?", The participants were able to choose scores from 0 to 10. Thus, 21.1% informed score 0; 22.8% scores between 1 - 3; 37.6% between 4 - 6; 17.3% between 7 - 10; and four participants (1.2%) did not evaluate themselves.

After that, it was asked “Of the methods below, which one have you heard about?”. The following methods were cited: Problem Based Learning (PBL), Team Based Learning (TBL), Project Based Learning (ProjBL), Portfolio (PORT), Peer Instruction (PI), Just-In-Time Teaching (JITT), Role Play (RP), Others, with specific field for mention by the interviewee, and None. In descending order, the most noted were PBL> PORT> TBL> JITT> RP> PI> ProjBL. Among the three best known methodologies, the frequency of citation was 98.1%, 89% and 76.1%. The least mentioned was ProjBL (6.3%). The entire sample indicated at least one ATLM and no participant marked the “Others” field.

Also about the presented methodologies, it was asked “Of the methods below, which one would you know how to explain the way it is applied?”. In descending order, we had the answer PBL> TBL> PORT> JITT> RP> PI> ProjBL. No participant mentioned other types of ATLM in the space provided for that purpose. The method that most students claimed to have ownership is PBL (70.6%), followed by TBL (64%). Regarding the application of the PORT, 60.7% answered positively. Only 2.2% of the participants claimed to have ownership over the application of ProjBL and 4.9% claimed not to be able to explain about the application of any form of ATLM.

Still using the list of methods presented, it was asked “Of the methods below, which ones have you participated in?”. Again in descending order, we had the answer PORT> TBL> JITT> PBL> RP> PI> ProjBL. We emphasize that 73.1% have already participated in PORT and 66.5% in TBL. However, 11.5% said that they have never participated in activities that used ATLM. After that, it was asked “In how many subjects do you participate / did you participate in activities that used ATLM?”. Of the total involved, 15.7% stated that they have already used ATLM in one subject; 51.6% in two subjects; 16.5% in three or more subjects; 16.1% stated they had never participated in any of the activities listed and 0.6% did not answer.

Then, it was asked “Of these, which subjects do you consider that use / used ATLM most often?”. We had as answers the following subjects: Embryology (188 answers)> Public Health (145 answers)> Histology (19 answers)> Physiology (17 answers), Cross-cutting Issues (17 answers)> Medical Clinic (6 answers), General Surgery (6 answers)> Activities in the Skills Laboratory (5 answers)> Biochemistry (2 answers),

Cell Biology (6 answers), Pathology (3 answers)> Anatomy (2 answers)> Genetics (1 answer), Humanistic Formation (1 answer) , Pediatrics (1 answer), Physicochemical Chemistry * (1 answer), Morphofunctional * (1 answer), Mentoring * (1 answer). The subjects followed by an asterisk were not taken at the institution where the present study was conducted.

At the end of the second part of the questionnaire, the participants used a Likert Scale given the statement "You would like to carry out activities which are based on ATLM more often". The answers are shown in

Table 2 - Perception of learners regarding ATLM

Statement	TA	PA	I	PD	TD
You would like to perform activities which are based on ATLM more often	28.9% (105)	42.4% (154)	20.1% (73)	5.2% (19)	3.3% (12)

***Legend**: TA (Totally Agree); PA (Partially Agree); I (Indifferent); PD (Partially Disagree); TD (Totally Disagree). About 0.5% did not answer.*

Finishing the second part of the questionnaire, the participants used a Likert Scale

3.3 Student's role in the view of ATLM

In the third and final stage, the participants also used the Likert Scale to position themselves regarding the statements. About the student's role in the view of ATLM, six notes were made. The results are shown in Table 3.

Table 3 - Student's role in the view of ATLM

Statement	TA	PA	I	PD	TD
ATLMs encourage study	30.7% (110)	51.6% (185)	13.7% (49)	2.8% (10)	1.1% (4)
Activities carried out in teams/groups favor learning and content fixation	96.2% (94)	48.3% (173)	13.4% (48)	9.8% (35)	2.2% (8)
The discussion of cases during the learning process better enables the student for the moments of decision making	44.7% (160)	45% (161)	8.4% (30)	1.4% (5)	0.5% (2)
The use of ATLM favors the retention of knowledge	27% (97)	50.5% (181)	17% (61)	4.2% (15)	1.1% (4)
Students are not prepared for ATLM due to lack of maturity	7.5% (27)	25.4% (91)	22% (79)	37.1% (133)	7.8% (28)
Students are not prepared for ATLM as they are used to the traditional method	12% (43)	40% (143)	19.3% (69)	22.6% (81)	6.1% (22)

***Legend**: TA (Totally Agree); PA (Partially Agree); I (Indifferent); PD (Partially Disagree); TD (Totally Disagree). About 0.5% did not answer.*

3.4 Teacher's role in the view of ATLM

Still regarding the third part of the questionnaire, four statements were made regarding the teacher's role in the view of ATLM. The results are shown in Table 4.

Table 4 – Teacher's role in the view of ATLM

Statement	TA	PA	I	PD	TD
The teacher will have less work	4.2% (15)	13.7% (49)	24.6% (88)	46.3% (166)	11.2% (40)
The teacher will spend less time preparing activities	2% (7)	11.7% (42)	20.4% (73)	54% (193)	12% (43)
The teacher does not need to have as much knowledge as in traditional methodologies	5.3% (19)	8.6% (31)	10.3% (37)	38.2% (137)	37.4% (134)
Less teachers are needed, generating less cost for colleges	3.6% (13)	13.7% (49)	26% (93)	36.3% (130)	20.3% (73)

***Legend**: TA (Totally Agree); PA (Partially Agree); I (Indifferent); PD (Partially Disagree); TD (Totally Disagree). About 0.5% did not answer.*

3.5 Teacher's role in the current educational context

To complete the questionnaire, the interviewees were asked to choose three options from those presented to answer the following question: "What is the teacher's role in the current educational context?". The answers are in Table 5.

Table 5 - "What is the teacher's role in the current educational context?"	
Direct the study	292 answers → 80.21%
Create strategies which favor learning	236 answers → 64.83%
Clear doubts	216 answers → 59.34%
Arise interest in the student	164 answers → 45.05%
Solve learning problems	120 answers → 32.96%
Provide all content that will be evaluated	49 answers → 13.46%
Adapt to innovative methodologies	41 answers → 11.26%
Value students' discipline/respect	35 answers → 9.61%

3.6 Correlational analyzes

After the correlational analyzes, it could be identified that female students agree more than male students, significantly ($p = 0.02$), that the discussion of cases during the learning process better enables the student for decision-making moments and that male students agree more that the teacher will have less work and spend less time preparing activities, significantly ($p = 0.003$ and $p = 0.004$, respectively).

The greater the age range of the students, the higher the scores for their knowledge of ATLM (positive correlation / $r = 0.1128$, and significant correlation / $p = 0.038$), they would like to perform more activities

which are based on ATLM at other times (positive correlation / r = 0.1071, and significant correlation / p = 0.041), agree more than discussion of cases during the learning process better empowers the student for decision making moments (positive correlation / r = 0.1134, and significant correlation / p = 0.0345), agree more that students are not prepared for ATLM due to lack of maturity (positive correlation / r = 0.1211, and significant correlation / p = 0.0111) and agree less (negative correlation / r = 0.1365-0.1482, and significant correlation / p = 0.005) that the teacher will have less work.

Students who were in more advanced grades had higher scores for their knowledge of ATLM (positive correlation / r = 0.1444, and significant correlation / p = 0.0062) and agree less (negative correlation / r = -0.1482, and significant correlation / p = 0.005) that the teacher will have less work.

Students who participated in more subjects which used ATLM had higher scores for their knowledge of ATLM (positive correlation / r = 0.1271, and significant correlation / p = 0.0177) and would like to perform more activities which are based on ATLM at other times (positive correlation / r = 0.1777, and significant correlation / p = 0.008).

4. Discussion

The data collection instrument used allowed not only to obtain an overview of the learners' perception regarding the ATLM, but also to define students' profiles which comply with it, to verify the percentage of students who would like to use ATLM in more activities, to identify subjects that use this tool more often and check how students view their position and that of instructors regarding such methodologies.

4.1 Perception of knowledge about ATLM

Approximately half of the students declared to have a very low knowledge about the ATLM (43.9% reported scores between 0 - 3 on a scale of 0 - 10, with almost half of them giving a score of 0 for their knowledge). The analysis of this call makes us think that perhaps many of them did not pay attention to the meaning of the acronym ATLM, although this was written at the top of the questionnaire. An alternative hypothesis to justify these data is the fact that, although the participants have already had experiences with ATLM, they have never encountered the theorization of this pedagogical resource, using active methodologies without knowing what they were. Still regarding the knowledge about the ATLM, this is higher, significantly from a statistical point of view, the older the student's are, the more advanced he is in the course and the more they had participated in subjects that used the ATLM, showing the direct relationship with the distance from high school and pre-university entrance courses totally based on little active methodologies. Being more advanced in the course increases the chance of the student having been exposed to ATLM since the use of them is not a "rule" among Famerp subjects.

Regarding to "Of the methods below, which one have you heard about?", The most noted were PBL, PORT and TBL. The first lives up to the fact that it is one of the most popular ATLM, being used in many other medical schools (Escolas Médicas do Brasil, 2020). The other two are basically the two ATLMs officially discussed at Famerp, converging on the broad knowledge of the students. The perception of individualized knowledge regarding ATLM is also expressed in the question "Of the methods below, which one would you explain how it is applied to?", for which PBL, TBL and PORT were also pointed out, probably for the

same reasons already mentioned.

As for "Of the methods below, which ones have you participated in?", The PBL loses space for another ATLM and the three most cited were TBL, PORT and JITT. The first two are officially discussed by the institution's subjects. The third is also used, but the name JITT is not propagated, which may justify the large distance between the frequency of use of JITT verified in the data obtained when compared to the first two. When inquired about how many subjects used ATLM, 11.5% considered never having participated in activities involving such methodologies, which contradicts the finding of the previous question, in which all participants reported having participated in at least one type of ATLM, referring again to the question of using active methodologies without knowing what they were. Regarding the most cited subjects that used ATLM, we had Embryology, Collective Health and Histology, precisely the subjects that use the ATLM most cited by students, which, respectively, are TBL, PORT and JITT and taught in the initial grades of the course.

4.2 Learners' profile and ATLM

Regarding the statement "Would you like to carry out activities which are based on ATLM more often", 70.9% partially or totally agreed. This index is higher than that found at the Federal University of Rio de Janeiro, by Gomes *et al.* (2010), which applied questionnaires to students who have contact with ATLM in their subjects in order to know the percentage of those who considered that such methodologies contributed to learning, having found the value of 60%. A study with undergraduate nursing students, carried out by Sousa *et al.* (2018), demonstrated that 80% of the interviewed student identified themselves with practical and dynamic activities which favor the interaction between teacher and student. The preference for ATLM can reach all learners, as demonstrated by Carvalho *et al.* (2016), who observed 100% of the interviewed dentistry students agreeing that the use of active methodologies in graduation is valid.

The answers to that statement were also analyzed by separating them by course grade, age and self-assessment scores, in order to define the student's profile which complies with the active methodologies.

Therefore, 77.6% of first grade students agreed with the statement; 64.7% of the second grade; 89.8% of the third grade; 65.4% of the fourth grade; 53.8% of the fifth grade; and 71.6% of the sixth grade. Discrepancies between grades may reflect the change in the curricular structure that the institution has been suffering in recent years or simply the heterogeneity that exists among students. However, it is noticeable that there is no clear trend that shows that one grade is specifically more favorable to the use of ATLM.

As for the age of the participating learners and their degree of agreement with the same sentence, 74% between 18 - 21 years old agreed; 69.3% between 22 - 25 years old; 73.9% between 26 - 30 years old; and 100% of those over 30 years old. The significant increase in agreement with this sentence regarding the increased age again refers to the distance from high school and pre-university entrance courses and the greater chance of the student having been exposed to ATLM.

Finally, comparing the self-assessment carried out by the learners regarding their knowledge of ATLM and the agreement with the aforementioned statement, 49.3% of those who assigned a score of 0 to themselves agreed; 71.0% with scores between 1 - 3 agreed; 77.3% between 4 - 6 agree; and 84.1% between 7 - 10 agreed. It is interesting to observe that the percentage of students who agreed with the statement grows as the scores given by the students themselves increase, that is, the more knowledge the learners expressed

having about the ATLM and the greater the participation in subjects they used the ATLM the greater the desire to carry out more activities with these methodologies.

Given these data, we can infer that the learner's profile which complies with the ATLM is the one that knows them, that is, those who have had contact with such methodologies want to use them more often.

4.3 Learners' perception regarding ATLM

In the third stage of the questionnaire, the intention was to verify how the relationship between learners and instructors with the ATLMs occurs from the students' perspective. The learners' impressions refer to the effectiveness of ATLM in contributing to their learning and the degree of personal aptitude in using them. Regarding the instructor, the learners' perception of the degree of knowledge and the necessary dedication of the teacher to perform ATLM was illustrated, as well as the teaching function that students believe to be the most relevant in the current scenario of education.

Regarding the effectiveness of ATLM, the fact that 80.7% agree with the sentence "The ATLM stimulates the study" and 76.3% agree with "The use of ATLM favors the retention of knowledge" allows us to assume that the student shows he is sympathetic to these methodologies and believes in their effectiveness. This approval is corroborated in the following items: "Activities carried out in teams/groups favor learning and fixing the content", with which 73.3% agreed, and "The discussion of cases during the learning process better enables the student to the moments of decision-making ", with 88.2% agreement, with greater, significant agreement, for female students and older age group. We realized how much group activity and case discussions are valued by students. Teamwork was also highlighted in the work of Gomes *et al.* (2010), who found that 68% of students agree that working in small groups contributed to learning, a percentage close to this study. Khansari and Coyne (2018) evidenced the satisfaction that learners of the pharmacy course at a Californian university had in the use of TBL, since 92.5% of the sample said they felt more motivated to study for an activity in TBL format.

With regard to personal aptitude for ATLM, would the lack of habit of using such methodologies or the young age of students be justifications for a possible difficulty in adapting? The statement "Students are not prepared for ATLM due to lack of maturity" generated separation among the participants (44.2% disagreed, 32.4% agreed and 21.7% declared to be indifferent), but with greater agreement, significant, as to the greater the age group, corroborated by the reasons already explained above. Although the majority disagrees, the group of those who agree with the fact is significant. But, the next data draws more attention. Given the statement "Students are not prepared for ATLM as they are used to the traditional method", approximately half of the students agreed (51.1%), 28.3% disagreed, and 19% were indifferent to the statement. The large group of students who agreed leads us to reflect that changes in Brazilian compulsory education are necessary, from the first grades of elementary school to high school, so that students get used to the ATLM and can take advantage of them with excellence during the University education. In addition, these results show the dimension of the obstacle that the insertion of ATLM face in the medical education scenario. Many students feel they are unfit to deal only with active methodologies. Sousa *et al.* (2018) also expressed this thought when explaining that many students still have difficulties with ATLM due to the fact that traditional teaching methods are the most used in the school period that precedes University education. Having placed teaching on the agenda, regarding the teacher's role regarding the ATLM, it was clear that

most learners agree, albeit with safeguards, that the use of active methodologies requires more knowledge, effort and dedication time on the part of the instructor, as we can see in the following results. More than half (56.6%) disagreed with the statement "The teacher will have less work", although only 20% of them were convinced to disagree, while a minority (17.3%) agreed. It is necessary to mention that regarding this statement, the highest, significant agreement is with male students, and the lowest, significant agreement is with students of the highest age group and the most advanced grades. Most students disagreed with the statements "The teacher will spend less time preparing activities" and "The teacher does not need to have as much knowledge as in traditional methodologies". Again, the greatest agreement, significant, with the least use of time by the teacher to prepare the activities is with male students. Although the majority (55.8%) disagreed with the statement "Less teachers are needed, generating less cost for colleges", most students were indifferent (25.5%), which may reflect a deficit in the discussion about medical teaching in the learner's curriculum, since the indifference and lack of conviction in the answers suggest ignorance on the part of the students.

Regarding the instructor's role in the current educational context, the learners opted for "Direct the study", "Create strategies which favor learning" and "Clear doubts" as the main functions of the teacher, demonstrating that wide access to a massive volume information currently leads to the need for a "filter" that selects knowledge in an objective way. This argument corroborates the fact that only 13% of the learners put "Provide all the content that will be evaluated" as a function of the instructor. The study by Yadav *et al.* (2018) conducted at a medical school in Nepal, corroborates this finding, considering that the interviewed learners placed the instructor as a catalyst for learning at PBL, behaving as a guide and director for learning and not as a sage on a stage. The answers found in the present study are also in line with what was reported by Morán in 2015, who stated that the instructor should select the content to be studied by the learners and give support and attention to the class.

5. Conclusion

The results show that, even though they do not participate in classes with ATLM very often (due to the type of methodology adopted in the institution), learners can be very interested, involved and motivated to participate in classes with active methodologies. Their intense learning perception at these moments is noteworthy.

It was observed that the students who gave higher scores to themselves, regarding ATLM, were the ones who were most favorable to the use of those frequently, which allowed us to outline the learner's profile which complies with the active methodologies.

The learners consider that the instructors' role should be that of a learning facilitator, who clear doubts, guides studies so that academic objectives are achieved and creates strategies for that.

We believe that the results obtained here can be extended to other institutions with a traditional curriculum, in which learners' contact with ATLM is still limited.

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Epidemiological and sociodemographic characterization of women and men with cancer in a State in the Brazilian Amazon

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Abstract

Objective: Objective: Analyzes the epidemiological and sociodemographic characterization of women and men with cancer in the State of Rondônia, Western Amazon (Brazil), diagnosed over a period of 2 (two) years. Materials and Methods: It is a documentary, cross-sectional and descriptive study, with the systematization of primary data, according to the methodological model recommended by Paraguassú-Chaves et al [25]. We used an instrument developde by Paraguassu-Chaves et al [26], semi-structured, divided into two blocks: (a) Block I – sociodemographic profile and (b) Block II – epidemiological profile. The Ethics Committee on Human Research at the reference hospital was asked to waive the Informed Consent Form. The research project is in accordance with Resolution 196/96 of the National Health Council of Brazil. Results: Of the 3.333 new cases of cancer, 53.4% were female and 46.5% male. The 10 (ten) most common types of cancer among men and women in Rondônia over a 2-year period were non-melanoma skin (C44), breast (C50), prostate (C61), cervix (C53), stomach (C16), thyroid gland (C73), bronchi and lungs (C33-C34), colon (C18), reticuloendothelial hematopoietic system (C42) and rectal

cancer (C20). An age range of 50 to 69 years was predominant in both sexes and patients with low educational level. The highest frequency was for married patients. There was a predominance of brown skin, patients born in the State of Rondônia (22.6%) and agricultural workers. The Unified Health System - SUS was responsible for the entry for treatment of 99.5% of patients. Most patients underwent "other isolated therapeutic procedures" and with the disease in advanced stages. Conclusions: The estimate of new cancer cases in Rondônia follows an increasing trend. The scenarios selected from the variables of the sociodemographic and epidemiological indicators of the research require the public health authorities of Rondônia, urgent redirection of actions and strategies for the prevention, control, assistance and treatment of cancer in women and men in Rondônia.

Keywords— Cancer. Epidemiological and sociodemographic characterization. Rondônia. Western Amazonia.

I. INTRODUCTION

The estimate for each year of the 2020-2022 triennium indicates that 625 thousand new cases of cancer will occur in Brazil. Non-melanoma skin cancer will be the most incident (177 thousand), followed by breast and prostate cancer (66 thousand each), colon and rectum (41 thousand), lung (30 thousand) and stomach (21 thousand) [1]. The most common types of cancer in men, with the exception of non-melanoma skin cancer, are prostate (29.2%), colon and rectum (9.1%), lung (7.9%), stomach (5.9%) and oral cavity (5.0%). In women, except for non-melanoma skin cancer, the main ones are cancers of the breast (29.7%), colon and rectum (9.2%), cervix (7.4%), bronchus and lung (5.6%) and thyroid (5.4%).

The age-adjusted incidence rates, with the exception of non-melanoma skin cancer, both in men (215.86 / 100 thousand) and in women (145.00 / 100 thousand) are considered to be intermediate and are close to those found in countries under development [1]. Prostate cancer and female breast cancer have the highest adjusted rates for all regions of Brazil and their magnitude is about twice that of the second most common, except in the Northern Region of Brazil, where the adjusted rates of cancer of breast and cervix are very close [2].

The number of new cases of non-melanoma skin cancer expected, for each year of the 2020-2022 period, will be 83.770 men and 93.160 in women, corresponding to an estimated risk of 80.12 new cases per 100 thousand men and 86.65 new cases a every 100.000 women. Non-melanoma skin cancer in men in the North Region (Brazilian Amazon) ranks second, with an estimated risk of 21.28 / 100 thousand. In women, non-melanoma skin cancer is more prevalent in all Brazilian regions, with an estimated risk of 39.24 / 100 thousand in the North Region [1]. Ferlay et al [3] estimated new cases of non-melanoma skin cancer compared to other types of cancer, while Stewart, Wild [4] found the highest incidence rates and made an analogy with several risk factors. Perhaps the most representative studies in terms of numbers are those presented by the American Cancer Society [5], [6], [7], [8]. In Brazil, the most consistent study is that of the National Cancer Institute - INCA [9].

Female breast cancer (except non-melanoma skin tumors) occupies the first most frequent position in all Brazilian regions, with an estimated risk of 21.34 per 100 thousand in the Northern Region.

Stewart, Wild [4] observed a prevalence of breast cancer and prediction of survivors, while Ferlay et al. (3) observed a variation in incidence in different regions of the world. Other reference works are from the American Cancer Society [5] and INCA [10].

Prostate cancer (except for non-melanoma skin tumors) ranks first in the country in all Brazilian regions, with an estimated risk of 29.39 / 100 thousand in the Northern Region. Howlader et al [11], had already observed that prostate cancer is a highly prevalent disease. Stewart, Wild [4] studied the behavior and position of prostate cancer among malignant neoplasms that affect men worldwide, and Ferlay et al [3], [12] estimated the number of new cases of cancer of the prostate in the world.

Cervical cancer (except for non-melanoma skin tumors) is the second most incident in the North (21.20 / 100 thousand). Ferlay et al [3] and Ferlay et al [13], [14], [15], [16] describe the variation in the frequency of cervical cancer in areas with different levels of human development, while the American Cancer Society [5] analyzes its impact on developing countries, the implementation of effective prevention and control programs, tracking and statistics.

Stomach cancer in men (except for non-melanoma skin tumors) is the second most frequent in the Northern Region (11.75 / 100 thousand), while in women, it is the fifth most frequent in the Northern Region (6.03 / 100 thousand) [1]. Ferlay et al [3] studied the prevalence of stomach cancer in the world and Stewart, Wild [4] observed the differences between genders. The studies by Ferlay et al [12] and Forman et al [17] identified incidence rates between men and women.

Thyroid cancer (except non-melanoma skin tumors) in men ranks third most frequently in the North Region (0.50 / 100 thousand) and for women they occupy the ninth most frequent position [1]. An estimated 17.760 new cases of lung cancer in men and 12.440 in women. These figures include an estimated risk of 16.99 new cases per 100.000 men and 11.56 per 100.000 women [1]. Estimates of new cases worldwide and the incidence rate by sex were revealed by Ferlay et al [3] and geographical differences and patterns of diversity were pointed out by Forman et al [17] and La Vecchia et al [18]. Lung cancer (except for non-melanoma skin tumors) in men ranks third most frequently in the North Region (9.24 / 100 thousand) and in women it ranks fourth most frequently in the North Region (6.47 / 100 thousand) [1]. The American Cancer Society [19] and Canadian Cancer Society [20], [21] describe the main cause of lung cancer, as well as the incidence of new cases, making a worldwide estimate of new cases of the disease. These studies are corroborated by Ferlay et al [3] and the World Health Organization [22], which also establish the pattern of occurrence of this type of neoplasia.

Cancer of the colon and rectum (except non-melanoma skin tumors) in men is the fourth most incident in the North Region (5.27 / 100 thousand) and in women, it is the third most incident (6.48 / 100 thousand). Colon and rectal cancer has epidemiological relevance worldwide [3]. Its incidence pattern differs between genders [3]. A wide geographical variation of colon cancer and rectal cancer has been observed and monitored worldwide [23], [3].

Leukemia (except non-melanoma skin tumors) in men is the fifth most common in the Northern Region (4.45 / 100 thousand) and the sixth most frequent in women (3.55 / 100 thousand). Stewart, Wild [4] studied the variation in leukemia incidence rates by countries, while Ferlay et al [3] estimated new cases in men and women. Non-Hodgkin's lymphoma (except non-melanoma skin tumors) in men is the tenth

most frequent (2.23 / 100 thousand) and, in women, is the eleventh in the North (1.95 / 100 thousand). Ferlay et al [3] estimated and compared NHL between men and women worldwide.

In the North region, where the state of Rondônia is geographically located, cervical and stomach cancer has an important impact, although it also exhibits prostate and female breast cancer as the main types of cancer in this population. The Northern Region is the only one in the country where breast and cervical cancer rates are equivalent among women [2].

In Brazil, the distribution of different types of cancer suggests an ongoing epidemiological transition. According to Paraguassú-Chaves and others "Rondônia's Epidemiological Profile" [24], one explanation for the significant increase in the incidence of cancer lies in the greater exposure of people to cancer risk factors. The redefinition of living standards, standardization of working conditions, nutrition and consumption triggered by the global industrialization process, has important repercussions on the epidemiological profile of populations.

Until a few decades ago, little or nothing was known about the epidemiology of cancer in the State of Rondônia, in the Western Amazon (Northern Region of Brazil). The official cancer information in Rondônia started with the implantation of the High Complexity Unit - UNACON, in 2007, at Hospital de Base Dr. Ary Pinheiro, in the city of Porto Velho, headquarters of the State of Rondônia. UNACON aims to catalog the data to support the Hospital Cancer Information System - SISRHC / INCA, as systematic sources of information, based on medical records regarding the registration and use of admitted cases, assessing quantity, quality of survival and, indirectly, the quality of assistance provided at the institution. This information being primary sources not only for epidemiological research on determinants of cancer, but also for planning prevention, diagnosis and treatment of the disease [25], [26], [27].

Research by Paraguassu-Chaves et al [25] "Epidemiological profile of cancer in Rondônia: Brazilian Amazon", records as a historical landmark in the systematization and analysis of cancer data in Rondônia. In recent years, cancer has been incorporated into the fear of the population of the Brazilian Amazon. Most of the population is unaware of neoplasms, which has led people to live with fear of the disease and fear of death [26].

In Rondônia, research by Paraguassu-Chaves and others [24] "Epidemiological profile of Rondônia", Paraguassú-Chaves and others [25] "Epidemiological profile of cancer in Rondônia: Brazilian Amazon", Paraguassu-Chaves and others [26] "Epidemiology of cancer in Rondônia", Paraguassu-Chaves [27] "Diagnosis of cancer in women in Rondônia: Study of Medical Geography" and Paraguassú-Chaves et al [28] "Analysis of the histological frequency and pediatric cancer in Rondônia, Western Amazonia (Brazil)", have contributed to the direction of new research on cancer, sociodemodemographic profile, clinical profile, epidemiological profile and territorial and spatial cancer production and distribution in Rondônia, Western Amazon.

The National Cancer Institute of Brazil (INCA) recognizes that the prevention and control of cancer in our country, of continental dimensions and strong regional differences, because it houses a population of behaviors, beliefs and attitudes in a very diverse way, currently represents great challenges public health. The description of the distribution of the most incident types of cancer, over time, has been one of the main strategies for the establishment of guidelines in public policies and, mainly, for the planning of cancer prevention and control actions [26].

The estimate of cancer in Rondônia follows a linear trend in progress. In 2013, 1.816 patients were diagnosed, in 2014 there was a small regression to 1.731 patients and in 2015, 1.602 patients. However, those numbers increased to 2.980 patients in 2018 and projected to 3.090 patients in 2020.

In the search to know a little more about the behavior of cancer in Rondônia, we defined the objective of this study, analyze an epidemiological and sociodemographic characterization of women and men with cancer in the State of Rondônia, Western Amazon (Brazil), diagnosed during a period of 2 (two) years.

II. MATERIALS AND METHODS

2.1 **Study Type**

This is a documentary, transversal and descriptive study, with the systematization of primary data according to the methodological model recommended by Paraguassu-Chaves *et al* [25]. It was used as an official source, the primary data organized by the Hospital Epidemiology Nucleus - NHE of the Hospital de Base Dr. Ary Pinheiro and the Hospital de Câncer de Barretos - Porto Velho Unit, based on the diagnoses performed, for a period of 2 (two) years .

2.2 **Model of Semi-structured Instrument Paraguassu-Chaves**

We used an instrument developde by Paraguassu-Chaves *et al* [26], semi-structured, divided into two blocks: (a) Block I – sociodemographic profile and (b) Block II – epidemiological profile. The sociodemographic profile is composed of the following variables: sex, age, education, marital status, ethnicity / skin color, place of birth and occupation of the patient. The epidemiological profile according to the model adopted in the research is composed of the following variables: proportional distribution of the 10 (ten) most common types of cancer in women and men, by location of the primary tumor; location of the primary tumor of all types of cancer diagnosed; origino f the patient's referral; patient entry clinic; clinic responsible for the first care of the patient; entry clinic according to previous diagnosis and treatment; cancer distribution according to previous diagnosis and treatment; 1st treatment received by the patient; diagnosis and stage of the disease; basis for diagnosis, number of primary tumors and topography of occurrence of first metastasis; reason for not performing the treatment; median between enrollment and diagnosis, diagnosis and treatment and between enrollment and treatment.

2.3 Sampling Number

The research was carried out with the database of 3.333 female and male patients diagnosed with cancer in Rondônia, corresponding to the period of 2 years.

2.4 Inclusion and exclusion criteria

All protocols with cancer diagnoses that were admitted to the Dr. Ary Pinherio and Barretos / Rondônia Base Hospitals were included. Data without information or those that do not apply (discarded) due to inconsistent data or incomplete protocols were excluded.

2.5 Ethical Aspects

The Human Research Ethics Committee of the reference hospital was asked to waive the Informed Consent Form, because the study did not require patient intervention or collection of biological material and there was no possibility of constraints for the patient and his family, in compliance with Resolution 196/96 of the National Health Council of Brazil.

III. RESULTS

3.1 Block 1: Sociodemographic Profile of Patients

Cancer distribution according to patient's gender.

During the study period, corresponding to 2 years, 3.333 new cases of cancer were diagnosed in Rondônia. The female sex with 1.781 new cases (53.4%) "versus" 1.552 new cases (46.5%) in males represents the highest proportion of new cancer cases in the State of Rondônia. According to data from the Epidemiology Center, it can be noted that there is a small inversion of values compared to the national and international bibliography. (Table 1).

Cancer distribution according to the patient's age group.

The intermediate values reported in the range of 20 to 34 years of age in relation to the adult phase, present a relative frequency of 7.9%, 10.7% in women and 4.7% in men. The age group with the highest incidence of females and males occurs between 50 and 69 years (46.5%). The female sex has a higher relative frequency of 47.1% of new cases in the age group of 45 to 69 years old and in males, with 54.5% in the age group of 55 to 74 years old. It can also be noted that the female sex shows a decrease in new cases after 65 years.

Cancer distribution according to the patient's level of education.

Patients with incomplete and complete elementary education represent 54.2% of the reported cases of cancer, when added to the illiterate (17.1%), the relative frequency rises to 71.3%. Patients with an average level of education have a frequency of 11.9% and graduates 5.3%.

Distribution of cancer according to or marital status.

Married patients have a greater number of new cases (1.804), corresponding to 54.1%, single with 487 new cases (14.6%) and finally widowers with 159 new cases (10.6%). Patients without information about their marital status correspond to 12.3%.

Cancer distribution according to the patient's ethnicity / skin color.

The brown patient is predominant in the state of Rondônia and also has higher frequencies, making a total of 73.3% of all types of cancer, followed by the white patient with 18.5% and black with 2,9%. The indigenous population is present with 0.7%, yellow with 0.6% and with no information representing 4.0%.

Patients born in the State of Rondônia are predominant and contributed with 753 new cases (22.6%), followed by patients born in the State of Minas Gerais with 386 new cases (11.6%), in the State of Paraná with 380 new ones cases (11,4%), State of Amazonas with 247 new cases (7.4%), State of Espírito Santo with 246 cases, São Paulo with 183 cases and Acre with 173 cases. The other States of Brazil contributed with 26.1% and foreign patients with 0.9%.

Cancer distribution according to patient occupation.

Of 3.333 new cancer cases diagnosed, 715 cases without information were excluded and 1.184 cases "not applicable" were discarded, totaling 1.899 cases. Of the 1.434 cases with information on patient occupation, workers in agricultural activities predominate, with 662 cases (43.4%). (Table 1).

Table 1: Sociodemographic characterization of men and women with cancer in Rondônia.

Genre					**Fa***	**Fr %**
Female					1.781	53.4
Male					1.552	46.6
Total					**3.333**	**100**
Age Range	**Female**		**Male**		**Total**	
Age	**Fa***	**Fr %**	**Fa***	**Fr %**	**Fa***	**Fr %**
00 – 04	7	0.4	14	0.9	21	0.6
05 – 09	1	0.06	7	0.4	8	0.2
10 – 14	6	0.3	11	0.7	17	0.5
15 – 19	14	0.8	11	0.7	25	0.7
20 – 24	39	2.2	17	1.1	56	1.7
25 – 29	68	3.8	23	1.5	91	2.7
30 – 34	83	4.7	33	2.1	116	3.5
35 – 39	142	8.0	44	2.8	186	5.6
40 – 44	168	9.4	57	3.7	225	6.7
45 – 49	204	11.4	101	6.5	305	9.1
50 – 54	203	11.4	149	9.6	352	10.6
55 – 59	228	12.8	168	10.8	396	11.9
60 – 64	205	11.5	238	15.3	443	13.3
65 – 69	127	7.1	231	14.9	358	10.7
70 – 74	123	6.9	201	13.5	324	9.7
75 – 79	91	5.1	145	9.3	236	7.1
80 e +	68	3.8	102	6.6	170	5.1
Total	**1781**	**100**	**1552**	**100**	**3333**	**100**
Education					**Fa***	**Fr %**
Illiterate					570	17.1
Incomplete Elementary School					1.286	38.6
Complete primary education					521	15.6
High school					398	11.9
University graduate					178	5.3
No information					380	11.4
Total					**3.333**	**100**
Marital Status					**Fa***	**Fr %**

Married	1.804	54.1
Not married	487	14.6
Consensual Union	119	3.6
Separated / Divorced	159	4.8
Widower	354	10.6
No information	409	12.3
Total	**3.333**	**100**

Ethnicity / Skin Color	**Fr %**
Brown	73.3
White	18.5
Black	2.9
Indigenous	0.7
Yellow	0.6
No information	4.0
Total	**100**

Place of Birth (State)	**Fa***	**Fr %**
Rondônia	753	22.6
Minas Gerais	386	11.6
Paraná	380	11.4
Amazonas	247	7.4
Espírito Santo	246	7.4
São Paulo	183	5.5
Acre	173	5.2
Other States of the country	871	26.1
Foreign	30	0.9
No information	64	1.9
Total	**3.333**	**100**

Occupation	**Fa***	**Fr %**
Farmer	622	43.37
Healthcare professionals, operator, industry worker	124	8.64
Elementary and high school teachers	64	4.46
Driver	62	4.32
Construction workers	60	4.18
Service workers (home, hotels, domestic, cope, baba, caretaker)	43	2.99
Nursing and similar technicians	22	1,53
Other occupations	437	30.47
Total	**1.434**	**100**

Fa* Absolute frequency **Fr%** Relative frequency

3.2 Block 2: Epidemiological Profile of Patients

Proportional distribution of the 10 most common types of cancer in women and men.

From the proportional distribution of the most frequent cancers in women in the period of 2 years reported in the Base Hospitals Dr. Ary Pinheiro and Barretos / RO, breast cancer stands out as the highest incidence in the State of Rondônia with 32.2% of new cases, followed by for cervical cancer (21.5%) and non-melanoma skin cancer (17.3%). The ten most common types of cancer in women were in decreasing order: breast, cervix, non-melanoma skin, thyroid gland, stomach, colon, bronchi and lungs, ovary, reticuloendothelial hematopoietic system and cancer in the body of the uterus. (Table 2).

In men, prostate cancer has the highest frequency (30.9%), followed by non-melanoma skin cancer (22.9%) and stomach cancer (11.7%). The proportional distribution of 10 (ten) most common types of cancer in men were: prostate, non-melanoma skin, stomach, bronchi and lungs, colon, reticuloendothelial hematopoietic system, esophagus, brain, rectum and bladder. (Table 2).

The most common types of cancer among men and women were: non-melanoma skin - C44 (21.2%) of new cases, breast - C50 (19.1%), prostate - C61 (14.7%), cervix - C53 (12.7%), stomach - C16 (8.7%), thyroid gland - C73 (5.6%), bronchi and lungs - C33-C34 (5.2%), colon - C18 (5%), reticuloendothelial hematopoietic system - C42 (4.5%) and rectum C20 (3.3%) of new cases. (Table 2).

Table 2: Proportional distribution of the 10 (ten) most frequent types of cancer in Rondônia.

Localization of Primary Tumor in Women	**Fa***	**Fr %**	**Localization of Primary Tumor in Men**	**Fa***	**Fr%**	**Primary tumor location in women and men**	**Fa***	**Fr%**
Breast	466	32.2	Prostate	359	30.9	Non-melanoma skin	518	21.2
Cervix	311	21.5	Non-melanoma skin	267	22.9	Breast	466	19.1
Non-melanoma skin	251	17.3	Stomach	136	11.7	Prostate	359	14.7
Thyroid Gland	111	7.7	Bronchus and Lung	78	6.7	Cervix	311	12.7
Stomach	77	5.3	Colon	68	5.8	Stomach	213	8.7
Colon	53	3.7	Reticuloendothelial Hematopoietic System	68	5.8	Thyroid Gland	133	5.6

Bronchus and Lung	50	3.4	Esophagus	51	4.4	Bronchus and Lung	128	5.2
Ovary	48	3.3	Brain	49	4.2	Colon	121	5.0
Reticuloendolteli al Hematopoietic System	42	2.9	Rectum	45	3.9	Reticuloe ndothelial Hematop oietic System	110	4.5
Body of the uterus	39	2.69	Bladder	42	3.6	Rectum	81	3.3
Total	**1.448**	**100**	**Total**	**1.163**	**100**	**Total**	**2.440**	**100**

Fa* Absolute frequency **Fr%** Relative frequency

Proportional distribution of cancer cases by location of the primary tumor.

Non-melanoma skin cancer (C44) stands out with the highest incidence of all types of cancer in the State of Rondônia, with 15.5% of cases. Of these, 14.1% in women and 17.2% in men. The second highest incidence is breast cancer (C50), with 14.4% of all cancers. In women they represent a frequency of 26.2%. Prostate cancer (C61) with 10.8% of all cancers is the third most incident. It represents 23.1% of cancers in men and is the 3rd in the proportional order of cancer cases by location of the primary tumor, followed by cervical cancer (C53) with 9.3% of cancers and 17.5% of cancers in women. In the sequence, stomach cancer (C16) appears with 6.4% of all cancers, responsible for 4.3% of cases in women and 8.8% of cases in men and thyroid cancer (C73) with 4.0% of cancers, 6.2% in women and 1.4% in men. The sequence and decreasing order among the 10 most common types of cancer are bronchi and lungs (C33-C34), with 3.8% of cancers, 2.8% in women and 5% in men, colon cancer (3.6%) of all cancers, 3% in women and 4.4% in men, cancer of the hematopoietic retinuloendothelial system (2.3%) of all cancers, 2.3% in women and 4.4% in men and rectal cancer (2%), 2% in women and 2.9% in men. (Table 3). There is no evidence that the distribution of cancer by location of the primary tumor notified in Rondônia is very distant from the projections of neoplasms distributed in Brazil.

Table 3: Proportional distribution of cases of all types of cancer by location of the primary tumor.

Primary tumor location of all types of câncer	**CID-O**	**Female**		**Male**		**Total**	
		Fa*	**Fr%**	**Fa***	**Fr%**	**Fa***	**Fr%**
Lip	C00	1	0.05	6	0.38	7	0.21
Base of tongue	C01	0	0.0	6	0.38	6	0.18
Other Unspecified Parts and Parts of tongue	C02	7	0.39	20	1.28	27	0.81

Mouth Floor	C04	1	0.05	3	0.19	4	0.12
Palate	C05	3	0.16	4	0.25	7	0.21
Other and unspecified parts of Bica	C06	1	0.05	6	0.38	7	0.21
Parotid Paland Gland	C07	1	0.05	2	0.12	3	0.09
Other Major Salivary Glands	C08	0	0.0	3	0.19	3	0.09
Amygdala	C09	0	0.0	1	0.06	1	0.03
Oropharynx	C10	10	1.28	24	1.54	34	1.02
Nasopharynx	C11	0	0.0	4	0.25	4	0.12
Hypopharynx	C13	1	0.05	7	0.45	8	0.24
Other and Badly Defined Locations of the Lip, Oral Cavity and Pharynx	C14	1	0.05	1	0.06	2	0.06
Esophagus	C15	11	0.6	51	3.3	62	1.9
Stomach	C16	77	4.3	136	8.8	213	6.4
Small intestine	C17	7	0.39	2	0.12	9	0.27
Colon	C18	53	3.0	68	4.4	121	**3.6**
Rectosigmoid Junction	C19	5	0.28	4	0.25	9	0.27
Rectal	C20	36	2.0	45	2.9	81	2.4
Anus and Anal Canal	C21	17	0.95	9	0.57	26	0.78
Liver and Intrahepatic Bile Ducts	C22	31	1.7	35	2.2	66	2.0
Gallbladder	C23	1	0.05	4	0.25	5	0.15
Other Parts and Unspecified Parts of Bile Ducts	C24	4	0.22	3	0.19	7	0.21
Pancreas	C25	12	0.67	19	1.22	31	0.93
Outros Órgãos Digestivos e Localizações Mal Definidas do Aparelho Digestivo	C26	2	0.11	1	0.06	3	0.09
Face Breasts	C31	2	0.11	3	0.19	5	0.15
Larynx	C32	3	0.16	34	2.2	37	1.1
Bronchi and Lungs	C34	50	2.8	78	5.0	128	3.8
Thymus	C37	0	0.0	1	0.06	1	0.03
Heart, Mediastinum and Pleura	C38	11	0.61	2	0.12	13	0.39
Other Locations and Ill-Defined Locations of the Respiratory System and Intrathoracic Organs	C39	0	0.0	1	0.06	1	0.03

Bones, Joints and Joint Cartilage of the limbs	C40	11	0.61	9	0.57	20	0.60
Malignant Neoplasm of Bones and Joint Cartilages from Other Unspecified Locations	C41	8	0.44	6	0.38	14	0.42
Hematopoietic and Reticuloendothelial System	C42	42	2.3	68	4.4	110	3.3
Skin	C44	251	14.1	267	17.2	518	15.5
Retroperitoneum and Peritoneum	C48	6	0.33	5	0.32	11	0.33
Connective, Subcutaneous and Other Soft Tissues	C49	18	1.01	15	0.96	33	0.99
Breast	C50	466	26.2	14	0.9	480	14.4
Vulva	C51	4	0.22	0	0.0	4	0.12
Vagina	C52	6	0.33	0	0.0	6	0.18
Cervix	C53	311	17.5	0	0.0	311	9.3
Body of the uterus	C54	39	2.2	0	0.0	39	1.2
Uterus	C55	1	0.05	0	0.0	1	0.03
Ovary	C56	48	2.7	0	0.0	48	1.4
Other Female and Unspecified Genital Organs	C57	2	0.11	0	0.0	2	0.06
Placenta	C58	11	0.61	0	0.0	11	0.33
Penis	C60	0	0.0	16	1.03	16	0.48
Prostate	C61	0	0.0	359	23.1	359	10.8
Testicle	C62	0	0.0	14	0.90	14	0.42
Kidney	C64	18	1.0	33	2.1	51	1.5
Renal Pelvis	C65	0	0.0	1	0.06	1	0.03
Ureter	C66	0	0.0	1	0.06	1	0.03
Bladder	C67	16	0.9	42	2.7	58	1.7
Other Urinary and Unspecified Organs	C68	0	0.0	1	0.06	1	0.03
Eye and Attachments	C69	3	0.16	2	0.12	5	0.15
Meninges	C70	6	0.33	5	0.32	11	0.33
Brain	C71	29	1.6	49	3.1	78	2.3
Spinal Cord, Cranial Nerves and Other Parts of the Central Nervous System	C72	0	0.0	1	0.06	1	0.03
Thyroid gland	C73	111	6.2	22	1.4	133	4.0
Adrenal Gland	C74	0	0.0	2	0.12	2	0.06

Other Endocrine Glands and Related Structures	C75	8	0.44	6	0.38	14	0.42
Other Locations and Badly Defined Locations	C76	6	0.33	9	0.57	15	0.45
Lymph Nodes	C77	10	0.56	19	1.22	29	0.87
Unknown Primary Location	C80	2	0.11	0	0.0	2	0.06
Total		**1.781**	**100**	**1.552**	**100**	**3.333**	**100**

Fa* Absolute frequency **Fr%** Relative frequency

Proportional distribution of cancer by source of referral.

Out of a universe of 3.333 diagnosed cases, 3.316 were notified by the Unified Health System - SUS, corresponding to 99.5% of the patients admitted to the Hospital de Base Dr. Ary Pinheiro and / or Barretos / RO. In total, only less than 0.2% of all cancer cases registered at HBAP / Barretos / RO were not reported by SUS. (Table 4).

Table 4: Proportional Distribution of Cancer by Origin of the Referral.

Origem do Encaminhamento	**Fa***	**Fr %**
SUS	3.316	99.5
Not SUS	6	0.2
On its own	0	0.0
Not applicable	1	0.03
No information	10	0.3
Total	**3.333**	**100**

Fa* Absolute frequency **Fr%** Relative frequency

Proportional distribution of cancer according to entry clinic and clinic responsible for the 1st service.

For the 2 years of studies of cancer distribution according to the entry clinic at the base hospitals Dr. Ary Pinheiro and Barretos in Rondônia follows the pattern of the annual frequency distribution. Clinical oncology with 2.726 patients represents 81.8% of all cancer patients. (Table 5).

Clinical oncology with 937 cases (responsible for 28% of all cases), mastology with 451 cases (13.5% of all cases), urology with 399 cases (12% of all cases), gynecology with 398 cases (11.9% of all cases), gastroenterology with 395 cases (11.9% of all cases) are, respectively, the main clinics responsible for the first service at Hospital de Base Dr. Ary Pinheiro and Barretos / RO. (Table 5).

Table 5: Proportional distribution of cancer according to entry clinic and clinic responsible for the 1st service.

Entrance Clinic	Fa*	Fr %	1st Service Clinic	Fa*	Fr%
Clinical Oncology	2.726	81.8	Clinical Oncology	937	28.1
Gynecology	110	3.3	Mastology	451	13.5
Gastroenterology	104	3.1	Urology	399	12.0
Mastology	92	2.8	Gynecology	398	11.9
Neurology	61	1.8	Gastroenterology	395	11.9
Other Clinics	231	6.9	Head and neck	291	8.7
Screening	9	0.3	Other Clinics	445	13.4
No information	0	0.0	No information	17	0.5
Total	**3.333**	**100**	**Total**	**3.333**	**100**

Fa* Absolute frequency **Fr%** Relative frequency

Proportional distribution of cancer by entry clinic, according to previous diagnosis and treatment.

The oncology clinic provided 2.725 initial care services. Of the patients seen at the oncology clinic, 496 (18.2%) patients were diagnosed and obtained treatment. However, 1.881 patients (69%) of the patients were diagnosed without receiving treatment and 342 (12.6%) were not diagnosed and also received no treatment. (Table 6).

Table 6: Distribution of cancer by entry clinic, according to previous diagnosis and treatment.

Entrance Clinic	With Diag / With Trat	With Diag / Without Trat	Without Diag/ Without Treat	No Infor
Clinical Oncology	496	1.881	342	6
Gynecology	14	74	22	0
Neurology	7	40	14	0
Clinical Hematology	14	14	20	0
Mastology	10	57	25	0
Urology	5	36	7	0
Gastroenterology	10	53	41	0
Head and neck	4	28	13	0
Other Clinics	16	51	3	2
Total 3.333	**576**	**2.234**	**515**	**8**

Fa* Absolute frequency **Fr%** Relative frequency

Proportional distribution of cancer, according to previous diagnosis and treatment.

2.234 (67.3%) patients were diagnosed, but received no treatment. This is followed by 575 cases (17.1%) of patients with diagnosis and treatment and 515 (15.4%) of patients without diagnosis and without treatment. (Table 7).

Table 7: Proportional distribution of cancer, according to or previous diagnosis and treatment.

Diagnosis and Previous Treatment	Fa*	Fr%
With Diagnosis / Without Treatment	2.234	67.3
With Diagnosis / With Treatment	575	17.1
Without Diagnosis / Without Treatment	515	15.4
No information	9	0.2
Total	**3.333**	**100**

Fa* Absolute frequency **Fr%** Relative frequency

Proportional distribution of cancer according to the first treatment.

Other isolated therapeutic procedures showed a higher frequency with 807 cases (44.4%) of the total sample universe of 1.816 cases. Then 490 cases (27%) of patients who did not receive any procedure. Surgery with 277 cases (15.2%) and chemotherapy 109 cases (6.0%) are also representative for the first treatment of cancer patients. (Table 8).

Table 8: Distribution of cancer according to first treatment received.

First Treatment	Fa*	Fr%
Other Isolated Therapeutic Procedures	807	44.4
No Procedure	490	27.0
Surgery	277	15.2
Chemotherapy	109	6.0
Other isolated therapeutic procedures + surgery	44	2.4
Surgery + Chemotherapy	19	1.0
Radiotherapy	16	0.9
Other Isolated Therapeutic Procedures + Chemotherapy	13	0.7
Other combinations of procedures **	39	2.2

No information	4	0.2
Total	**1.818**	**100**

** Chemotherapy + Radiotherapy; Chemotherapy + Surgery; Radiotherapy + Chemotherapy; Others.

Fa* Absolute frequency **Fr%** Relative frequency

Proportional distribution of cancer by clinical stage, according to previous diagnosis and treatment.

Table 9 represents the proportional distribution of cancer by clinical stage, according to previous diagnosis and treatment. Of the total of 3.333 cancer patients notified, 2.724 (81.7%) are patients without information about the disease. Excluding the sub-stratification of patients without information and without knowledge of the stage of the disease, there was a predominance of patients (55.8%) with diagnosis and treatment in stages I, stage II, stage III and stage IV. Undiagnosed and untreated patients represent 13% of all patients in the 4 stages of the disease. In the three diagnostic categories, there was a predominance in stages III and IV. It should be noted that the sum of the stages (I, II, III, IV) excluding patients without information, corresponds to 88% of the analyzed universe. (Table 9).

Table 9: Proportional distribution of cancer by clinical stage, second or previous diagnosis and treatment.

Diagnosis	Stage I	Stage II	Stage III	Stage IV	Non-Internship	Without / Infor
With Diag / Without Trat	20	30	36	43	187	1.918
With Diag / With Trat	11	18	21	22	80	423
Without Diag / Without Treat	6	8	6	10	111	374
No information	0	0	0	0	0	9
Total	**37**	**56**	**63**	**75**	**378**	**2.724**

Fa* Absolute frequency **Fr%** Relative frequency

Proportional distribution of cancer, by examination performed for diagnosis, number of primary tumors and topography of the occurrence of the first metastasis.

According to table 10, of the total of 3.333 patients, 92% had their diagnosis confirmed by histological examination of the primary tumor. A single primary tumor was identified in 99.96% of the exams. From the topographies of occurrence of the 1st metastasis, there was a predominance of liver cancer and intrahepatic biliary tract with 13 occurrences (25%), bronchi and lungs with 12 occurrences (23.1%), bones, joints and joint cartilage of the limbs with 12 occurrences (23.1%) and meninges with 4 occurrences (11.5%). (Table 10).

Table 10: Proportional distribution of cancer, by examination performed for diagnosis, number of primary tumors and topography of the occurrence of the first metastasis.

Most important basis of diagnosis	**Fa***	**Fr%**
Clinic	3	0.1
Clinical research	8	0.2
Examination by Image	161	4.8
Tumor Markers	53	1.6
Cytology	34	1.0
Primary Tumor Histology	3.065	92.0
No information	9	0.3
Total	**3.333**	**100**
Primary Tumor Numbers	**Fa***	**Fr %**
Single Primary Tumor	3.332	99.96
Multiple Primary Tumor	1	0.04
Total	**3.333**	**100**
Topography of the occurrence of the 1st metastasis	**Fa***	**Fr*%**
Liver and Intrahepatic Bile Ducts	13	25.0
Bronchi and Lungs	12	23.1
Heart, Mediastinum and Pleura	2	3.9
Bones, Joints and Joint Cartilage of Limbs	12	23.1
Malignant Neoplasm of Bones and Articular Cartilages from Other Unspecified Locations	1	1.9
Ovary	1	1.9
Kidney	1	1.9
Meninges	6	11.5
Brain	2	3.9
Thyroid gland	1	1.9
Other locations and ill-defined locations	1	1.9
Total	**52**	**100**

Fa* Absolute frequency **Fr%** Relative frequency

Proportional distribution of cancer due to not undergoing treatment.

Of the total of 3.333 cases, 101 did not undergo the 1st (first) treatment. Of these, 9 (8.4%) undergo treatment for the State, 3 cases (3%) simply abandoned treatment, 2 cases (2%) due to advanced disease stage, lack of clinical conditions or other associated diseases and 84 patients (83.1%) did not treat the disease for any other reason.

Regarding the disease state at the end of the 1st (first) treatment, it is observed that 2.457 (73.7%) of the patients had disease progression, 430 (12.9%) cases with stable disease and 224 (6.7 %) died. (Table 11).

Table 11: Proportional Distribution of Cancer Cases Whose Initial Treatment, According to the Reason for Not Performing the First Treatment and Disease Status at the End of the First Treatment.

Cancer whose initial treatment cannot be performed according to reason for not treating	**Fa***	**Fr%**
Treatment Performed Outside	9	8.9
Advanced Illness, Lack of Clinical Conditions or Other Associated Diseases	2	2.0
Treatment Abandonment	3	3.0
Refusal of Treatment	1	1.0
Other reasons	84	83.1
No information	2	2.0
Total	**101**	**100**
Cancer status at the end of the 1st treatment	**Fa***	**Fr%**
Complete Remission	30	0.9
Partial Remission	72	2.2
Stable Disease	430	12.9
Disease in progress	2.457	73.7
Oncological Therapeutic Support	1	0.03
Death	224	6.7
Not applicable	90	2.7
No information	29	0.9
Total	**3.333**	**100**

Fa* Absolute frequency **Fr%** Relative frequency

Time interval according to the average, median, fashion, quartile, minimum and maximum.

One of the factors in assessing the quality of care of a reference institution in cancer treatment is the time interval between the three most important moments in caring for a patient: admission date, diagnosis date and treatment start date. The average time since registration / diagnosis is 19.5 days, the period of diagnosis / treatment can reach 79 days and the maximum duration of 2.444 days. The median between enrollment and diagnosis is 10 days and between diagnosis treatment reaches 40.5 days. In the

third quartile, the time between enrollment and diagnosis is 28 days and between diagnosis and treatment it reaches 82.5 days. (Table 12).

Table 12: Time interval (in days) elapsed, according to the average, median, mode, quartile, minimum and maximum, between: 1st consultation-1st diagnosis, 1st diagnosis-beginning of treatment, 1st consultation-beginning of treatment.

Indicator	Registration / Diagnosis	Diagnosis / Treatment	Registration / Treatment
Maximum	209.5	2444	129.5
Average	19.5	79	5.5
Median	10	40.5	2
Minimum	0	0	0
Mode	1	0	0
First Quartile	3.5	13.5	0
Third Quartile	28	82.5	4

Time interval between 1st consultation and 1st diagnosis; 1st diagnosis - start of treatment; 1st consultation and start of treatment.

The entry clinics with medians between registration and diagnosis with the longest time elapsed are general surgery with 38 days, plastic surgery with 31.2 days and chest surgery with 27.5 days and clinics with the most significant median between diagnosis and treatment, are in decreasing order: allergy / immunology (114) days, dermatology (106) days, plastic surgery (59.5) days, clinical oncology (49.5) days, clinical oncology (49.5) days, clinical oncology (49.5) days, clinical oncology (49.5) days, head and neck (43.5) days, thoracic surgery (37.5) days, mastology (36.2)) days, general surgery (31.7) days, gastroenterology (27.5) days, and gastrosurgery (24.5) days. (Table 13).

Table 13: Time interval (in days) elapsed, according to the median, between: 1st consultation-1st diagnosis; 1st diagnosis - start of treatment; 1st consultation and start of treatment, according to the clinic responsible for the 1st treatment.

Entrance Clinic	Median Registration / Diagnosis	Median Diagnosis / Treatment	Median Registration / Treatment
Allergy / Immunology	0	114	2
Head and neck	11	43.5	2
General surgery	38	31.7	20.2

Plastic surgery	31.2	59.5	17
Thoracic surgery	27.5	37.5	5.5
Dermatology	0	106	0
Gastrosurgery	18.5	24.5	3.5
Gastroenterology	6.5	27.5	2
Ginecologia	5.5	41	1
Clinical Hematology	4.5	2.5	4
Neurosurgery	7	15.2	2.7
Neurology	5.2	23	3
Clinical Oncology	14.7	49.5	1
Oncology Pediatrics	4.2	2.7	3.2
Orthopedics	3	0	3
Pneumology	8	10.2	7.2
Urology	11.5	61	1
Mastology	18.7	36.2	2
Not applicable	0	344	0
No information	4	19	4

IV DISCUSSION

The incidence and prevalence of cancer as a public health problem in Brazil and the State of Rondônia motivated the search to know the profile of women and men diagnosed with cancer treated at the Reference Hospital for Cancer Treatment in Rondôni. For that, we use a methodology that allows the documentary, transversal and retrospective search of systematized primary data, in order to allow the analysis of the epidemiological and sociodemographic aspects of the studied population, comprising the diagnosis of 2 (two) years.

The state of Rondônia is located in the Western Amazon (Northern Region of Brazil), with 1.777.225 inhabitants and comprises 52 municipalities [29]. The demand for patients at the referral cancer hospital in Rondônia is motivated by the assistance provided by this health unit specialized in cancer treatment - the largest cancer hospital in the Amazon, by the free services, the attention of the Unified Health System and also by the inability of the municipalities of origin of the patients and other states to offer similar care.

4.1 Sociodemographic Profile of Patients

This research revealed that 3.333 new cases of cancer diagnosed in the 2 years of study, women present 53.4% of the cases. Paraguassú-Chaves et al [22] recorded 53.8% relative incidence in women at the same study site.

The profile of the patients revealed a predominance in the age group between 45 to 69 years old (47.1%) in women and in the age group between 55 and 74 years old (54.5%) in men. In the study by Paraguassu-Chaves et al [25] there was a predominance of cancer in women 45 to 49 years old (11.7%), 50 to 54 years old (13.6%) and 55 to 59 years old (12.7), while in men the age group of onset between 55 and 59 years (14.6%), 60 to 64 years (14%), 65 to 69 years (12.2%), 70 to 74 years (12%) and extends to 75 to 79 years (11.3%).

It does not refer to the level of education, it is possible to observe, in general, low education, reaching 54.2% of the cases in illiterate patients, with incomplete elementary school and complete elementary school. Of 1.816 cancer cases analyzed, according to education level, 1,067 protocols were discarded due to lack of information. In another study, of the 749 cancer cases with correct completion of the protocol, 42% of the patients had incomplete elementary school, 18.9% completed elementary school and 21.3% are illiterate. It is concluded that most of the population with cancer has a low level of education [25].

Most patients were married (54.1%), with a predominance of patients with brown skin color (73.3%). According to the IBGE [30], in Rondônia the population with brown skin predominates (55.8%), accompanied by the population of white (35%), black (6.8%), yellow (1.4%) and indigenous (0.9%). Paraguassu-Chaves et al. [25] when studying the distribution of cancer according to skin color, found a predominance of brown skin color (46.9%), followed by white skin color with 21.6% and, in smaller proportions of cancer in patients with black (3.3%), yellow (0.6%) and indigenous (0.5%) skin color. Most patients are married and justified by the predominant age group of adults [31]. The brown color is predominant in the state of Rondônia and the one with the highest incidence of cancer, making up 64.4% of all registered neoplasms, followed by white with 19.5% and black with 3.0%. The indigenous population is present with 0.6% and yellow with 0.5% [25].

Patients born in Rondônia contributed 22.6% of the cases, where it can be seen that the majority of cases are in people born in other states in the country. Cancer was predominant in workers in the agricultural and agricultural activities (43.4%) of the cases. More than 40% of the inhabitants who live in Rondônia were born in other states of Brazil [31], [32]. The population of Rondônia is one of the most diversified in Brazil, composed of migrants from all regions of the country [31], [32], [33], [34]. Most of the migrants who live in Rondônia come from the Southeast and South regions of Brazil. In addition, there are migrants from the Northeast and Midwest regions [32]. The state of Rondônia also has the third largest foreign population in the North region [32].

The predominance of cancer in patients working in agriculture and farming activities is directly related to the economic activity of Rondônia. The economy of the state of Rondônia has as its main activities agriculture, livestock, food industry and plant and mineral extraction [35].

Sociodemographic aspects and their indicators allow us to know the characteristics of a specific population and its evolution over time in the territory. In the health sector, this information supports the decision-making process, since it helps in the knowledge about health conditions, mortality and morbidity, risk factors, population; gender ratio; population growth; fertility rate; crude birth rate, by age in children under one year; life expectancy at birth; aging index, demographic conditions among others [36], [37].

4.2 Epidemiological Profile of Patients

In this stage of the research, the distribution of cancer by primary tumor location is analyzed, according to sex. Among the 10 most common types of cancer in Rondônia, non-melanoma skin cancer (21.2%) and breast cancer (19.1%), stand out as the highest frequencies, followed by prostate cancer (14.7%), cervix (12.7%), stomach (8.7%), thyroid gland (5.6%), bronchi and lungs (5.2%), colon (5%), hematopoietic system reticuloendothelial (4.5%) and rectum (3.3%).

According to INCA [1], as for the year 2020 the incidence rates of 100 thousand inhabitants and the number of new cancer cases in Rondônia, according to sex and tumor location, reaches 1.530 new cancer cases in men and 1.560 in women.

The 10 highest frequencies in men are non-melanoma skin cancer (380), new cases, prostate (310), bronchi and lungs (110), stomach (80), colon and rectum (60), oral cavity (50), esophagus (40), central nervous system (40), leukemias (40) and larynx (30) new cases. In women, the most frequent estimates are non-melanoma skin cancer (600) new cases, breast (220), cervix (130), bronchi and lungs (70), colon and rectum (70), stomach (40), ovary (30), central nervous system (30), leukemias (30) and thyroid gland (20) new cases [1].

Study by Paraguassu-Chaves et al [25] found 10 most frequent neoplasms in women in the following order: breast cancer with 32.9% of cases, cervix (23.5%), stomach (5.9%), thyroid gland (4.5%), colon (4.5%), ovary (4.4%), rectum (4.2%) and cancer of the liver and hepatic bile ducts (3.2%). And, in males, the 10 most common neoplasms were: prostate cancer (33%), non-melanoma skin (22%), stomach (12%), bladder (5.2%), bronchi and lungs (5.2%), colon (4.8%), rectum (4.8%), esophagus (4.5%), liver and intrahepatic bile ducts (4.1%).

According to Bray et al [38] and Ferlay et al [14] of all diagnosed malignancies worldwide, non-melanoma skin cancer is the most common type in both sexes. According to INCA [1], they are more common in people with fair skin over 40, with exceptions in people already with skin diseases. However, this age profile has been changing with a constant exposure of young people to sunlight. Non-melanoma skin cancer is the most common tumor among men and women in Brazil [9]. Despite being the most frequent cancer, non-melanoma skin cancer is difficult to estimate, since not all cancer records are collected [1]. Despite the low lethality, however, its high incidence, may be the explanation for the occurrence of deaths from non-melanoma cancer, almost identical to melanoma skin cancer [10]. Non-melanoma skin cancer is curable in most cases. The main risk factor for melanoma and non-melanoma skin cancer is excessive exposure to ultraviolet (UV) solar radiation. Other factors, such as skin color, eyes and light hair; family or personal history of skin cancer; the immune system weakened by the disease or in transplant patients due to the use of immunosuppressants (azathioprine and cyclosporine), may increase the risk of

skin cancer [5], [9]. In addition, it is also important to highlight environmental and occupational factors. In Rondônia, skin cancer may be related to the main economic activities [25], [26], which involve the management of pesticides, agriculture, construction, health, fishing, plant and mineral extraction, among others [9].

Breast cancer (except non-melanoma skin cancer) is the most common tumor among women [1]. It is also the leading cause of cancer death among women. According to Stewart, Wild [4], although it has a higher death rate than other cancer (12.9 / 100 thousand), breast cancer has relatively low lethality, given that the mortality rate is less than a third of the incidence rate. According to INCA [1], the incidence trend has increased in most regions of the world. However, in highly advanced countries, the incidence has reached the least stability in the last decade with a downward trend.

Even in these countries, mortality rates have been on a downward trend since the late 1980s and early 1990s, reflecting a combination of improvements in early detection, through population screening and more efficient therapeutic interventions [4].

According to the American Cancer Society [5], INCA [10] and Stewart, Wild [4] multiple factors are involved in the etiology of breast cancer: age of first menstruation less than 12 years; menopause after 55 years; women who never got pregnant or never had children (nullity); first pregnancy after 30 years; use of some contraceptives and hormone replacement therapy (HRT) in menopause, especially for prolonged periods; exposure to ionizing radiation; consumption of alcoholic beverages; hypercaloric diets; sedentary lifestyle; and genetic predisposition (by mutations in certain genes transmitted in family genetic inheritance – mainly by two high-risk genes, BRCA1 and BRCA2). In low and middle income countries, breast cancer diagnosis occurs at more advanced stages of the disease. Morbidity increases when related to treatment, compromises quality of life and reduces patient survival [39].

Prostate cancer is a highly prevalent disease. It occupies the second position among malignant neoplasms that affect men, worldwide, behind lung cancer only [4]. In Brazil, it is the cancer with the highest incidence among men (except non-melanoma skin cancer) [40], [41], [42]. According to Ferlay et al [3], [12] the overall incidence rate can vary by more than 25 times. This can be attributed, according to [3], [12] in part, to screening strategies, carrying out a prostate specific antigen test (PSA) and subsequent biopsy, since it allows the identification of small tumors, latent or in early stages of growth.

In the study by Nakandi et al [43], higher mortality rates were observed in low-income countries when compared to high-income countries. And, according to Howlader et al [11], since it is a neoplasm with a good prognosis, the probability of five-year survival is over 80%, varying according to clinical, genetic, socioeconomic and environmental factors. Regarding the risk factors for prostate cancer, advanced age comprises a well-established risk factor, since incidence and mortality increase after 50 years of age. There are other important factors are attributed to prostate cancer. Chan, Stampfer, Giovannucci [44] and Sterwart, Wild [4] consider family history in the first degree (father, siblings or children) showing a positive association to increase the risk of developing this neoplasm. Howlader et al [11], Nakandi et al [43] consider that skin color / ethnicity is relevant in the etiology of this type of cancer.

Cervical cancer is one of the most common cancers in the female population and is caused by persistent infection with some types of human papillomavirus (HPV) virus [1]. Genital infection with this virus is very common and does not cause disease most of the time. However, in some cases, cellular

changes occur that can progress to cancer. These changes are easily discovered in the preventive exam (also known as a Pap smear) and are curable in almost all cases [1]. There are several factors involved in the etiology of cervical cancer, but persistent HPV infections are the main causes. Among its 13 oncogenic types, HPV16 and HPV18 are the most common related to the occurrence of diseases. The onset of sexual activity at an early age increases exposure to the risk of HPV infection, in addition to immunosuppression, multiparity (having many children), smoking and prolonged use of oral contraceptives (estrogen) are factors associated with cervical cancer [4].

The worldwide estimate indicates that cervical cancer was the fourth most common worldwide, with an estimated 3.2% of new cases of all cancers. According to Ferlay et al [3], globally, most cases (70%) occur in areas with lower levels of human development. Almost nine out of ten cervical cancer deaths occur in less developed regions, where the risk of dying from cervical cancer before age 75 is three times greater. Despite its epidemiological importance, cervical cancer has a high cure potential when diagnosed in the early stages [9].

Of all cancers that occur in the world, stomach cancer ranks fifth [3]. Differences between genders are observed, being twice as frequent in men than in women. Corresponds to 8.5% of the total cancer in men, using a position in the ranking of the most common tumors when compared to the female sex (4.8%) [4]. Geographically, it is more frequent in countries with low or medium HDI [12], [17].
In relation to mortality, for both sexes, it becomes the third cause worldwide, with 8.8% of the total deaths. In Brazil, in 2015 alone, there were 9,132 deaths from stomach cancer in men and 5.132 in women [45]. Helicobacter Pylori infection comprises a cause more strongly associated with the risk of developing stomach cancer [46], [47], [4].

Other environmental factors include nutritional habits, such as diets rich in smoked foods or preserved in salt, obesity, alcohol and tobacco consumption. On the other hand, an intake of fruits and vegetables, cereals and seafood has been reported as a protective factor [4], [48]. Hereditary factors contribute to a lesser extent to the burden of this type of cancer, such as previous family history, around 2%. Just as the incidence can be affected by the development of the Region, the level of education seems to be associated with the risk; therefore, more advanced levels of education can be a protective factor [49], [50].

According to INCA [1] the most common histological types for thyroid cancer are differentiated carcinomas. Among them are papillary, follicular and Hürthle cells. Bray et al [38], Ferlay et al [14] and INCA [2] add that there are still poorly differentiated and undifferentiated carcinomas. According to Bray and collaborators [38] and Ferlay and collaborators [14] in 2018, there were 567 million new cases of thyroid cancer, or the equivalent of 3% of all estimated cancers that occupy the ninth position in the world. For these authors, predominantly, the cases are female with 11.5 new cases per 100 thousand, in which the incidence is higher than male sex with 3.4 new cases per 100 thousand) and in countries with high HDI.

In Brazil, in 2017, there were 279 deaths from thyroid cancer in men, this value corresponds to the risk of 0.28 / 100 thousand. In women, 526 deaths occurred, with a risk of 0.51 / 100 thousand [39]. For the American Cancer Society [7], INCA [1], Stewart, Wild [4], history of irradiation in the neck, low-dose radiation therapy (mainly in childhood), family history of thyroid cancer and low iodine diet are the

main risk factors for the development of the disease. According to Thun et al [51] other risk factors for the development of diseases are: obesity, smoking, hormonal exposure and environmental pollution.

In the world, lung cancer is among the main incidences, occupying the first position among men and the third position among women. According to INCA [1], the estimated total of new cases for this disease, in 2018, worldwide, represented 1.37 million new cases in men and 725 thousand new cases in women, corresponding to an estimated risk of 35.5/100 thousand men and 19.2 / 100 thousand women. In Brazil, in 2017, there were 16,137 deaths from lung cancer in men and 11,792 deaths in women, values that represent an estimated risk of 15.98 / 100 thousand men and 11.39 / 100 thousand women [1], [2]. Smoking and passive tobacco exposure are the main risk factors for the development of lung cancer. Eighty-five percent of diagnosed cases are associated with tobacco use [1].

According to the INCA [1], the most recent world estimate indicates that, in men, 1 million new cases of colon and rectal cancer occurred. It is the third most incident tumor among all cancers, with an estimated risk of 26.6 / 100 thousand. In women, there were 800 thousand new cases, ranking as the second most frequent tumor with an incidence rate of 21.8 / 100 thousand. Also according to the INCA [39] in terms of mortality, in Brazil, in 2017, there were 9.207 deaths from cervical and rectal cancer (9.12 / 100 thousand) in men and 9.660 (9.33 / 100 thousand) in women.

According to the American Cancer Society [7] and INCA [1], the main factors related to the increased risk of developing cervical and rectal cancer are: age 50 years or older, obesity, physical inactivity, prolonged smoking, high consumption of red or processed meat, low calcium intake, excessive alcohol consumption and poor diet in fruits and fibers. There are factors of hereditary origin that increase the risk, including family history of colorectal cancer and / or adenomatous polyps, some genetic conditions such as familial adenomatous polyposis and hereditary colorectal cancer without polyposis, history of chronic inflammatory bowel disease (ulcerative colitis or Crohn's disease) and type 2 diabetes; and factors such as occupational exposure to ionizing radiation.

Leukemia is a disease that affects blood cells and the main factor is the number of diseased cells in the bone marrow that replace normal blood cells. Leukemia occurs most frequently in adults over 55, but it is also the most common cancer in children under 15 [1]. There are more than 12 types of leukemia, the main four being: acute myeloid leukemia (MLA), chronic myeloid leukemia (CML), acute lymphocytic leukemia (ALL) and chronic lymphocytic leukemia (LLC). For Bray et al [38] and Ferlay et al. [14] a worldwide estimate shows that there were 249.000 new cases of leukemia, the tenth most incident tumor among all cancers, with an estimated risk of 6.5 / 100.000 men. In women, 187 thousand new cases were estimated, with an incidence rate of 5.0 / 100 thousand, occupying the twelfth position. According to INCA [39] in relation to mortality, in 2017, 4.795 deaths from leukemia occurred in Brazil with a mortality rate of 4.75 / 100 thousand men and 4.401 deaths with a crude rate of 4.25 / 100 thousand in women. According to INCA [1] the risk factors for leukemia are not yet well defined, but there is a suspicion of an association between risk factors with a greater chance of developing some types of disease, among them: smoking (AML); ionizing radiation (X-rays and gamma); chemotherapy – some classes of drugs used to treat cancer and autoimmune diseases (AML and ALL); occupational exposure to formaldehyde in industries (chemical, textile, among others); rubber production (leukemias); Down syndrome and other inherited diseases (AML);

myelodysplastic syndrome and other blood disorders (AML); family history; and, finally, exposure to pesticides, solvents and infection by hepatitis B and C viruses (leukemias) [1].

Non-Hodgkin's lymphoma is a type of cancer that originates in the lymphatic system. There are more than 20 different types of this cancer. Overall, the risk of illness increases as you get older [1]. Worldwide estimates show that approximately 510.000 new cases of non-Hodgkin's lymphoma have occurred, or the equivalent of 3% of the estimated total new cases. Of these, 285 thousand new cases occurred in men with an estimated risk of 7.4 per 100 thousand and, in women, there were 225 thousand new cases with an estimated risk of 5.9 per 100 thousand. In men, it ranks eighth among all estimated cancers and, in women, it ranks tenth. In terms of mortality, in Brazil, in 2017, there were 2,498 deaths from non-Hodgkin's lymphoma in men, with a risk of 2.47 / 100 thousand and, in women, 2.016 deaths, with a risk of 1.95 / 100 thousand [1]. For the American Cancer Society [7], among the main risk factors are people with an immunocompromised system, as a result of inherited genetic diseases or carriers of the human immunodeficiency virus infection (from english, human immunodeficiency vírus - HIV); patients using immunosuppressive drugs, with Epstein-Barr virus and Human T-Cell Lymphotropic Virus Type 1 (HTLV1), people with Helicobacter pylori bacteria, as well as some chemical substances (pesticides, ionizing and ultraviolet pollution).

In the present study, 99.5% of the patients admitted to the Hospital de Base Dr. Ary Pinheiro and / or Barretos / RO were notified by the Unified Health System - SUS. The National Cancer Prevention and Control Policy guarantees comprehensive care to any cancer patient, through the High Complexity Assistance Units in Oncology (UNACON) and the High Complexity Assistance Centers in Oncology (CACON) based on laws and specific Ordinance. In the State of Rondônia, the notifications made by RHC / NHE / HB at the Dr. Ary Pinheiro and Barretos Rondônia Base Hospitals cover almost 100% of the Unified Health System Program. 98.5% of cancer patients in Rondônia were diagnosed and admitted by the Unified Health System - SUS [25].

Clinical oncology represents 81.8% of all cancer patient entries and was responsible for 28% for the first visit and 67.2% of patients were diagnosed and received no treatments. Among the first procedures received by patients, “Other isolated therapeutic procedures” stands out, with a frequency of 44.4%. A negative highlight is that 27% of patients who did not receive any therapeutic treatment procedure. In the research by Paraguassu-Chaves et al [25], the oncology clinic recorded a higher relative value of patient entry with 89.5% of the sample universe and 52.2% of patients were diagnosed and did not receive treatment. Unlike the results of current research, Paraguassu-Chaves et al. [25] identified a gastroenterology clinic (22.5%), urology (17.5%), mastology (15.6%), dermatology (13.9%) and gynecology (13.8%) as responsible clinics By the entry of cancer patients.

We found in Rondônia 55.8% of patients diagnosed with the disease and without treatment in stages I, stage II, stage III and stage IV. Undiagnosed and untreated patients represent 13% of all patients in the four stages of the disease. Ninety-two percent of the patients had their diagnosis confirmed by histological examination of the primary tumor and in 99.96% a single primary tumor was found. From the topographies of occurrence of the 1st metastasis, there was a predominance of liver cancer and intrahepatic biliary tract with (25%, bronchi and lungs with (23.1%) and bones, joints and articular cartilages with members of 23.1% of the cases. Paraguassu-Chaves et al [25], [26] corroborate these results. Of the patients

who stopped treating the disease, 83.1% used some kind of excuse for not treating it. And those under treatment, the state of the disease at the end of the 1st treatment represents 73.7% of the disease in progress. Paraguassu-Chaves et al. [25], [26] em pesquisas no mesmo local e com pacientes com câncer em Rondônia, encontraram resultados muito próximos desses. In the same way that they confirm the findings related to the median between the 1st consultation and the 1st diagnosis; the 1st diagnosis and the start of treatment; the 1st consultation and start of treatment, according to the clinic responsible for the patient's first care.

V. CONCLUSIONS

In 2 (two) years, 3.333 new cases of cancer were diagnosed in Rondônia. Of these, 1.781 (53.4%) were female and 1.552 (46.5%) were male.

The age group with the highest incidence of women and men occurs between 50 and 69 years (46.5%). The level of education predominated at the incomplete and complete elementary level and illiterate with 71.3%. Higher frequency of married patients 54.1%, predominance of brown skin, born in the state of Rondônia (22.6%) and predominance of workers in agricultural activities.

The most common types of cancer in men and women were non-melanoma skin cancer (C44), breast (C50), prostate (C61), cervix (C53), stomach (C16), thyroid gland (C73), bronchi and lungs (C33-C34), reticuloendothelial hematopoietic system (C18), colon (C42) and cancer of the rectum (C20).

In women, breast cancer (32.2%), cervix (21.5%) and non-melanoma skin (17.3%) stand out as the highest incidences. In men, prostate cancer (30.9%), non-melanoma skin cancer (22.9%) and stomach (11.7%) are the most prevalent. These results follow relatively the cancer estimates in Brazil.

Through the Unified Health System - SUS, 99.5% of patients were admitted, showing the importance of the public health system for cancer treatment in Rondônia. The oncology clinic also stands out, as it is responsible for 81.8% of all entries for cancer patients and also responsible for 28% of the first patient care.

67.3% of patients were diagnosed and failed to undergo treatment. Of the patients undergoing treatment, 44.4% received other isolated therapeutic procedures, 27% did not receive any therapeutic procedure, 15.2% underwent surgery and 6% underwent chemotherapy. A similar situation was found by Paraguassu-Chaves et al [25], [26].

In the three diagnostic categories, there was a predominance in stages III and IV of the disease. The absolute majority of patients (92%) had their diagnosis confirmed by histological examination of the primary tumor. The single primary tumor was found in 99.9% of the patients, and from the topographies of occurrence of the 1st metastasis, there was a predominance in liver cancer and intrahepatic biliary tract (25%), bronchi and lungs (23.1%), bones, joints and joint cartilage of the limbs (23.1%) and meninges (11.5%). One hundred and one patients did not treat the disease for any reason. After the first treatment, 73.7% of patients had the disease in progress, with 6.7% of deaths. These results are similar to those found in previous research in Rondônia. The time interval (in days) elapsed, between the 1st consultation and the 1st diagnosis; the 1st diagnosis and the start of treatment; the 1st consultation and start of treatment, according to the clinic responsible for the first service, varies according to the medical clinic and depends

on the type of cancer. In general, the median time between the beginning and the end of the first consultation process and the start of treatment is in line with those found previously.

Estimates of cancer in Rondônia follow an increasing trend. The scenarios constructed from the variables of the sociodemographic and epidemiological indicators of the research demand from the public health authorities of Rondônia, an urgent redirection of the actions and strategies of prevention, control, assistance and treatment of cancer.

We believe that the systematization of these data is essential for the planning, execution and actions of promotion, prevention, control and treatment of cancer in Rondônia, as well as for the establishment of public health policies, in particular, cancer as a public health problem in Rondônia State.

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Advances in HealthCare teaching: a patent mapping about the models simulators or not used

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Abstract

The objective in this article, the realization of a patent mapping on medical education, especially using simulators, since we know that in the teaching of medicine, the development of technical and motor skills in practice is essential, and historically, this training happens with the use of corpses, small animals and later monitoring procedures. With all the advent of technological innovation, financial, cultural and social changes demanded the emergence of new teaching technologies, and through this study, one of the utilities of the technological mapping of the activity can be confirmed through patent documents, which is to obtain the technological evolution of a given subject, in this case: use of models, including simulators in medical education. The temporal evolution of patent documents referring to medical education peaked from 2009 to 2018, and above all, it can be concluded that the latest technologies are models of simulators and there are indications from the United States in exporting this technology to Brazil. recent. From this mapping, it is possible to subsidize technological innovation strategies and assist in the promotion of policies and legislation aimed at stimulating national entrepreneurship and the generation of business opportunities.

Keywords: patent documents; patent mapping; health education; anatomy education; educational simulators; medical education;

1. Introduction

In the teaching of medicine it is essential to develop technical and motor skills in practice. Traditionally, this training took place with the use of corpses, small animals and later in the monitoring of procedures. Currently, financial, cultural and social changes have demanded the emergence of new teaching technologies [1].

In addition, In health care education, especially in medical education, a series of innovations and trends in relation to teaching-learning practices point to the use and adoption of innovative methods, thus requiring institutions and teachers to seek new strategies capable of improving the final result of the learning process and offer to the student, necessary subsidies for their training with autonomy [2].

One of the methods that have been used to improve the learning process is the use of simulators, an effective and innovative method that expands the relationship between the theory and practice of the student body in a safe environment, offering better learning and training opportunities, contributing to professional training [3].

With this growing amount of information, effective teaching methodologies need to be developed and used to filter relevant information, facilitating constant professional updating. This is of paramount importance, as it brings benefits to society by reducing the mortality rate in more complex medical procedures. Furthermore, it can decrease operational errors even in simpler procedures [4, 5, 6].

One of the methods that have been used to improve the learning process is the use of simulators, an effective and innovative method that expands the relationship between the theory and practice of the student body in a safe environment, offering better learning and training opportunities, contributing to professional training [3].

In this way, every time that training is obtained, repetitively, the student to evolve it reaching an automatic or associative phase. It now shows a significant improvement in performance and a reduction in attention levels. At this stage he is already able to identify some technical errors. The use of simulators promotes a complement to the cognitive phase, allowing the user to reach more advanced levels of mastery of techniques before using them in real situations [7].

The use of automated pedagogical methodologies with also automatic responses in order to improve self-learning is not a recent concept. It did not start to be used after the development of computerized virtual reality simulators from the 1980s. This concept dates back to 1866 when Pressey made the first patent registration in the United States Patent Office for a Teaching Machine. This equipment was intended to teach speech through a self-learning method. In order to be considered a Teaching Machine, the equipment should have three requirements: present an informative content, provide some way for the user to answer the questions of the machine and that the device could provide a correct or wrong answer to the user [8].

With the use of simulators in educational routines, we noticed that in the last few decades, simulation models have progressed to more interactive platforms. With the emergence of Information and Comunication Technologies (ICTs), changes and progress in traditional teaching methods have been seen.

The use of technologies has enabled more meaningful learning, changing the way knowledge is shared between teachers and students in the classroom. These are very different from those students for whom the predominant school model was created. Thus, the use of new ICTs can be an important ally to motivate students in educational processes, such as the construction of learning [9].

Notably, with the use of ICTs and its improvement in computer graphics techniques, augmented reality and virtual reality, it has made the market for simulated environments and simulators of great prominence in several industries, mainly in health and health education. In this way, we aim to observe the behavior of market players regarding their innovation and protection through patent documents [10].

The use of simulators and model training focuses on the technical skill that can be acquired through repetitions of the practice, however it can be lost if the repetitions cease. But these do not replace real situations, but rather allow learning to take place in situations of controlled risk. However, they do not simulate the natural pressures of the medical environment, for example, operating rooms [1].

It was not found any patent mapping article about education in medicine, especially, procedure simulator model, diagnostic simulator model, and, other non-simulator models.

The purpose of this article is to carry out a patent mapping article about education in medicine, especially, procedure simulator model, diagnostic simulator model, and, other non-simulator models.

The focus of this patent mapping on medical education, especially the procedure simulator model, diagnostic simulator model and other non-simulator models, is to perform a patent mapping by activity, as defined by Porter [11], to study how technologies within medical education are changing.

This article is divided into five parts. Next, the concept of patent and the importance of patent documents will be presented. Soon after, the methodology developed to carry out this patent mapping will be presented. Later, the results and speeches will be presented. Finally, the conclusions will be presented.

2. Theoretical Foundation - Patent Documents

According to the INPI [12] patent documents are one of the most complete sources for research, in addition, it is estimated that approximately 70% available as patent documents will not be made available as another source of information.

Regarding their legal nature, patent documents can be divided into: (a) patent application documents (patent document filed with any patent office); and (b) patent (title granted by the State to the holders of the right of the invention during the term of the patent). In addition to the detailed description of the invention, it is necessary to meet the three requirements of patentability: novelty, inventive step and industrial application to obtain a patent [13].

Regarding the deposit, the patent documents can be: (a) priority document - first deposit of the document, normally made in the country of origin of the invention, however it can be done in another country due to the attractiveness of that country's patent process; (b) “same family” documents - deposits made after priority extend protection to other countries in accordance with the Paris Convention [14], this deposit must be made within 12 months of the deposit date. priority document [15].

In order to facilitate access to information (technical and legal) contained in patent documents presented in several languages and without using keywords with uniformity, the international patent classification (IPC)

was created, a hierarchical system of letters and numbers that groups the patent documents by technology [16].

3. Methodology

For this article it was used as methodology the Porter's [11] patent mapping for activity with the folling steps: definition of search criteria, search, summary analysis and data processing.

The search criteria were defined as: (a) territorial limitation = Brazil (BR); (b) database = INPI (free database of coverage only in Brazil); (c) subject limitation = International Patent Classification (IPC) related to the theme - Education in Medicine (IPC = G09B 23/28, G09B 23/30, G09B 23/32 and G09B 23/34 – show on Table 1); (d) time limitation = no time limitation.

Table 1. Description of the classifications (IPC´s) G09B 23/28, G09B 23/30, G09B 23/32, G09B 23/34, belonging to class G09B23

IPC	Descrição
G09B23	Models for scientific, medical, or mathematical purposes, e.g. full-sized device for demonstration purposes
G09B23/28	* for medicine
G09B23/30	** Anatomical models
G09B23/32	*** with moving parts
G09B23/34	*** with removable parts

With the criteria defined above the search was carried out on April 14, 2020. After the search, all documents found had their summary read and were classified into: (a) procedure simulator model, (b) diagnostic simulator model, (c) other non-simulator models, (d) not relevant to the topic.

The documents relevant to the topic (procedure simulator, diagnostic simulator and other non-simulator models) were treated in order to obtain: (i) number of documents deposited per year, (ii) main classifications, (iii) main priority countries, and (iv) main applicants.

4. Results and Discussion

There were recovery 162 patent documents using the methodology above, after reading the summary the classified documents are showed on Table 2. The result of 35% not relevant to the topic was not a surprise because the class G09B23, as shown on Table 1, involves other areas such as, dentistry and veterinary; these documents were discarded.

Table 2. Classifications of the recovery patent documents

	Number of patent documents	%
Procedure Simulator Model	39	24%
Diagnostic Simulator Model	26	16%
Other Non-Simulator Models	40	25%
Not Relevant to the Topic	57	35%

The temporal evolution of patent documents on medical education (Figure 1) shows how the tegnologies (procedure simulator model, diagnostic simulator model and other non-simulator models) evolve over time. The non other non-simulator models tecnology (with 40 patent documents) evolutes form 1980 to 2018, with a peak between 2009 and 2011. The procedure simulator model tecnology (with 39 patent documents) evolutes from 1986 to 2018, with a peak between 2012 and 2017. And, the diagnostic simulator model tecnology (with 26 patent documents) evolutes from 1996 to 2018, with a peak between 2012 and 2018. The three technologies have their greatest development at the peak (2009-2018) and those that are at the peak of their development are the technologies of simulation models (procedure and diagnostic). Indicating the current interest in the development of products or processes in the area of education in medicine involving the technologies of simulation models of process and diagnosis, corroborating with that presented by Motta and Baracat, Figueiredo and Oliveira, and Sousa *et al*. [1, 5, 7]. The absence of documents in the years 2019 and 2020 is due to the period of confidentiality that the patent document has between its deposit and its publication (the request is only available for consultation after its publication).

The peak between 2009 and 2018, was show in detail on Figure 2, has 77 patent documents with represents 77% of the patent documents on education in medicine. At the peak there is emphasis on the procedure simulator model with 35 patent documents (90% of the procedure simulator model patent documents), indicating that this is a recent tecnology corroborating with that presented by Motta and Baracat, Figueiredo and Oliveira, and Sousa *et al*. [1, 5, 7]. The dignostic simulator model has 20 patent documents (78% of the procedure simulator model patent documents), indicating that this is also a recent tecnology corroborating with that presented by Motta and Baracat, Figueiredo and Oliveira, and Sousa *et al*. [1, 5, 7]. The other non-simulator model has 22 patent documents (55% of the procedure simulator model patent documents), indicating that it is a technology that has been developing since 1980 and is still present today. Looking at figures 1 and 2, the behavior of each studied technology is verified and from this behavior, new inventions can be expected in all these technologies (procedure simulator model, diagnostic simulator model, and, other non-simulator models).

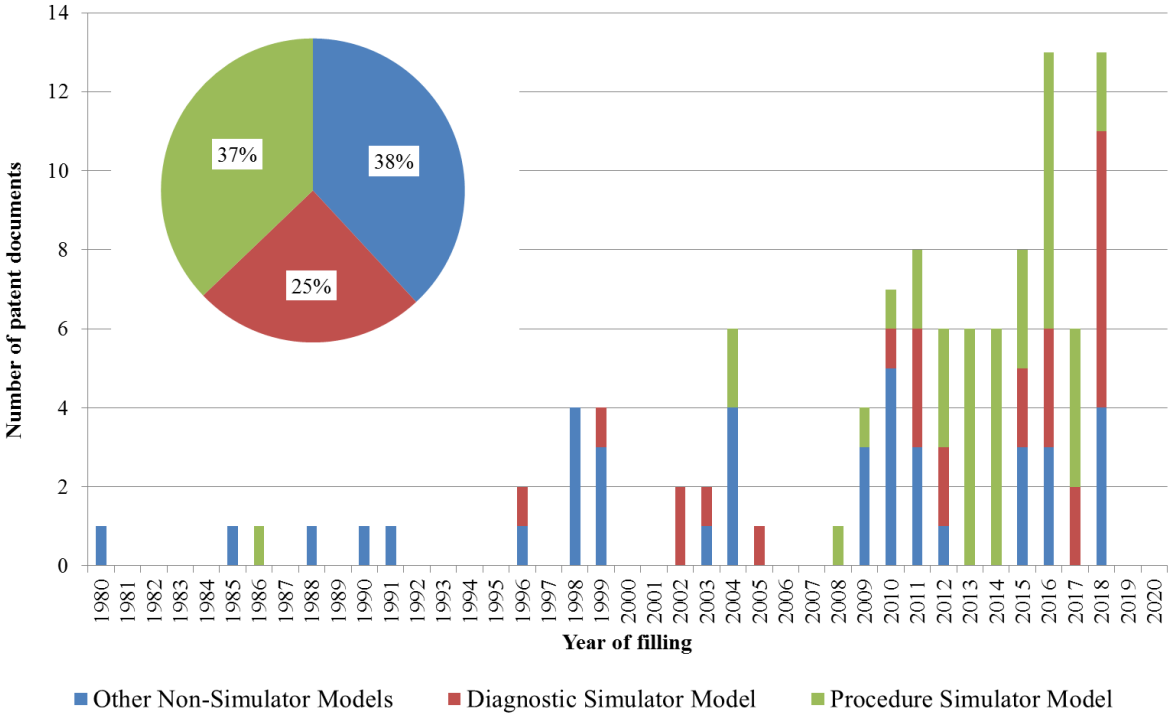

Figure 1. Temporal evolution of patent documents on education in medicine.

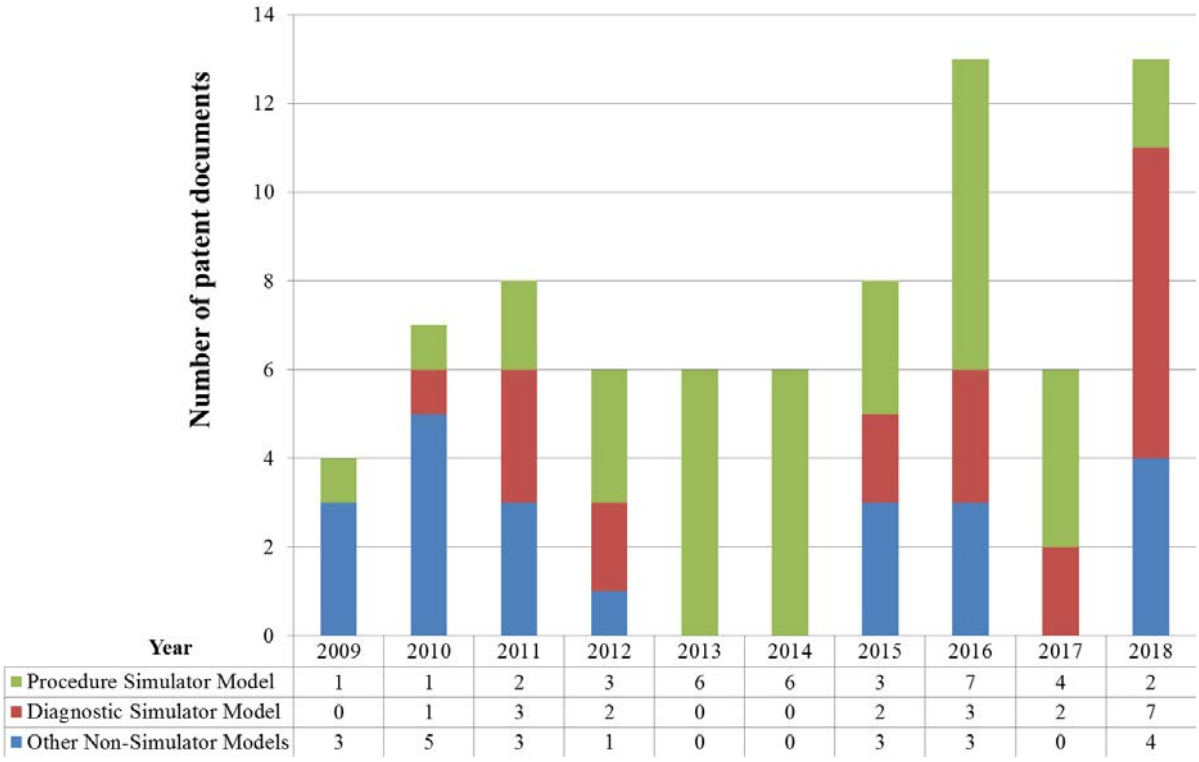

Figure 2. Peak of the temporal evolution of patent documents on education in medicine.

Figure 3 shows the priority countries, where the technology was first deposited, usually reflects where the technology was developed. Most documents were deposited directly in Brazil - 67 documents (54%) followed by the United States - 35 documents (28%), with a highly concentrated behavior (86% in the first

two countries). As the focus of the work are teaching tools in medicine that use technologies and innovation through patent documents deposited in Brazil, it was expected that the largest number of documents would have Brazilian priority, the focus of the work, since education as patent documents are regional, however the second place being the United States shows the United States' interest in the Brazilian market, that is, exporting its inventions to Brazil for use in our education and training system.

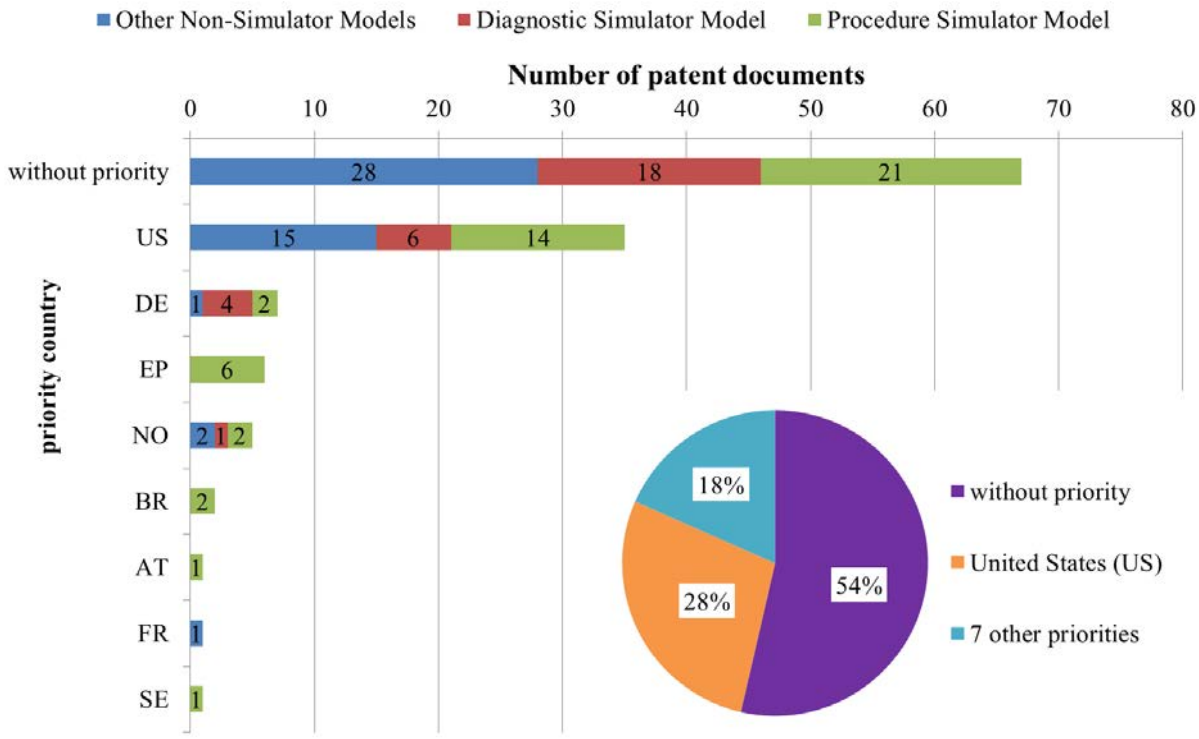

Figure 3. Priority countries evolution of patent documents on education in medicine.

Regarding the applicants, the following analyzes were made: main applicants (Figure 4), distribution of applicants by number of patent documents (Figure 5) and type of applicant (Figure 5). Figure 4 shows the main applicants, those who deposited 3 or more patent documents each, with emphasis on the University of São Paulo - USP with 5 patent documents deposited (3 on process simulator model and 2 on other non-simulator models); followed by companies: Janssen Pharmaceutica with 4 patent documents (all on other non-simulator models); Koninklijke Philips with 4 patent documents (2 on process simulator model, 1 on diagnostic simulator model and 1 on other non-simulator models); and, Laerdal Medical with 4 patent documents (2 on process simulator model, 1 on diagnostic simulator model and 1 on other non-simulator models). Figure 5 shows that the behavior towards the applicant is distributed since the majority of applicants (69 applicants) filed only one patent document, which represents 52% of the total patent documents. Figure 5 also shows that most patent documents deposited in Brazil regarding education in medicine are carried out by individual inventors (physical person with 55%), then there is a balance between companies (legal person with 23%) and universities (22%). Most patent documents are from separate inventors (legal person) is related to the fact that most depositors have only one patent document. The fact that 3 of the 5 main depositors are companies (legal entities) indicates interest by companies to

develop and commercialize these models, including simulators; considering the total number of patent documents, companies (legal person) represent 23% of the documents.

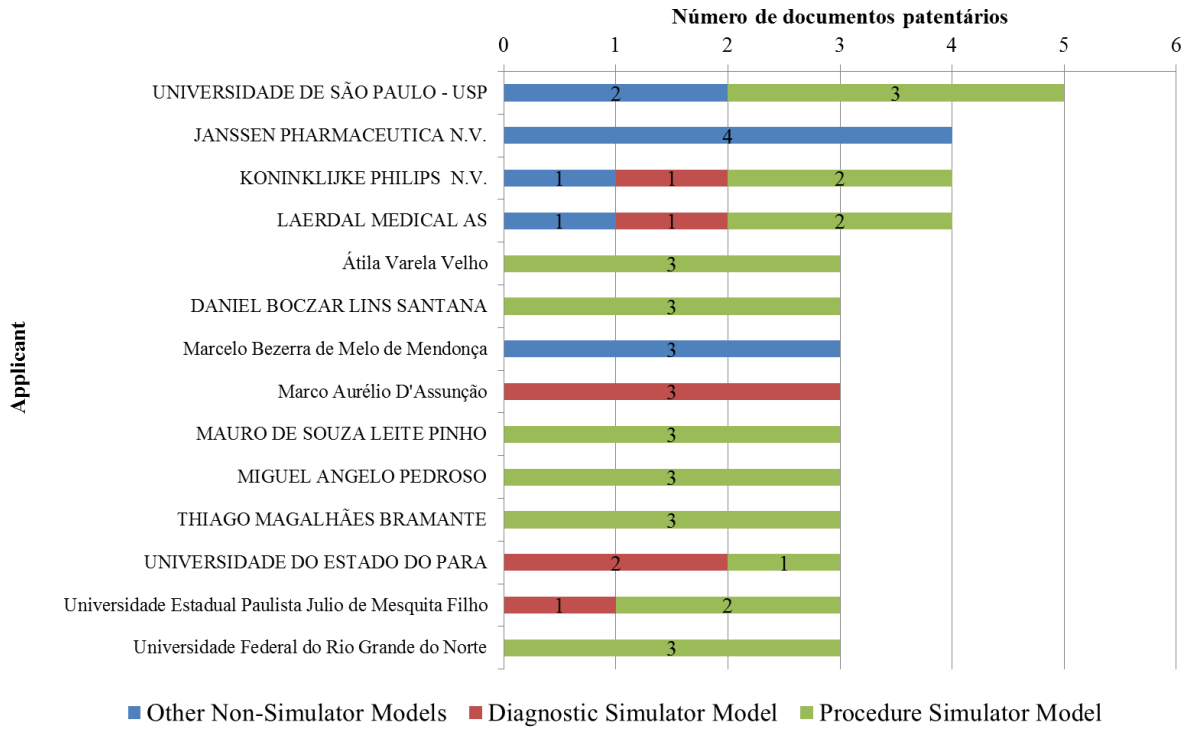

Figure 4. Main applicants of patent documents on education in medicine.

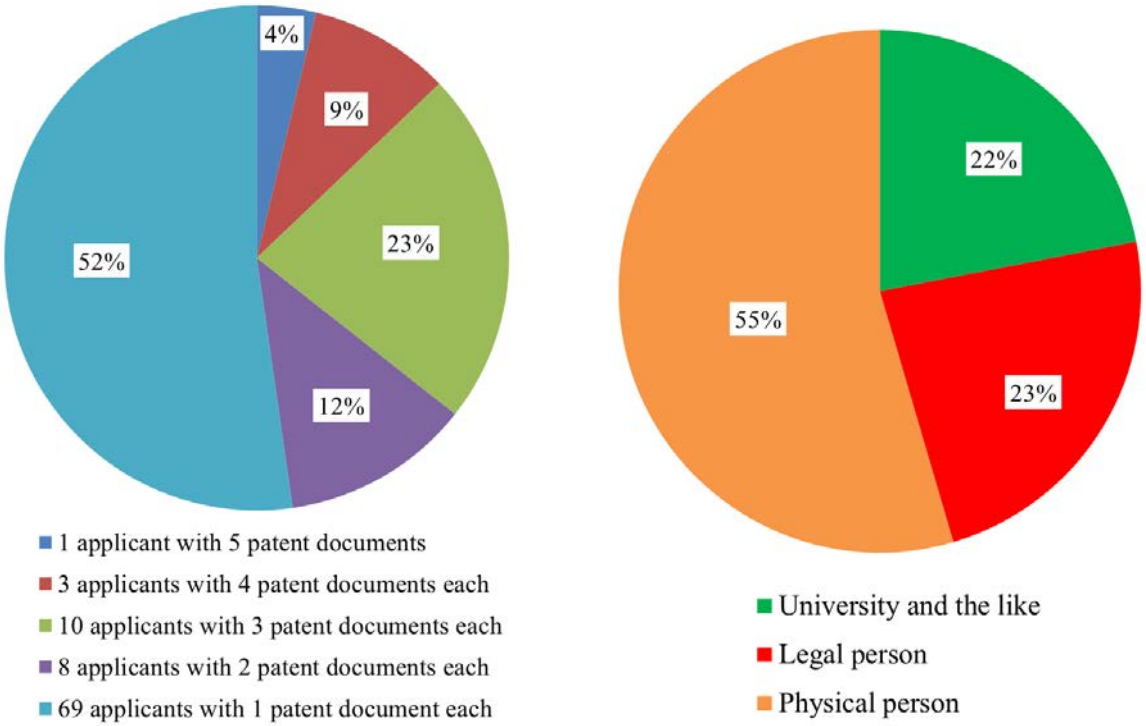

Figure 5. Other information of applicants of patent documents on education in medicine.

5. Conclusion

This article proposes to carry out patent mapping to study how technologies, especially: procedure simulator model, diagnostic simulator model and other non-simulator models, used in medical education are changing.

Through this article, one of the utilities of technological mapping for activity can be confirmed by means of patent documents, which is to obtain the technological evolution of a given subject, in this case: use of models, including simulators in the teaching of medicine. The temporal evolution of patent documents referring to medical education peaked from 2009 to 2018; with respect to technologies: the other non-simulator models are being replaced at the peak by the simulator models (of procedure and diagnosis).

In this work it was possible to detect several models, including simulators, used in the area of medical education; highlighting the procedure simulator model with 39 patent documents, representing 37% of the relevant documents, of these 35 documents are at the peak between 2009 and 2018.

It can be concluded that the latest technologies are simulator models (of procedure and diagnosis), and, and that the other non-simulator models technology continues to develop today. It can also be concluded that the majority of patent documents referring to medical education were first deposited in Brazil and secondly in the United States, indicating that this technology is, for the most part, being developed in Brazil or in the United States; indicating the United States' interest in exporting this technology to Brazil. It was also concluded that most patent documents are made by independent inventors (individuals), who generally deposit a single document; which indicates that it was probably done by a teacher and / or student in order to be used locally. However, the presence of the majority of companies among the first 5 depositors indicates interest on the part of the companies to develop and commercialize these models (including simulators); considering the total number of patent documents, companies (legal person) represent 23% of the documents.

This patent mapping is interesting for those who want to know the state of the art, the history of technologies: procedure simulator model, diagnostic simulator model and other non-simulator models, including the most recent technologies. From this mapping, it is possible to subsidize technological innovation strategies and assist in the promotion of policies and legislation aimed at stimulating national entrepreneurship and the generation of business opportunities.

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