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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-11 of IJIER*** which is scheduled to be published on **1st November 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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Smart Drugs: A Review

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Abstracts

Smart drugs can change the way our mind functions. Smart drugs are also known as nootropics, which literally means the ability to bend or shape our mind. Smart drugs are classified into two main categories. They are classified based on their pharmacological action and their availability. The stimulant category of drugs is highly used and misused. There has been a rampant increase in the sale of smart drugs, which could be attributed to the rise in competition all over the world. Two major criteria for selecting a good drug are its mechanism of action and bioavailability. Owing to the short-term benefits of smart drugs, many countries have openly accepted this concept. There is still no concrete scientific evidence backing the safety and efficacy of these drugs. Some believe that this is just a fad that will soon pass, while others believe that this is something that will revolutionize our future.

Key Words: Smart drugs, Nootropics, Cognitive enhancers, Stimulants, Uses and Side effects.

What are Smart Drugs?

"Smart drugs" are a group of compounds that can promote brain performance. They have got a lot of attention due to our stressful lifestyle, and these drugs help to boost our memory, focus, creativity, intelligence, and motivation. The origin of the word comes from the Greek language meaning “to bend or shape the mind”.[1]

These chemicals have many mechanisms of action. Some of these mechanisms include improving blood flow, stimulating neurogenesis, and improving cell membrane fluidity. These actions create positive changes in the body, which help the body to function at 100% efficiency irrespective of the current state of the body.[2]

The examples of smart drugs are Caffeine (mostly used), L-theanine, Creatine, *Bacopa monnieri*, *Panax ginseng*, Nicotine, and Modafinil (most popular).[1]

What are Nootropics?

Nootropics are non-prescription compounds and include a variety of substances, such as vitamins, herbs, which could improve cognitive ability and support peak performance.[2]

Difference between nootropics and smart drugs

Nootropics and smart drugs function in a very different manner. Nootropics facilitate the long-term strengthening of various brain regions by improving blood flow and oxygenation. Nootropics are

considered as super supplements. Nootropics are compounds that do not offer any side effects; the same is not true for smart drugs.[3]The examples of nootropics are Lions' Mane and Huperzine-A.[3]

Classification of Smart Drugs

Smart drugs can be classified in the following two ways:

1. Based on their availability
2. Based on their pharmacological action

1. Based on their availability

A. Prescription smart drugs: These drugs are psychostimulants that can be purchased only on a prescription. These drugs are used for patients with attention-deficit hyperactivity disorder (ADHD) and narcolepsy. In today's world, a lot of individuals used them as a way to enhance their ability to work and their attention span. The examples include Modafinil and Adderall.[4]

B. Over-the-counter smart drugs: These drugs can be purchased from ordinary retail stores. These drugs do not need a prescription or licensing as such. The examples include Caffeine and L-theanine.[4]

2. Based on their pharmacological action

On the basis of the pharmacological activity, smart drugs are divided into four groups, namely stimulants, racetams, cholinergic, and dopaminergic.[4]

A. Stimulants

These drugs are the most abused category of drugs. Their basic function is to make us feel more awake, alert, and focused, hence providing a boost of energy. These drugs have side effects that cannot be avoided, and hence, this category has built a bad name for them. On the other hand, some drugs are very useful and can be used to treat brain-related impairments. The examples are Modafinil and Adrafinil.[4]

B. Racetams

These drugs have a lot of evidence for their productivity. They function by fastening the chemical exchange between the brain cells. This process has a direct impact on our mental clarity and learning ability. These drugs are prescription drugs, for example, Piracetam.[4]

C. Cholinergics

These drugs affect the chemical acetylcholine, which in turn affects the peripheral nervous system. These drugs have a direct impact on our memory, mood, and attention span. Cholinergics are used with the racetam class of drugs, as the racetam class of drugs decreases our cholinergic levels also decrease. An example is Choline.[4]

D. Dopaminergics

These smart drugs are directly responsible for the release of the neurotransmitter dopamine. Dopamine makes us aware of our good feelings, and thus, gives us positive feedback. Moreover, our attention levels and alertness are improved by dopamine. The examples are Yohimbe and L-Deprenyl.[4]

Need for Smart Drugs

The immense pressure in jobs and the competitive environment in schools as well as colleges created the need for smart drugs. Students and professionals take these drugs because it seems as if it will provide them with an extra edge, and thus, help them with combating the pressure. Shockingly, the use of these drugs is accepted, and some students believe that these drugs increase memory and intelligence. Such claims have attracted a lot of students to try out and use these drugs. Most of them don't adhere to it, but there are some for whom it becomes a part of their lifestyle.[5]

These drugs have gained a lot of interest in professionals and tech startups. These individuals have claimed that these drugs increase their attention span and their ability to focus on the task at hand.

There is a set of professionals who are inclined to take these smart drugs. People who are at the higher managing post are likely to take these drugs more often. They take these drugs because their brain has to be active constantly. Their emotions cannot be driving their decision. These drugs help them in all their functions.[5]

These pills also help people make their decision faster than normal people. This is why it is an essential drug for military men, pilots, and astronauts.[5] The drugs are also used by people who stay up all night for their professions, for example, surgeons, nurses, and DJs. A high level of concentration, stamina, attention, and energy is needed to accomplish such jobs. This is something provided by these smart drugs.[5]

People working as accountants, programmers, and PC analysts need to be accurate in every aspect of their job.[5] This implies that they need to have the substantial mental capacity to be correct the entire time. Along with the mental capacity, they also require high concentration and the ability to hold one thought for long periods. These are the exact effects smart drugs provide; hence, its need has risen.[5]

Smart Drugs Used on Daily Basis

Smart Drugs	Uses	Side Effects
Modafinil (Provigil) This drug possesses similar stimulating effects like cocaine albeit with less dependence. It is sold under the schedule IV category. It is mostly considered as non-addictive; however, reports of dependence and withdrawal have been noted. [6, 7]	This drug is medicinally used to treat narcolepsy and sleep disorders.[6] It also is used by many people to stay awake and improve focus and productivity.	The most common side effects are headache, nausea, nervousness, anxiety, insomnia, diarrhea, indigestion, back pain.

Adderall It is a prescription medication that contains two drugs, namely amphetamine and dextroamphetamine.[8] It is available in two forms—the oral tablet form and the extended-release oral capsule form. [10]	This drug is used to treat ADHD and narcolepsy. It can increase the ability of an individual to pay attention and stay focused on an activity. The drug also has the ability to control behavior problems.[12]	This drug has a fair share of side effects, which include stomach ache, dry mouth, weight loss, and a decrease in libido.[9-11]
Ritalin: It has the ability to cause hyperactivity, and quick impulses are sent to the brain. Its generic name is methylphenidate, and it goes by the brand name Methylin.[13]	Ritalin is used to treat patients with ADHD and narcolepsy.[14]It can increase attention span and decrease restlessness in children and adults.[15]	Ritalin has two kinds of side effects[13, 14] More common side effects: Ones that do not need medical attention include headache, stomach pain, Less common side effects: Ones that need immediate medical attention include chest pain
Caffeine It is the most common stimulant used around the world.[6] It was accidentally discovered by an Ethiopian shepherd. More than 85% of the world's population consumes this product.	Caffeine is used for treating migraine when taken with aspirin. It is used to treat breathing problems in premature infants. Also, it is used to enhance mental alertness and reduce weight. It has also been proven to be useful in asthma.	Excess caffeine could lead to anxiety, irregular heart conditions, and weak bones (Caffeine can flush out calcium from the body through the urine).[16]

Different dosage forms of caffeine

One of the most popular dosage forms of caffeine is bulletproof coffee. It is a high-calorie coffee that can replace our breakfast. It is rich in healthy saturated fats. Bulletproof coffee is known to impact metabolism, decrease weight, stabilize gut health, improve mood, and increase strength[17, 18].

Another form of intake of caffeine is caffeine tablets, which contain natural caffeine or artificial caffeine. It is known to provide a quick energy boost, reduce constipation, sharpen focus, and improve memory[19].

L-theanine It is an amino acid, which is found in tea leaves and mushrooms.[20] It is a source of umami, which has been known to stimulate metabolism, boost the sensation of fullness, and lengthen the time before another meal.[21]	L-theanine reduces anxiety and stress without any sedative effect. It reduces heart rate and blood pressure. It helps in improving mental performance and also helps people fall asleep quickly. [20] It has applications in cancer.	It has side effects, namely nausea, upset stomach, and irritability. Additionally, it can lead to low blood pressure in cases having a history.
Ginkgo Biloba It is one of the top-selling herbal drugs. It is obtained from dried green leaves. It is available in capsule and tablet forms.[22] **Rhodiola** It is native to the arctic region of Europe, Asia, and Alaska. The root is used as a medicine. It is called an adaptogen, as it adapts and resists stress.[6]	An extract of Ginkgo Biloba known as EGb 761 is used for Alzheimer's dementia. It increases blood circulation, and hence, enhances memory. It also has uses in glaucoma.[22] It is used to treat anxiety, anger, and confusion. Also, it is used to treat conditions, like irregular heartbeat and diabetes.[23]	It may cause side effects, such as nausea, diarrhea, stomach ache, restlessness, and vomiting.[22] The drug stimulates the immune system and worsens conditions, like multiple sclerosis and rheumatoid arthritis, and lowers blood pressure.[23]

Omega-3 fatty acids Omega-3-fatty acids are found in fatty acids and fish oil supplements. They are polyunsaturated fats that enhance cognition.	Omega-3-fatty acids reduce the risk of heart disease and promote healthy skin. They are used to lower the levels of blood fats and raise the levels of good cholesterol. They are efficient in treating rheumatoid arthritis.[24, 25]	Side effects include back pain, dry mouth, altered sense of taste.
Creatine It is found predominantly in muscle cells and helps the muscles produce energy while heavy lifting. Muscles store 95% of creatine as phosphocreatine, while the brain and the kidneys store 5%.[26]	Its use leads to improved strength, power, and short-term muscle growth as well as long-term muscle growth. It can effectively treat conditions, namely epilepsy, Parkinson's disease, and Huntington's disease. Additionally, it also improves cell signaling and cell hydration.[26]	Side effects of creatine include muscle cramping, stomach pain [26].
Memantine It has several additional uses such as to improve memory and awareness. It also can enhance the ability to perform daily actions.	This drug is used in the treatment of moderate-to-severe Alzheimer's disease. It can also be used in cases of hepatic impairment.[27]	This drug has a lot of side effects, which include hypersensitivity, shortness of breath, hallucination, dizziness, irregular heartbeats, and tingling of hand.[27]

Mechanism of Action and Pharmacokinetics

Smart Drugs	Mechanism of Action	Pharmacokinetics

Modafinil	The drug binds to the dopamine reuptake pump.  Thus, the reuptake of dopamine is inhibited, and an increase is noted in extracellular dopamine.  The drug also causes indirect inhibition	The drug has rapid absorption and attains peak plasma in 2–4 hours.[29]It is well distributed in the body tissue. Its volume of distribution is larger than the volume of total body water.[29] The liver is the major pathway of elimination by which 90% of the drug is eliminated.[29]
Adderall	The drug promotes the release of dopamine and norepinephrine from the storage sites in the presynaptic neurons.  More dopamine and norepinephrine cause more stimulation. This leads to an increase in attention span, motivation, and memory.	The drug gets absorbed in the gut as it is a weak base. After 1–3 hours of oral administration and 15 minutes of injection, peak response for the same takes place. It shows bioavailability of over 75%. It is mainly excreted through the urine (90% in 3 days). The clearance rate is 0.7 L.h/kg.[30]
Ritalin	The drug modulates and blocks the dopamine and norepinephrine transporter.  This increases the amount of available norepinephrine and dopamine, thus increasing their effects on the body.	The distribution is very low in the body. The drug is metabolized by de-esterification to alpha-phenyl piperidine acetic acid. After oral administration, 78% to 97% of the dose is excreted through the urine within 2–4 days.[31]

Memantine (Axura)	The drug blocks special types of receptors called N-Methyl-D-Aspartate (NMDA) ↓ This improves the transmission of signals in the brain, thus reducing the symptoms of Alzheimer's disease.	The drug possesses good absorption and has bioavailability of 100%. It has T_{max} of about 3–8 hours. Daily doses of 20 mg would achieve a steady concentration. The drug has t1/2 of about 60–100 hours.[32]
Caffeine	The drug acts as an antagonist binding to the adenosine receptors. Therefore, it blocks the adenosine receptors. ↓ It reduces the activity of adenosine receptors, which promote sleep in humans. ↓ Adenosine receptors also reduce the activity of dopamine and norepinephrine. Thus, by blocking the adenosine receptors, caffeine increases the activity of dopamine and norepinephrine.[33, 34]	This drug takes 30 mins to 2 hours to reach peak concentration. Caffeine is rapidly distributed in the body tissues.[35] The drug can cross the placenta and the blood-brain barrier. The peak plasma range for the drug is 6–10 mg/L.[36]
L-theanine	After 20–30 mins of administration, theanine increases alpha brain waves, which take the brain into an alert yet a relaxed state. ↓ The drug also reduces beta waves, reducing excitability in the body.	First, the drug is absorbed in the gut and then into the blood-brain barrier. It takes approximately 1 hour for the onset of action[37]. After intake of L-theanine in the form of capsule or tea, drug excretion occurs through the urine. A minor part of L-theanine is absorbed in the erythrocytes.[38]

Ginkgo Biloba	The drug is known to exert anti-inflammatory, antioxidant, cerebral glucose utilization, neurotransmitter regulation, and vasomotor actions.[39]	The maximum concentration of the drug is reported after 2.5 hours of drug administration. It can cross the blood-brain barrier and show its effect there.[40]
Rhodiola	It functions in two ways, which are interactions with the hypothalamic-pituitary-adrenal axis and influence on nitric oxide production.[41]	The plasma concentration of the drug depends on the frequency of administration. It shows rapid absorption and elimination. Most of the drug excretion takes place through the urine.[42]
Omega-3 fatty acids	Omega-3 fatty acids lower the body's production of triglycerides. Omega-3 polyunsaturated fatty acids along with diet and exercise could lower the triglyceride level in the blood.	Omega-3 fatty acids are hydrolyzed in the intestinal lumen and incorporated into the bile salt. After which they are absorbed in the enterocytes by passive diffusion. Omega-3 fatty acids are metabolized and oxidized.
Creatine	The drug exerts its action by increasing phosphocreatine stores in the muscle. Thus, these additional stores could be used in producing extra ATP, which is then used as an energy source in lifting.[26]	The average half-life of the drug is four years. Half-life increases in patients with renal impairment. Major amount of the drug is eliminated by the kidney, and no reabsorption occurs.[43]

Smart Drugs Used by Different Countries

The number of individuals using smart drugs across the world has gone up drastically. The potential concern is that these drugs are not being used primarily for its medicinal effects. These drugs have other benefits that are being exploited by healthy individuals. These other benefits include memory enhancement or increase in concentration span. These benefits together are termed as pharmacological cognitive enhancement. The request for drugs like Ritalin and Adderall increased by 300% from 2015 to 2017.[44]

In the period mentioned above, nearly 1/3rd of the population used the drugs for pharmacological cognitive enhancement only. The introduction of this drug created frenzy in a lot of developed countries in the world. Maximum units were sold in Europe in the year 2017, followed by the United Kingdom. The drug sales increased from a mere 3% to 16% in France. [44]

There is a serious correlation between the increase in the sales of smart drugs in all developed countries with a high number of working hours. This is an indication of the prevalent competition that exists in such

countries. The question worth discussing—is using smart drugs ethical or is it cheating to others who do not use it?

These drugs originally aimed at treating diseases like ADHD. This line of treatment was introduced in the United States of America. Other countries with a higher number of patients for ADHD followed the same routine. The other countries include Canada and Australia.[44]

This sudden rise of smart drugs points to the fact that people might be having problems with their working capacity and their social world rather than anything else. Many units of these drugs were sold through friends and word of mouth; 48% of people acquired the drug this way. Moreover, 10% of people bought through the internet, and only 4% had a prescription for the same.[44]

Discussion

Many supplements are available at the present that claim to enhance our cognitive ability; however, several experts believe that these supplements do not increase our cognitive abilities unless taken for a very long time. Other reports claim that these supplements cannot compensate for natural food and provide health benefits. [45]

Certain pharmaceutical preparations could increase our cognitive power and memory. The examples include Modafinil and Ritalin. Modafinil is a drug of superior effects and has proven pharmacological benefits. Though it has pharmacological benefits, it also has unwanted effects, such as headache, anxiety, and insomnia. Till date many drugs are termed as "SMART DRUGS," but none of them have effectively proved to be safe in improving cognition. [45]

The potential role of smart drugs is to increase the ability of people to do tasks which they would not do under normal circumstances. In layman's terms, the effects of these drugs will ensure that people are focused for a longer period and work faster at their jobs. This does tend to extract a lot of work from an individual but is that what a "SMART DRUG" should do!

The most tapped in community of smart drugs is the stimulant type, which has escalated because of the rise in competition among people. It is true that right now almost anyone can apply for a job while sitting in any corner of the world.[46]

Thus, people are going to an extreme extent to increase their efficiency. Other reports claim that smart drugs might alter the mechanism of the brain but do not increase the speed of the entire process. [46] A rough analogy for the same could be that you can't accelerate an entire bus by just speeding its rear tires; all the tires and engine have to in sync for the bus to move fast.

It is certainly not easy to change the cognitive ability using these smart drugs and there is not much support in favour of using them.[47] Thus, it should be used when prescribed and in recommended quantities only.

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Decolonizing Moral Education: An African Indigenous Perspective

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Abstract

This paper has examined the importance of African Indigenous Moral Education versus Moral Education introduced by the colonizers in maintaining social fabric. In doing so, concepts pertaining to colonialism, decolonization, education, morals, have been defined. Further, aims of education of African Indigenous people have been articulated as well as their status in these societies and corresponding state of morality among Indigenous African people versus the rest of the world today. Finally, suggestions towards integration of African Indigenous Moral Education into school curriculum has been made.

Key words: Colonialism, Decolonizing, Culture, Morals, Education, Indigenous

Introduction

It is difficult to grasp the meaning of the decolonizing process without understanding the underpinnings of colonialism. Simply defined, colonialism is an elaborate system of forceful physical occupation of lands or territories belonging to indigenous peoples by a foreign nation(s) exclusively for self-centered interests. Besides, forced physical occupation of lands by foreigners, colonialism was totally involved in devaluation of the colonized peoples' skills, knowledge and particularly culture in terms of beliefs, traditions, norms, and morals. Morals are concerned with what is considered right or wrong. The word moral is derived from a Latin word **mores** which refers to customs, beliefs, values, norms and traditions of a particular society or community.

According to Summer (1907) **mores** refer to morality of a given society with regard to what is regarded right or wrong, moral or immoral actions, as well as thoughts and feelings. People in a society are obliged to abide with a particular society's mores in order to promote harmonious co-existence. The term moral, therefore, seems to describe what is considered right or virtuous or wrong and evil in a society.

Given that human beings are born neither moral nor immoral, the society through its institutions especially the family, churches and schools are therefore charged with the responsibility of transmitting what is considered to be right or wrong to its new members. Lack of such standards lead to social disorder or anomie.

Essentially, the colonizers viewed the colonized peoples as primitive and subhuman. Moreover, colonizers from time immemorial and particularly from 15th Century to early twentieth century took every opportunity to strip off indigenous people of Africa and other colonized peoples naked of their culture and its associated

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skills, knowledge and value systems that had set them apart as a people with unique identity. The school setup by the colonialists including ways of worship initiated by different denominations that competed for sphere of religious influence were particularly designed to colonize the mind, the heart and the spirit of the indigenous people.

Once the mind, the seat of consciousness, understanding, reason and imagination of the indigenous people were baptized "inferior" and "barbaric" their creativity, self-identity and self-esteem were crushed. With suppressed self-identity, it was only a matter of time before indigenous people developed self-hate and emptiness. To fill this void they started to ape the ways of the colonizers.

Similarly, the heart which is said to be the seat of human personality became very fragile. The term personality refers to characteristics sets of behaviours, cognitions, and emotional patterns, moods, attitudes and opinions that evolve from biological and environmental factors. A combination of these characteristics distinguish one individual from another except in rare cases of identical twins when they are brought up under the same environmental factors.

Finally, the term "spirit" which is derived from a Latin word which means "breath"; it is believed to be a part of being alive as well as part of a person that is associated with eternity even after physical death of the body in most cultures. This seems to justify the reason why most of the African indigenous peoples talk of the "living dead" (Mbiti, 1971:132). From biblical perspective, God breathed his spirit into human beings (Genesis 2:7). The spirit, therefore, is the intangible aspect of a person and is the reservoir of conscience and character. The term character stands for the mental and moral qualities unique to an individual while conscience deals with ethical issues relating to an awareness of what is right and wrong motives and behavior. For instance, it is considered unethical even to contemplate to cheat and to actualize cheating in an examination.

Decolonization of Moral Education

Having defined the concept of colonialism and observed how it robbed individuals and societies of their identities, an examination of decolonization of moral education is attempted. Decolonization refers to the process by which the colonized peoples forced out the colonizers from the occupied territories through non-violent resistance movements like in the case of India or violent means in case of Kenya. It important to note that decolonization of now independent former colonies from colonial cultural heritage has been a very slow process. This is because education they introduced coupled with their ways of worship colonized the mind, heart and spirit as mentioned earlier. Therefore, though former colonial states fly their flags as symbols of political independence, they still remain chained to their former colonial oppressors in their world view and to some extent in their cultural orientation. By and large, leaders of the former colonized nations use similar strategies to oppress their people and often with the help of their former colonial masters.

According to Ralph Linton (1945) culture of a society is the totality way of life of its members. This in turn is shared and transmitted from adult generation to incoming generation through social institutions such as the family, school, religion and government among others. In other words, culture consists of knowledge, skills, language, beliefs, art, morals, laws, religion, customs, traditions and other human-acquired capabilities. All these components of culture are better understood by those who have been born and grown in it through socialization and active participation. It is almost impossible to decolonize minds of the former colonized people unless deliberate steps are taken to retrace the true history of their cultural heritage. For this reason, focus is directed towards establishing the role of education in general and moral education in particular in the present time in decolonizing the mind, heart and spirit former colonized peoples.

Concept of Education

The term education is derived from Latin words *educere or educare*. The word "educere" means to lead out or draw out while "educare" means to train, mould, and bring up. In ancient Rome the verb *educare* which is adapted in this paper, is used to refer to the general process of bringing up children in the community's or society's way of life or culture. International Dictionary of Education (1977:94) defines culture as the sum total of values, beliefs, customs, arts, scholarship, institutions and artefacts of a group or community or nation. This seems to suggest that education is wider than moral education, though no society can survive without moral education since it is the social glue that facilitates peaceful co-existence. It teaches about all that a society holds to be right and wrong or "dos" and "don'ts" that regulate behavior, thinking and actions of people.

Plato (428-BC to 348-BC) stated that "education is the creation of sound mind in a solid body" leading to development of a person's idea of what is good, and virtuous. A virtuous individual is one who honest, respectful, courageous, humble, hardworking and dependable. He or she lives according to high moral standards. Plato thus regarded education as a means by which both individuals and social justice can be achieved. Plato to a very large degree envisaged education that would be intellectually fulfilling as well as morally sound.

Emile Durkheim (1858-1917) like Plato seemed to agree that education with a heavy component of morals was critical to creation of a just and orderly society. He defined education as the "influence exercised by the adult generations on those that are not yet ready for social life". He continued to state that the objective of education was "to develop in the child a certain number of physical, intellectual and moral states which are demanded of him/her by both the political society as a whole and the special milieu for which he/she is specifically destined". Unfortunately, most of the former colonies followed and still follow education systems of the colonizers. The quotations cited hereabove, seem to imply that education fashioned after the colonizer's system may not sufficiently serve the aspirations of indigenous peoples and in particular in the moral realm.

In the recent past, Radcliffe, (2017 (ed.) has quoted Nelson Mandela who asserted that "education is the most powerful weapon you can use to change the world". However, while this sounds perfect, it may only happen if that education is designed to touch mind, the heart and the spirit of indigenous peoples particularly in relations to moral issues. It is observed that education devoid of morals that are deeply rooted in the culture of the people produces people with superficial sense of morality and therefore lacking in social justice.

Aims and Content of Moral Education of African Indigenous Societies

The word moral is derived from a Latin word *mos/moris* meaning customs, beliefs, values, norms and traditions. *Morals* of a given community define morality in terms of what is regarded right or wrong, moral or immoral actions or thoughts or feelings. People in a society are obliged to abide with a particular society's morals in order to promote harmonious co-existence. Morality, therefore describes what is considered right or virtuous or wrong or evil in a given society. Morals therefore provide a social glue that prescribes how individual members of a specific society should live together harmoniously.

Broadly speaking, the African indigenous form of education had three main aims. These comprised equipping individuals with relevant knowledge and skills and proper codes of conduct that would enable them to be properly integrated in the society. Every step was taken to ensure that necessary, knowledge, skills, and codes of behaviour were learnt at specific stages during the life cycle, as the individual progressed from childhood to adulthood and old age. As a matter of fact, education was compulsory throughout one's life in African traditional societies.

African indigenous education had a heavy component of moral education whose overarching goal was promotion of community life weaved around religious underpinnings. According to Mbiti (1969) "to be, is to be religious". Religion from this perspective touched every aspect of human communal life, in terms of supernationalism or myths, beliefs, traditions, actions, morals and social relationships. Indeed, religion was to be practised every minute of one's entire life and not an appointed specific day of worship such as Friday or Saturday or Sunday or any other day of worship. It is also important to note people of a given community for example the Gikuyus or the Kambas or the Luos, or the Masaais of Kenya were bound by a monolithic religion. Diversity of religions within a community was unheard of; thus religion formed unbreakable bond of community unlike in the era colonization when a community was bombarded with different religious beliefs from diverse denominations. These divergent beliefs divided families as well as community at large.

Challenges of Teaching Moral Education in Post-colonial Africa

The coming of Europeans to Africa and elsewhere led to the introduction of western type of education which failed to appreciate the moral teaching of colonized people and particularly in management of human sexuality, intimate relationships and fair distribution of material wealth. The abandonment of traditional ways of life enmass left a moral vacuum. This is may be attributed to the fact that European way of life and

formal education mainly concentrated on reading, writing, arithmetic and pursuit of an individual's self-development at expense of inculcation of societal human values and social skills for communal life.

The overemphasis of academic education made many African parents feel incompetent to teach their children moral values, for what they knew with respect to moral issues was no longer valued. The parents who insisted on their traditional ways of bringing up children found out that the school and the church taught them to abandon traditional morality which they labelled negatively as "evil" and "satanic". Unfortunately, even when more and more parents become "converted" colonialist ways of life, they did not feel confident and competent to impart moral values because they had not grown up in them. Thus, though Christian moral values are perceived to be good, they are still largely viewed as "foreign" since they lacked socially inbuilt mechanisms to ensure that they are followed, other than appeal to a very distant god who did not appear to punish bad behaviours immediately and decisively. Apparently, conscience and judicial legal systems do not appear to be applied to all equally and effectively (Kibera & Kimokoti, 2007). In traditional societies every individual without exception had to comply with the agreed moral code at both family and societal level. In fact, moral education in Africa today, is in crisis; there are no clear-cut objectives as far as moral education is concerned. Indeed, religious education which was initially used to instill morals during colonial times, is no longer a compulsory subject and in many developed countries, teaching of religious education is outlawed.
For instance, abstinence from sexual involvement is no longer emphasized and this is aggravated by the electronic media seem to glorify sexual gratification outside of marriage. Furthermore, Constitutions of most countries of the world have legalized abortion and those that have not are under intense pressure to do so. One can no longer persuade girls not to engage in sexual activity on account of pregnancy. It has been reported that within the first three months of lockdown of schools in Kenya mid-March, 2020 and June 17, 2020, 152,000 teenage girls became pregnant from Machakos County alone (https://ncpd.go.ke>teneage pregna...& https://www.voanews.com.

Replication of this number if it is duplicated to the rest of other 46 counties in Kenya would translate into over 900,000 thousand girls being pregnant. This seems to confirm that parents are not capable of teaching their children to delay sexual activity until they are of age and able to take care of themselves and their own children. Prevalence of pregnancy during corona pandemic seems to run against the protocols of social distancing. Children should be advised that unbridled sexual activity leads to teenage pregnancy, and also may lead to corona virus infection as result of physical closeness in addition to other sexually transmitted diseases such as HIV and AIDs among others.

Lack of agreed standards of moral code has created divergent views on moral issues has led to unbridled sexual activity thus, outside marriage 37.9 million people are currently infected with HIV/AIDS (https://hiv.gov>datatrends, 2018). HIV, the virus which causes AIDS (Acquired Immunodeficiency Syndrome) is mainly sexually transmitted. It has been reported that 2/3 of those infected with AIDS virus live in Sub-Saharan Africa. In Kenya, 8 percent and 4 percent of adult women and men respectively are

infected with HIV/AIDS. This seems to suggest that there has been a breakdown of sexual morality among the former colonized nations as result of invasion into their culture by foreign ideologies.

Moral education and sustainable development

The Sustainable Development Goals (SDGs) also referred to as Global Goals were adopted by all United Nations members states in 2015. These goals have called for action to eliminate poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030. A close look of 17 SDGs and even the previous 8 Millennium Development Goals (MDGs) have not included a goal implicitly on moral education. Consequently, MDGs and SDGs goals are not likely to succeed since they are not grounded on sound moral principles relating to control of self-interest at individual, national and global levels in management of sexuality which also leads population explosion, fanatism, terrorism and self-gratification. The "ubuntu" philosophy among indigenous African peoples and elsewhere in the world created a conducive environment for moral education which effectively equipped people with common values that fostered social justice as well as individual justice. The Ubuntu philosophy postulates that "I am" because "you are" (Ogude, 2018).

Currently, most nations are involved in internal and inter-states tensions. Some of these nations include and not limited to Yemen, Afghanistan, United States- Chinese tensions, Saudi Arabia, The United States, Israel and Iran, Syria, Nigeria, South Sudan, Ukraine, and Venezuela (www.crisisgroup.org, 2019). Oftentimes, a majority countries having internal and inter-state wars have a colonial past. These wars most of the time being funded by the former colonial powers or other powerful foreign nations interested in exploitation of material resources of less developed nations.

Conclusion

Towards elimination of suffering and unending conflicts within and without national borders and in general moral decadence, each nation especially less developed nations must decolonize their current way of life that seems to be devoid of communal life and replace it with moral values that foster Ubuntu philosophy. To realize this, each community within a nation like Kenya, which has 45 registered communities should be facilitated by the Government to identify and codify the best of their moral code that guided the conduct of its people before colonization, westernization and europeanization. Out of these write ups on moral values that cut across and are relevant to modern life should be put together into a curriculum that should be studied directly through curriculum and indirectly by examples at every level of education and especially at basic level. Once this is done, it is hoped that school education will deliberately and consciously teach skills, knowledge and appropriate to moral underpinnings in every lesson. Further, all those who transgress the agreed moral code should without exception be sanctioned. Finally, parents, teachers and leaders at all levels of society should set good examples to incoming generations.

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Some guidelines for a smart and suitable design of applications for the social inclusion of functional illiterates

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Abstract

This article investigates the design of application interfaces and the development of activities based on the principles of active methodologies that focus on the social inclusion of a population with low linguistic proficiency in the Portuguese language spoken in Brazil. The focus is on the inclusive, smart and suitable design of activities for learning and improving the writing and reading levels of these individuals, who are classified as functional illiterates, as defined by the National Indicator of Functional Literacy (INAF). They feel the direct impact of access to new technologies mainly because they cannot read written documents and interpret visual language. The people on whom this study focuses are keen to improve their native language skills but should also be guided and helped by an inclusive design in technological applications. They use WhatsApp to produce communications and exchange content, whether through audio messages or pictures, but they avoid writing or reading text. In this paper, we propose an inclusive smart design for an application to expand the possibilities of linguistic communication.

Keywords: functional illiteracy, app interfaces, smart design, social inclusion, educational apps.

1. Introduction

This study has the general objective of deepening the theoretical and practical research of the Research Group "Hybrid Education, Methodologies and Digital Learning Objects in Mobility Environments", based at the International University Center (UNINTER), Brazil, on inclusive designs for functional illiterates. A design thinking approach is used to materialize the ideas of constructing an application directed at functional illiterates. This type of thinking covers different phases of work for collaborative construction and opens itself to creative contributions from all the researchers involved, namely, a professor (the research coordinator), Master's students and a scientific initiation student. In addition to involving research and design issues, this study intends to expand the scope of the area. It aims to involve content from the literacy and digital literacy spheres, with issues emerging in today's society forming one of its theoretical and empirical supports.

The problem faced by functional illiterates is not a recent one, and it is necessary to outline more consistent paths for their inclusion into society by incorporating technologies in more practical and

effective ways. These people are viewed as invisible in their society as if they did not exist because of their difficulties in reading and writing, and they appear to reinforce statistics on obstacles that impede the social, cultural, and economic development of their country.

The decisive fact that favors the justification of this research is that the functional illiterate shows diversified fluencies and personalized forms of digital literacy when using smartphones in their day to day lives. Data provided by ANATEL (The National Telecommunications Agency) in February 2019 indicates that there are 229 million cell phones and a density of 109 cell phones per 100 inhabitants in Brazil.

Access to data from the Brazilian Institute of Geography and Statistics (IBGE) shows that, as of April 2019, Brazil has a population of 202,768,562 inhabitants. In Brazil, there are consequently more cell phones than people in the total its population; the difference is 27 million more cell phones than inhabitants.

Brazilian functional illiterates are frequent users of social networks. Among them, 86% use WhatsApp, 72% are fans of Facebook, and 31% have an Instagram account (Fajardo, 2018). It is possible to identify some common behaviors of the functional illiterates through their use of smartphones. For example, there is a predominance of Internet access through smartphones, and they make constant use of social networks due to their ease of communication and the influence of their social circle. Moreover, even if they are restricted in terms of written content, access to free Wi-Fi networks has made it possible to include such people in the digital world (Conceição, 2016).

Thus, by proposing the design of more inclusive learning objects, we can reveal new ways of promoting social inclusion and the democratization of knowledge, as well as improving the condition of the person who becomes a citizen in the digital context.

This study uses the foundations built by authors such as Freire (2010), Castells (2013), Garcia (2017), Marcuschi (2004), Burd (2010), and Ferreiro (1983), all of whom emphasize several aspects about digital literacy/illiteracy, design, and mobile issues for the focal audience. In general, it can be inferred that digital literate is not a mere reader. They can become a critical individual with social action and with the cognitive capacity to influence and expand the cultural production that they have access to. Therefore, in this study, we aim to highlight aspects of digital inclusion as well as distinctions and convergences between concepts of literacy and illiteracy in order to incorporate them into the design of the interface of this application.

The objective is to have the necessary theoretical foundations for the construction of a "humanized" design according to the referred phases of design thinking in order to reach a model of smart pedagogy (Filatro & Cavalcanti, 2016).

In this sense, it should be emphasized that, in the knowledge and information society, the learning process must be focused on the preparation of the individual, making him a citizen so that he not only understands texts or performs intellection or even writing, but so that he may be able to go beyond that. Thus, this citizen must legitimately interact with the environment in which he lives, building new connections, acting socially with self-esteem from the domain of written language, and inserting himself in the local culture and going beyond it.

It is hoped that these individuals can achieve a new level of knowledge that will materialize in a more autonomous and authorial way through their handling of information and communication technologies. Consequently, in the present article, since the topic is more general than can be

comprehensively discussed here, considerations regarding the current challenges about the digital literacy of functional illiterates in the face of the adversities and achievements of their daily life and their preparation for the sustenance of their professional life are dealt with. The preliminary results point to the hypothesis that the literacy required for more autonomous use of smart mobile devices by illiterates depends not only on their ability to read and write but also on the establishment and promotion of means that provide a more inclusive interface that gives the necessary conditions for this appropriation, as well as on achieving a social conscience about daily access to this, based on digital technologies.

2. Justification and objectives

This study is a result of the actions developed in the Research Group "Hybrid Education, Methodologies and Digital Learning Objects in Mobility Environments" connected to the Master's degree program in Education and New Technologies at UNINTER, Brazil.

Three out of ten young people and adults aged between 15-64 in the country – about 38 million people – are considered functional illiterates. A study by the Paulo Montenegro Institute has shown that 29% of Brazilians are considered functional illiterates, and 8% are absolute illiterates (those who cannot read words or phrases). 21% are at the level considered to be rudimentary, while the others are at either an elementary level (34%), an intermediate level (25%) or are proficient (12%). However, in the last ten years, the ratios of Brazilians in this situation have been stagnant, as shown by the National Indicator of Functional Literacy (INAF).

For Fajardo (2018), the damage is relevant because it compromises the productivity of the economy and the chances of education contributing to the improvement of people's lives. The life expectancy of people among functional illiterates is minimal. Brazil has decided to opt for quantity rather than quality in education.

For Freire (2001, apud Ferraro, 2002, p. 29),

> The best conception of illiteracy is as a "weed" – hence the expression "the eradication of illiteracy" – or as a "disease" that passes from one person to another, almost by contagion, sometimes as a depressing "sore" to be "cured" and whose indices, stamped on the statistics of international organizations, speak ill of the levels of "civilization" of specific societies. Moreover, illiteracy also appears in this naive or cunning view as a manifestation of the "inability" of people, their "lack of intelligence," and their "proverbial laziness."

Therefore, this research is justified by focusing on the design differentials for communication in the interface of applications that can potentially lead to interaction, immersion, engagement, decision-making, playful and motivating aspects and, consequently, learning. In this sense, they must also be compatible with the skills of the target audience.

The general objective of this study is to generate research inputs that can be expanded, highlighting the concept of social inclusion, and it is focused on designs for functional illiterates. The specific objectives are to develop the following: an application access interface that is compatible with the profile of said target

audience; learning activities that can improve the reading and writing conditions of the potential users; a differentiation of gamification and playfulness as a presupposition for the motivation of apprentices; the inclusion of daily references; and working on the potential users' sense of belonging and social inclusion.

This research is justified by the need to have more optimized and effective combinations of technologies with what is known about how learning works and how the methodologies can be applied for the benefit of learners.

The combination of technology and pedagogy can promote the development of an inclusive society and reduce social exclusion by implementing learning technologies in the learning process (Conceição, 2016; Fajardo, 2018; Bacich & Moran, 2018).

3. Methodology

The methodology applied in this study is based on a collection of familiar elements of this target population's lives, in which verbal communication needs are evidenced and dealt with in forms of interaction in the application design. Other authors have provided theoretical support for the concepts of gamification, instructional design, cognition, and learning mediated by mobile interfaces, among others, such as Conceição (2016), Santana et al. (2012) and Garcia (2016). The development process of this application is based on design thinking, the methodology of which is based on the following phases: 1) the definition of a problem and exploratory research; 2) the presentation of a solution and actions for the interface design of the application; 3) prototyping; and 4) testing and conceptualizing this process. At the current moment of our research, we are in the design phase of the activities and concepts that revolve around this prototype, which implies modeling the concepts that support the interactive activities and interfaces of the application.

The expectation is that the subjects who constitute the target audience can perform gamified activities in mobile interfaces and use the proposed application to extend both their interpretation conditions and their written comprehension of verbal codes. This design is represented in the 5 Design Thinking Phases model (Figure 1).

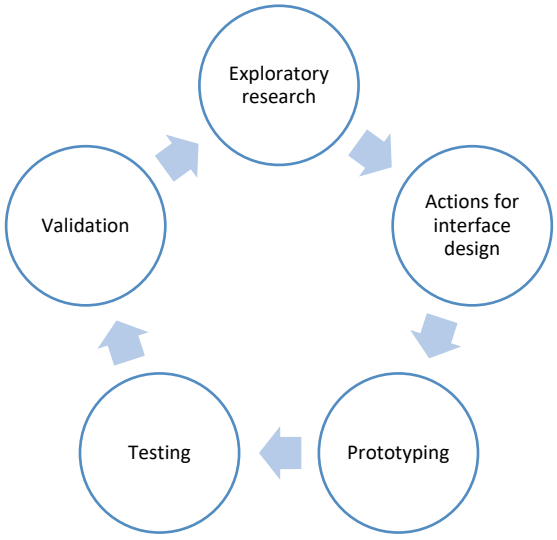

Figure 1 – 5 Design Thinking Phases

The steps involved in five stages of the methodology depicted in Figure 1 are as follows:

Exploratory research: This was conducted with a spontaneous focus group, who had previously been identified as encompassed as functional illiterates. The objective was to uncover the personal narratives and the difficulties faced by these people due to their lack of mastery of their mother language in the aspects of reading and writing.

Actions for interface design: This is the study of the smart pedagogical approaches allied to gamified aspects to support the created activities, and aims to promote the interactivity of these users of the smartphone interface.

Prototyping: This involves putting the collaborative ideals on paper and choosing a tool[1] To realize a prototype that allows collaborative work. One must reflect if the interface is helpful to the target audience of functional illiterates; if it is, the user can learn to improve his level of the written and spoken language.

Test: The same exploratory research group is used to test the application's features and evaluate the created activities and gamification. A survey was used to cover the following topics of importance to this study: if the user was able to interact while learning; if the user applied his intuition to navigate through the interface; if the user understood the proposals of the exercises; and finally, if he/she would recommend the application to other people from his/her social environment.

Validation: This is the incorporation of the test phase evaluations and the disclosure of the existence of the application to a larger number of users.

At present, we still have to carry out the prototyping, test, and validation phases for this project.

4. Functional Illiterates and the Use of Smartphones

The reflection and practice of this study are based on digital technologies. Studies indicate that functional illiterates use smartphones and social networks like Facebook, WhatsApp, and Messenger. This promotes a series of experiences in different contexts that demand different forms of reading and language domains (Conceição, 2016).

According to the INAF, there are approximately 14 million absolute illiterates and just over 35 million functional illiterates in Brazil. As a result, there are substantial repercussions in the daily lives of these individuals that prevent them from performing everyday actions such as getting on a bus, paying for a bill at an ATM, recognizing addresses for their commute, making simple calculations on purchases, or controlling the frequency and doses of their medications.

Recent research has indicated that the reading deficits of the Brazilian population have increasingly reinforced social, cultural, and work inequalities. When analyzed in a school environment, these deficiencies increase the difficulties in learning content from critical subjects and present challenges on how to prepare citizens to seek employability and on their productive sustainability in global knowledge societies (Mauch et al., 2016).

[1]. A strong option is to use the InVision application. This is a prototyping tool that runs on the web and allows one to have collaborative and interactive prototypes and receive feedback from colleagues. It is suitable for education projects and accepts uploads of PNG, JPG, GIF, AI and PSD files.

4.1 The Use of Mobile Devices

In Brazil, the survey published by *We Are Social* (2017) shows that 89% of the country's adult population uses a cell phone, with 62% being users of smartphones. This data demonstrates the potential use of this device for learning, allowing the development of applications that exploit literacy in an interactive way that mitigates functional illiteracy. Considering that mobile devices are becoming smaller and smaller, people are now able to carry them throughout their day. Besides, they can connect them to other devices, which enables them to incorporate their various daily activities with the physical world (Santana et al., 2012, p. 446).

Mobile technology presents itself as an instrument to support educational practices and not as an end on itself. Through portable devices, quick access, and low-cost initiatives, its use can help the literacy of the functional illiterate population that is immersed in the technological environment.

Educational mobile resources expand the learning context, as it is then not just limited to classroom environments, encompassing formal as well as informal education environments, and makes learning a continuous process. UNESCO (2013) point out that, thanks to the technological improvement of mobile devices, they will be able to translate spoken and written languages with great fluidity and precision, which will enable the inclusion of new educational interactions for this illiterate population.

The planning of the learning process of functional adult illiterates should consider the anchoring of new information that is already part of the repertoire of the literate individual. Vygotsky (1991) provides fundamental concepts on constructing knowledge from social interaction; that is, the interchange of an individual with other people and objects. In today's culture, individuals are interacting with each other using mobile technological objects as robust learning tools.

As a result of these interactions, mobile devices can promote different forms of social inclusion, whether for the disabled, the visually or audibly impaired, or people with low fluency in their mother tongue who need to improve their abilities.

4.2 The Social Aspect of Mobile Devices

For Barbosa (2017), Brazil has a social stratification composed of classes A1, A2, B1, B2, C1, C2, D, and E; the highest income families are classified in class A1, and families with the lowest income are classified in class E (this classification is used by the Brazilian Institute of Geography and Statistics – IBGE[2]).

For people in segments C, D, and E, the smartphone is their means of social inclusion because it is the only form of access to the Internet for specific individuals. People of lower social classes rely on smartphones for different reasons, as they do not own other devices such as desktops, laptops, or tablets.

Akharas mentions the fact that inclusion systems in the information society must be supported by learning communities:

Social inclusion systems involve processes of participation, mediation and interaction in which cognition and learning are situated in broader sociocultural contexts, and the notion of learning community

[2] The division of the Brazilian population into socioeconomic classes is based on the Brazilian Economic Classification Criterion. In practice, items that a family owns are worth points and define the class it belongs to. In Brazil, the primary materials evaluated are bath products in the house, color televisions, radios, DVDs, refrigerators and freezers, cars, washing machines and the use of a maid.

becomes central. According to an information society perspective, such systems may encompass the use of media technologies, such as learning portals or social networks, and the development of models and methods for the orchestration of learning communities. (Akharas, 2011, p. 25)

Mobile applications, such as personal platforms, can access digital universes and, in a sense, build new bridges for all types of people. With their massive use, they have been able to penetrate the most varied social segments, and that is why they are associated with inclusive processes with a focus on education. According to Candello (2013), the profile of the user, typology, background colors, and content distribution can affect the proposed design forms for the target audience.

5. Procedures

A group of 35 people, formed by professionals who declared that they had had little schooling, performed a preliminary test on their mother tongue to determine if they were functional illiterates. After the test, 14 people were classified as functional illiterates.

A multiple-choice test was carried out, and respondents had to choose their answers based on their understanding and interpretation of the questions. This preliminary test included questions on phrases and short texts in Portuguese referring to everyday topics, such as short messages (of the WhatsApp type), news, and small ads.

Following the test, individuals were categorized into one of two groups:

Individuals who answered 70% of the questions correctly formed a group of people with sufficient knowledge of the mother tongue because they could read the written materials presented;

Individuals who answered 30% of the questions correctly formed a group of people without sufficient knowledge because they had difficulty reading the materials presented.

Interviews with the group who answered 30% of the questions correctly were conducted after the test with the following questions:

What do you do to communicate in your day to day life?
Do you want to learn more about your mother tongue?
Do you know how to use a smartphone?

After analyzing the reports of these interviewed people, three main points were highlighted: 1) the use of communication strategies by functional illiterates; 2) their interest in deepening their knowledge of the language, and 3) their digital fluency for the proposed solution.

1) The Use of Communication Strategies

The results point out that the functional illiterates under study here can be interpreted as people who deal with difficulties in reading everyday things, but find their strategies to deviate from these difficulties, either by using audio for communications on their mobile phone, taking photographs to describe something,

or by using emojis to demonstrate their feelings. This shows a redefinition of the need to use a verbal code for some instances of communication.

These people improve their self-esteem by using their smartphones and communicating with other people with a similar profile who somehow use the same strategies to communicate. Some learn to have such communicative attitudes from others.

However, they can use communicative strategies that are sufficiently adequate for their profile on the subjects they want to communicate about in order to feel that they belong to a social group, especially their family. They complain about the difficulties of not mastering their mother tongue when performing tasks such as grocery shopping, reading product labels, reading information about their medicine intake, and reading and writing messages on WhatsApp.

2) Interest in Deepening Their Knowledge of the Language

The results show that they have tacit knowledge of the language and life experiences, but they prefer not to expose such knowledge as they do not want to show their incompetence in this field.

3) Digital Fluency for a Solution: Design of the Nine Stages for Smart Pedagogy

Based on this survey, the discussions of the research group and the methodology of design thinking (Filatro & Cavalcanti, 2016), we sought to develop nine stages to produce an inclusive design of an application for functional illiterates. These nine stages cover:

Survey of personal narratives – how they live, what they do, how they work;

Implementation of pedagogical approaches appropriate to the project and smart pedagogy – use the appropriate learning approaches to develop a more autonomous and engaged user;

Use of the user's life knowledge to support their challenges – use the appropriate challenges to explore the activities of the application's interface;

Appreciation of the audience's self-esteem – incorporate the sense of self-esteem from this target audience, from which feelings and the appreciation of the person are rescued;

Playful treatment and construction of challenges – give a playful meaning to activities;

Transformation of narratives into gamified activities – uncover narratives through the use of gamified challenges;

Definition of cognitive challenges and the use of intuition to explore the application – value the cognitive element and combine this with intuition during the performance of activities;

Definition of the content of verbal and audio-visual languages – define the different codes of language as forms of communicative contribution;

Distribution of the content of the activities – balance the information in different forms of activities.

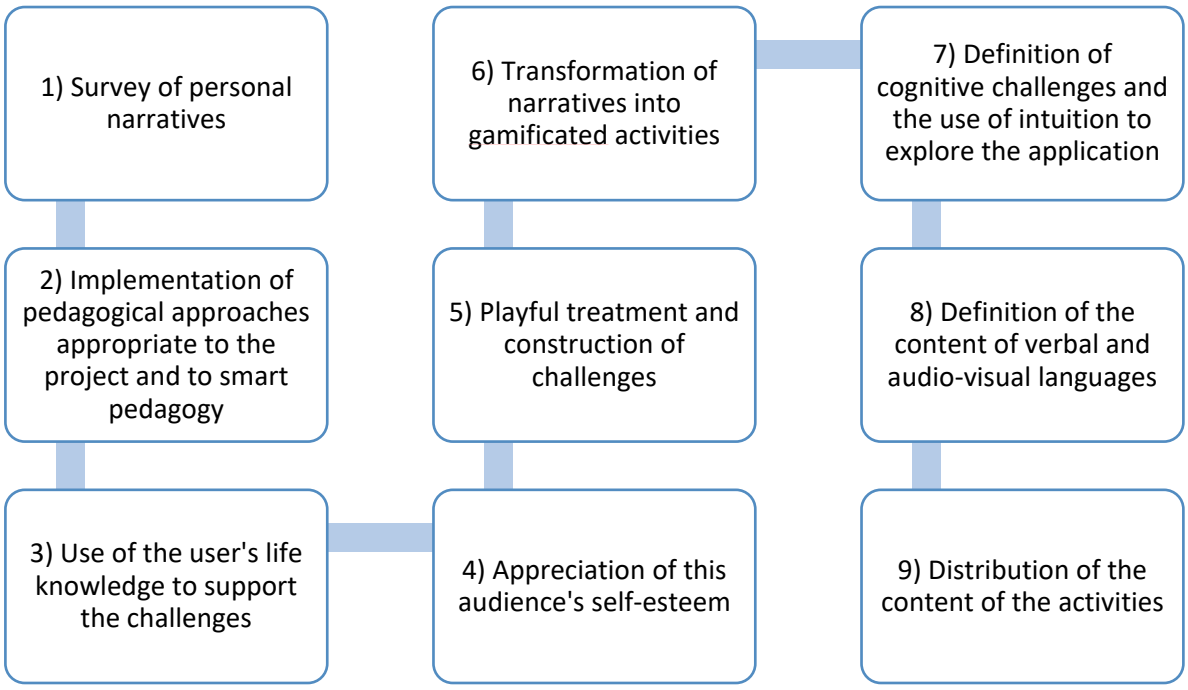

Figure 2 – The Nine Stages of an Inclusive Design for Smart Pedagogy

Thus, it is possible to develop a smartphone application with an inclusive design focused on cognitive challenges, gamification, playfulness and quality in learning, as shown in the nine stages in Figure 2.

The results were based on the use of the design thinking approach, which elaborates creative solutions for a real problem. In our case, the problem was approached as an issue of reading functional texts, including different ones in smart pedagogy, which drives the changes and actions of designing a mobile application.

6. Conclusions

Functional illiterates are not incapable people. They are the opposite. They seek to re-signify their potentialities. In this research, it has been inferred that in order to transform illiterate individuals into proficient literacy students, it is necessary to develop some differentials in communication interfaces in order for them to achieve their capacities and a better fluency for their use. In smart pedagogy, these differentials should include: the use of intuition and cognitive processes that are already present in the young and adults, the possibilities of making inferences and syntheses, associating rules with particular cases, recovering tacit knowledge of the mother tongue, accompanying the narratives and being protagonists as learners, and authorship in the search for solutions to challenges in order to follow the evolutionary sequence of the work, among other aspects.

It must adapt to a more "humanized" design that includes attention to the cognitive profile, as well as the daily, social, and individual experiences of this target audience. Applications of this nature seek to become sources of inputs in which autonomy and self-regulation can create new connections in a more

complex process of using individuals' cognitive capacity for the challenges of gamification presented in its design. Thus, it can be verified that the design of this type of application must:

Consider the possibilities of experiencing new things by the learners from their collection of other informal learning;

Recreate situations that include the use of components of language structure, vocabulary, and interpersonal linguistic communication;

Value narratives that aim at immersion and involvement in the same way that they entertain and teach;

Work on the intuitive aspect, which speaks for itself and does not require explanations, leading the user to improve their communication and learning strategies;

Build microcontainers that are inserted into micro situations, which present problems and challenges with the option of using resources to find solutions;

Find key elements that create an identity between the learner and the interface.

With this, the reflexive process that anchors the design of applications to include people with reading and writing difficulties is created.

Socially inclusive-designed products for mobile applications should also provide more autonomous and personalized processes, requiring attention and objectivity in activities, as well as more collective and spontaneous processes that express communicative forms. The autonomy of the learners is granted by their choices in what they consider essential to seek in order to improve their knowledge of their mother tongue. The design of this application should aim to meet both the demands of informal learning as well as those related to hybrid teaching – face-to-face modeling with distance modality mediated by mobile devices. This design considers: a) exploring the mobile applications of domain knowledge, developing activities so that the user can test their knowledge of writing and reading; b) recognizing the different fluencies: digital; verbal and non-verbal codes; and c) deciphering emotion through using music as a stimulus.

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Object of Study of Literacy: a learning object based on mobile learning to aid in the process of child literacy

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Abstract

The basic literacy is a complex phase, composed of several stages that require dedication to the conclusion of the process. Nowadays, with the evolution of electronic devices and with the advent of data mining technology, respectively, the teaching and monitoring of the stages of literacy can be facilitated by the introduction of its principles into the educational process. Based on this, this paper proposes the presentation of a learning object, consisting mainly of a mobile application and a follow-up system, named Object of study of Literacy, Objeto de Estudo de Letramento (OEL), for teaching and monitoring the initial stages of the process of basic literacy.

Keywords: literacy; mobile; educational; learning

1. Introduction

According to (ICAE 2003) the basic literacy is defined as the learning of reading, writing and numbering. The authors (Santos et al 2005) report that learning the alphabet writing system is a long, complex and constituted of several steps. These are specified by (Foulin 2000), which classifies them as: logographic, alphabetical and orthographic. In the first stage of the learning of the apprentice is able to recognize the name and elements he already know; in the second stage, the child can recognize the phoneme of letters and their graphemes; and in the third, the child can recognize a word in its entirety, without a need to fragment the simple sounds of the letters that make it up the word.(Soares 2011) expands a discussion about the knowledge of reading and writing, addressing the term "literacy." For the author, the literacy is the ability to use these knowledge in social practices that require writing, that is, in addition to having the capacity for recognize mechanically the words that make up a text, the student must be able to understand,knowing on the that they are referring to.

Basic literacy in Brazil began to be taught through traditional methods consisting in the teaching of staged writing. In these stages, the student first learn the letters; after this, the letters are combined with each other for the formation of syllables and words; they spell the syllables; they spell the words; and, in the finish,

they read short sentences and stories. In this type of method, booklets of literacy with a grapheme and their respective phoneme were used. This type of learning was considered by critics as the most tiring and tedious for children (Oliveira et al 2014). From the 80's, appear questionings and criticisms of the traditional method. These questions helped to replace the use of this method by constructivism in the literacy, introduced by the researcher Argentina Emilia Ferreiro in her works in the psychogenesis of language. This transition can be visualized by the analysis of the document "National Curricular Parameters" (Mortatti 2006) Constructivism says that the child builds his knowledge. This is a theory appliced in the process of learning of the writting emphasizes the following concepts: the appreciation of the child's prior knowledge; analysis of errors as constructive indicators; appreciation of the literacy environment; the teacher seen as like a mediator of knowledge; expansion of the concept of literacy; and children interacting with social practices. (Benjamim 2014) Despite the transition from the traditional method to a constructive philosophy, in the Brazil, there is still difficulty in literate the children. These difficulties are disclosed belatedly in numeric data collected by government agencies. The Brazilian Institute of Geography and Statistics (IBGE) (IBGE 2014) announced that, in Brazil, the number of people who not know read and write, with an age group over 10 years, is 16 million. According to Nogueira et al 2005, literacy is one of the most important important steps in the entire educational process, and solutions to help this process are welcome. In order to attend this important stage of the educational process, creative solutions can be proposed. According to (Teleco 2017) the amount of mobile devices used in the Brazil is of 242.2 million, resulting in a density of approximately 116 phones per 100 in habitants. With this excessive number of enabled device units, invest in this type of technology as a potential agent in the assist of the process of teaching can facility the learning, making it more diverse and flexible. Flexibility in teaching is a feature presented in mobile learning (m-learning). According (Kukulska-Hulme 2005) the m-learning enables the user to learn anywhere, anytime. (McGreal 2005) states that in the near future, Mlearning will become common for education, becoming a complementary modality to traditional teaching applied in society, gaining visibility and relevance, significantly affecting traditional learning. (Bacich et al. 2015) complements that the use of digital technologies offer different possibilities of learning, and can contribute to the student learning more and better. The learning in m-learning is supported by learning objects, which according to (Carneiro and Silvera 2014) are any electronic materials, such as simulations, that aid in the learning process, can be used and recombined with others learning objects. Based on this definition, softwares, graphic and sound resources, among others,used for educational purposes are considered learning objects. M-learning has demonstrated satisfactory results when applied to the teaching process. The author (Ndafenongo 2011) conducted a survey at a school in South Africa. In their research, the participating students had access, during class, to videos stored on their cell phones about the Pythagorean Theorem. These videos were used as a material to assist the trigonometry lessons. At the end of the research, the authors perceived an evolution in the learning of the participating students, evidencing that m-learning is effective when applied to teaching (Kallo and Mohan 2012) confirm these good results. When this authors applied an evaluation of the influence that a mobile application called MobileMath, whose focus was the teaching of elementary algebra contents, under the mathematical performance of students from the country of Trinidad and Tobago, after three months of use, adiquired good results. In fact, students who used the application after three months demonstrated an improvement in learning algebra The use of mobile technologies in the

learning process can influence the teaching process and improve it. Allying the benefits of mobile learning, supported by learning objects - specifically softwares, with technologies that monitor student performance and alert the teacher to student's difficulty is an interesting perspective. (Moran 2004) defends this point of view by emphasizing that teaching with new media will be a revolution if there are changes that allow the work together between teachers and students, otherwise only new technologies will be introduced, without essential changes in teaching. A way to allow the teacher to supervise as student interactions with learning objects, is the developed of a monitoring system, baseaded of a recommendation system. With this system, the teacher could monitoring through graphs, the performances of his students. In addition, the system notifies the tutor about the students that is presenting learning lags. A Recommendation System is a system that offers recommendations to the user based on their inclinations and, according to (Cazella 2012), help in increasing the capacity and efficiency of the indication process, already common in social relations among human beings. In the case the monitoring system, this solution indicates, to the teacher, students that are below a certain established average, saving him the time that would invest in an onerous analysis of the data stored in the graphs. Based on what has been exposed, this work intends to report the development of a learning object to be used in the m-learning paradigm, with the purpose of assisting in the early stages of child literacy, specifically in the alphabet teaching, of students of the kindergarten. It is a education material for assist the teaching, consisting of a mobile application, web service, database, and monitoring system developed to function as a recommendation system. This learning object aim at facilitating the assimilation of subsequent stages of the extensive process of acquisition of reading and writing skills, and its application in the social environment. In order to facilitate the understanding of the functioning of the learning object, as well as its theoretical reference, this article was divided into the following sections: Related work - there is the report of works related to the developed; Methodology - explanation of the nature of the research, applied teaching method, and operating philosophy of the monitoring system; OEL - detailed explanation of the functioning of each tool that composes the learning object; Conclusion and Future Work- relating the conclusion and future work.

2. Related Work

The process of virtualization of stages of literacy is something that has already been explored by researchers in the field of informatics in education. Through the cataloging of learning objects in conferences, events, and magazines, it is possible to find a range of softwares with the objective similar to that reported in this work, which is to facilitate the teaching of literacy. In spite of this, none of these tools offer solutions so that the teacher can follow the progress of his students, in a simpler way ... In a quick search, the following softwares were found: "alfabetizando", "abcAutista", and "digita". Alfabetizando, detailed in (Rodrigues 2014) is an educational software designed to assist the adult public in the learning of the literacy and in the acquisition of skills related to motor coordination during the handling of electronic equipment - such as mouse and keyboard. The user during the use of the software has access to several types of activities that are restricted to questions related to the composition and correspondence between graphic representation and writing of objects. The ABC Autista, detailed in (Farias et al 2015), is an educational application developed for mobile devices, basically formed by 4 levels of difficulties, each level consisting of 10

activities. Its goal is to teach the skills needed to teach literacy in children with autism and in your cognitive development. For this, this learning object discriminates its activities in levels, having as criterion the complexity and nature of the one natury othat pretends to be worked, being that the first two levels only aim to work with the cognitive capacity of the user and the rest generally requires the association between sound and element, letter sequencing, and word composition. In (An et al 2013), an educational game for the aid of literacy is shown. This game, presented by the name of Digita, uses problems in situations created, for the user to solve from the formation of the word of the object that solves the situation. For example, there is a situation where the cat is stuck in a tree, so the child should select the item that can help the cat to descend from the tree, after the selection, form the name of this object.

3. Methodology

The nature of this work is exploratory. Its elaboration is based on research on the flexibility in teaching brought about by the introduction of new technologies during the learning process. For the development of the parts of the learning object, specifically the application and the follow-up system, some aspects were sought through the literature review: in the case of the application - teaching methods that have already demonstrated effectiveness when applied in children , visual characteristics for the creation of a pleasant interface to the target audience; and in the followup system - mechanisms that would allow it to be able to participate during the process of supervision, and efficient ways of visually deposit the data so that the teacher could interpret them without difficulty. In order to explain the methodology applied in the application and in the monitoring system, this section has been subdivided into the following subsections: the application, and the monitoring system.

4. Application

The teaching method used in the application is the phonic, belonging to the set of synthetic methods. This method is approached by the author Isabel Cristina Alves da Silva Frade, phd in education by the federal university of Minas Gerais. This method makes the analogy of sounds with the letters of the alphabet, starting from the alphabetical principle to the domain of orthographic skills. (Frade 2017) The use of phonic methods in the literacy has been shown to be successful when applied to non-literate children. (Bradley and Bryant 1983) demonstrate the efficiency of using these methods in a field survey of 403 children. In this research, the authors compared the children's phonological level with their reading skills. The results of the research evidenced a strong correlation between these abilities. Subsequently, the same authors chose 65 children from the previous evaluation who presented very low levels of phonological knowledge. These children were divided into 4 groups and submitted to different interventions to try to improve reading and writing skills. At the end of these interventions, it was verified that the children belonging to group 1 and 2, who underwent grammatical and phoneme association phonologies and grouping of words by sound similarity, had a better reading performance than the children in group 1 and 2.

5. Methodology applied in the monitoring system

The monitoring system, as explained in the introduction section, was developed to act as a recommendation system. The logic applied in this system was to find students who had obtained a average of errors, in a certain activity, higher than the class. After finding these students, the system notifies the teacher the student's name, followed by the letter of the alphabet, presented in the activity, that the student presented greater difficulty to chose the correct alternative. These notifications are stored in a special system tab, available on your home screen - the first screen presented to the teacher after logging in to the system.

6. OEL

The user, when starting his interaction with the application, has access to an interactive alphabet, shown in figure 1. This is the main interface of the application, made up of interactive letters, that can be selected by the user. Each selection of the user in a letter plays an audio containing its sound representation. The sound response to the apprentice's touch allows him to associate phonology with the grapheme.

Figure1. Main Interface of the application

After the audio has finished playing, the application category screen starts. This screen is composed of interactive images of, respectively, food, animal, female name,male name, all with names starting with the selected letter. The adoption of this way of teaching the alphabet is defended by the phonics methodology, explained in the methodology section, and it is a way of teaching children the letters of the alphabet by means of analogies with objects. Despite the difficulty, it was sought to maintain a normalization regarding image choices, aiming to collect images of objects that were alredy included in the child's experience set. Figure 2 represents the category screen.

Figure 2. Screen of Category

After the interactions of the child with the alphabet and with the category screens, the apprentice can perform activities to validate what was taught. These activities were developed to be immersive, with a schematic of operation that allows the learner to evaluate their knowledge leisurely. The student first selects the enunciation of the question, initiating the audio with the instructions of the steps necessary to carry out the question. After the end of the enunciation, it drags an alternative to an orange box. If the dragged alternative is correct, he is congratulated and is transferred to another question; and if the alternative is the wrong answer, occurs the starts an audio warning to drag another alternative. In order to encourage users to continue using the application, the aplication contains a system of ranking available on their main screen to record the score of 20 students in the user's class, rewarding the first three with medals and giving them notoriety, with their placement in a special ranking guide . Figure 3 represents the ranking of the application. The application interface has been built to make the learning process immersive and attractive to the target audience. For this, colored and caricatured interfaces were developed, but with a minimalist design and focused on the content, characteristics perceived in figures 1 and 2. The use of letters with different colorations was done to facilitate the memorization of the alphabet.

7. Web service

The web service is a data transfer interface for applications that do not share compatibility. It is a mediation channel between two incompatible platforms, which has the function of transferring data from one platform to another. In the learning object the web service was used to carry data from user interactions with the letters and images to the external database. This data tells the database that the user has interacted with a certain element of the application, for example ,tells the database that the user has selected a certain letter of the alphabet. The database is designed to store user interaction data with the application. This data repository serves as consumption for the monitoring system. It is through this consumption that the graphs are assembled and, with their mining, the notifications to be made available in the system are created. According to (Fayyad et al), data mining is a technique that consists of data analysis and the application of

discovery algorithms that, under computational limitations, produce patterns of certain data.

8. Monitoring System

The monitoring system is a mirror of data provision and notification for teacher visualization. It is a system consisting of a home screen - intended to accommodate the notifications of students who are presenting an apparent learning gap, and a guide of graphics for consulting the individual and general performance of, respectively, individual student and all students, who teacher teaches.

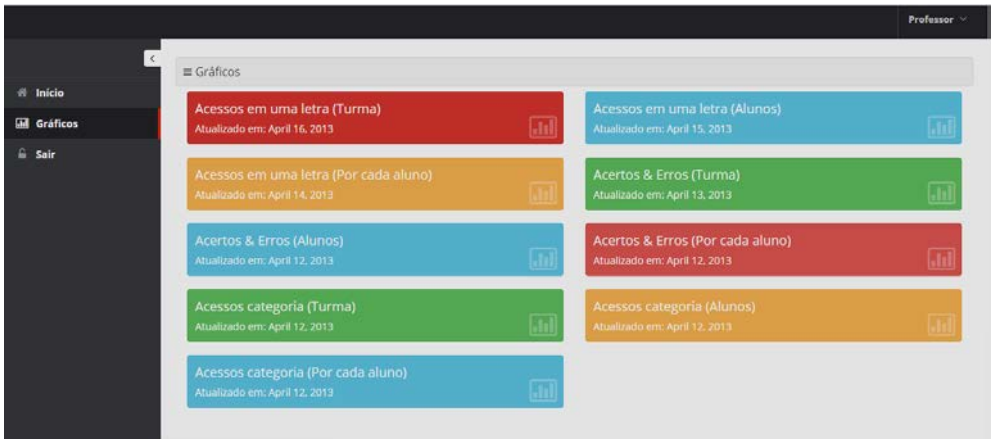

Figure 3. Interface of monitoring system

9. Conclusion and Future Work

This work presented the report of the development of a learning object, supported in the m-learning modality to facilitate the teaching of the initial phases of the literacy process. It is intended with this system to benefit students and teachers during the teaching. For the teacher was created, using the principles of the recommendation system and data mining techniques, the monitoring system that allows him to more easily follow and identify the possible learning deviations that may arise in his students during the use of the application, and for in the students, the mobile application was developed, so that they could have access to an immersive and pleasant education. As future work, it is intended to use this object of learning in schools, making them available to teachers and students. The purpose of this implementation is to verify the benefits that it can bring to the teaching process, and to make changes, if necessary, based on the needs of educators and apprentices, to refine the tool.

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Opportunities and Threats of Job Market for Graduates from The Administration Course at UNESPAR/Paranaguá/Brazil

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ABSTRACT

The administrator needs to be prepared to face the numerous challenges that the profession imposes. Practicing techniques and using tools, developing management strategies, knowing how to interact with individuals in the most diverse environments and hierarchical levels and being in constant improvement are some basic aspects of the profession exercise. To achieve those basic aspects, it is fundamental to have a good academic background, which also includes participating in research and extension projects that provide an approach to professional practice. If on one hand, regarding a public university in Brazil, the first challenges for academics are to conquer their vacancies and to graduate, on the other hand, entering job market could be an even greater challenge. This study has analyzed, through a field research, job

market niche for graduates from a Brazilian public university, from 2016 to 2019, evaluating some professionals' trajectories while entering job market, as well as opportunities and difficulties faced by them. Among the various aspects verified, it is worth mentioning the low offer of job vacancies and the low salary offered.

Keywords: Administration. Job Market. Opportunities. Threats.

INTRODUCTION

Managing organizations, be they public, private, or philanthropic is the role of the administrator, which is unquestionably important. An administration graduate will put into practice the knowledge acquired during his/her academic training to the detriment of the best administrative practices to maintain, to expand the business and to reach the organization's goals in which s/he works.

The minimum mandatory competencies for training the administrator, according to the Curricular Guidelines for the bachelor's degree in Administration (Resolution CNE / CES 4/2005), are:

> I - Recognize and define problems, consider solutions, think strategically, introduce changes during the production process, act preventively, transfer and generalize knowledge and exercise, in different degrees of complexity, the decision-making process;
> II - Develop expression and communication compatible with the professional exercise, including negotiation processes and interpersonal or intergroup communications;
> III – Reflect and act critically on the production sphere, understanding one's position and function in a productive structure under one's control and management;
> IV – Develop logical, critical and analytical reasoning to operate with mathematical values and formulations present in formal and casual relationship between productive, administrative and controling fenomena, as well as expressing oneself in a critical and creative way in different organizational and social contexts;
> V - Have initiative, creativity, determination, political and administrative will, learning will, openness to changes, and awareness of quality and ethical implications of their professional exercise;
> VI - Develop the ability to transfer life and daily experience knowledge to the work environment and one's field of action, in different organizational models, proving to be an adaptable professional;
> VII - Develop capacity to design, implement and consolidate projects in organizations;
> VIII - Develop capacity to perform management and administration consulting, administrative, managerial, organizational, strategic and operational opinions and expertise.
> (BRASIL, CNE/CES, 2005, p.2, own translation)

To achieve those minimum mandatory competencies listed above, when training undergraduate students, the Administration Course carries in its curriculum numerous areas beyond technical disciplines

such as psychology, philosophy, sociology, accounting, economics and law. However, what are those competencies?

The concept of professional competence can be understood as a set of knowledge, skills and attitudes that justify high performance, with the belief that the best performances are based on people's intelligence and personality (FLEURY and FLEURY, 2001). It is a set of cognitive resources to effectively solve various situations, supported by knowledge (PERRENOUD, 1999). In addition, it is a combination of knowledge, know-how, experiences, and behavior that is exercised in a precise context (ZARIFIAN, 2001). As far as it is concerned, the description of a professional competence represents an expected performance or behavior, indicating what the professional should be able to do (CARBONE, 2006).

Nevertheless, is acquiring competencies a condition to ensure the graduates from the Administration Course their effective entry into job market? What are the other challenges faced by them? This study aims to raise these and other questions.

THEORETICAL REFERENCE

During a time of complexities, changes and uncertainties, Administration has become one of the most important areas of human activity. We live in a civilization in which organizations predominate and in which the cooperative effort of the human is the fundamental basis of society. Moreover, the basic Administration task is to do things through people in an efficient and effective way (CHIAVENATO, 2014).

The administrator, in turn, is the dynamic and necessary element for any company, besides regarding a competitive economy it is mainly the quality and performance of administrators that determine the success of a company and its survival (DRUCKER, 2006).

To that purpose, the administrator plays several roles, which were identified by Henry Mintezberg, divided into three categories: interpersonal, informational, and decision-making. The first category relates to interpersonal roles that are the relationships with other people and are centered on human skills and how the administrator interacts with other people, employees, customers, suppliers, among others. Secondly, there are the informational roles that are the activities the administrator performs to maintain and develop an information network. Finally, there are decision-making roles that refer to situations in which choices must be made, thus requiring human and conceptual skills (CHIAVENATO, 2014).

The administration course aims to train professionals who have the skills and competencies to perform their roles efficiently and effectively. Consequently, higher education institutions in general seek to promote learning through the best administrative techniques preparing academics for the job market. Regarding the skills to be developed, there are some worthy to be highlighted, such as technical, human, and conceptual skills.

Primarily, technical skill is the ability to use knowledge, methods, techniques, and equipment necessary to perform specific tasks based on education and professional experience. Next in order, human skill consists of the ability and discernment to work with people, enabling communication, understanding of attitudes, and motivations. Finally, conceptual skill translates into the ability to deal with abstract ideas and concepts, allowing the development of abstractions, philosophies, and general principles of action, providing global ideas, concepts, values, and principles (CHIAVENATO, 2014).

Regarding the graduates' Administration course general objective, it consists of:

> Graduating people bachelors in Administration, committed to current political and economic issues and capable of developing a set of skills and competencies that accredit them to intervene in organizational processes, especially to perform their functions in institutions where their actions are pertinent, proactively and within ethical principles, aiming to ensure levels of strategic competitiveness. (PPC, 2020).

As to specific objectives:

> - Recognize and define problems, equate solutions and think strategically;
> - Exercise in different degrees of complexity the decision making process;
> - Develop logical, critical and analytical reasoning to operate with mathematical values and formulations present in the relationship between productive, administrative, and controling fenomena;
> - Develop expression and communication compatible with the professional exercise;
> - Develop organizational models;
> - Stimulate the knowledge about the foreign trade system, regarding exports and imports, customs and fiscal regimes of each country;
> - Analyze and interpret economic, technological, political, and social scenarios of the country and abroad. (PPC, 2020).

Regarding the pedagogical proposal, it is stated that:

> The institution's teaching policy is based on a dynamic process of knowledge socialization, prioritizing the articulation between theory and practice through proposed actions, both at the curricular level and in complementary activities, as well as through the involvement of teachers and the integration of various areas of knowledge. Teaching is inseparable from research, which generates knowledge and produces extension actions, guided by a clear vision of the graduate profile defined according to the University's Mission [...] Interdisciplinarity is understood as the result of dialogues among different fields of knowledge that make up the PPCs, and were used as a fundamental orientation for the pedagogical action of the course. (PPC, 2020).

By analyzing the course's PPC in its entirety and in more detail, it is possible to verify its commitment to teaching, research, and extension. And this is done through, among other factors, the commitment of the institution, the students, and the teachers, most of whom are exclusively dedicated to the course. However, despite all those positive aspects, there is the "job market" factor that may or may not absorb the graduates.

Administration courses graduates need to adapt to the new demands of the job market, to be constantly updated and aware of the importance they should give to network of relationships, those are some of the maxims widely discussed, even in the academic environment.

After all, have the low economic activity, the large supply of qualified labor, and the recessive period

that has been dragging on since 2014, made it difficult for administration graduates to enter the job market? In addition, there is data from the 2017 Higher Education Census to be taken in account, that is, the Administration course is the third largest course in number of enrollments (682,555) behind Law (879,234) and Pedagogy (714,345).

Therefore, analyzing the regional aspects of job offer, concomitantly with the macroeconomic movement, can contribute to a better understanding of the opportunities and threats of the labor market for new Administrators.

MATERIALS AND METHODS

This study aimed to raise the Administration course graduates' perception from 2016 to 2019, from the State University of Paraná – Unespar/Campus Paranaguá – regarding the following aspects: current occupation and acting field, difficulties of insertion in the job market, and career.

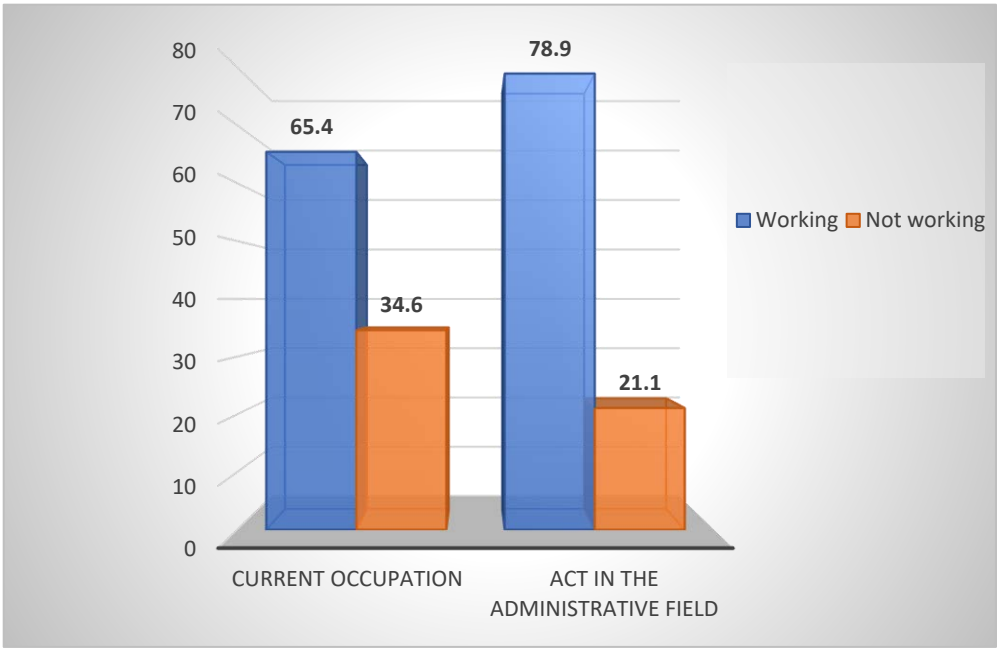
This study was characterized as quali-quantitative, as to the objectives it was descriptive and as to the means it was configured as field, bibliographical, and documental research. The fact that the collected data was from a specific course and campus of the university, it was also characterized as a case study. During the field survey the primary data was collected from 54 (fifty-four) graduates through a questionnaire with open and closed questions via Google Forms platform. The data analysis took place in a statistical way.

RESULTS AND DISCUSSION

Two types of questionnaires were used to deepen the analysis: a questionnaire for graduates who were outside the labor market when they graduated (26 respondents); and another for graduates who were already working in the labor market when they graduated (28 respondents).

PROFESSIONALS WHO WERE OUT OF THE JOB MARKET WHEN THEY GRADUATED

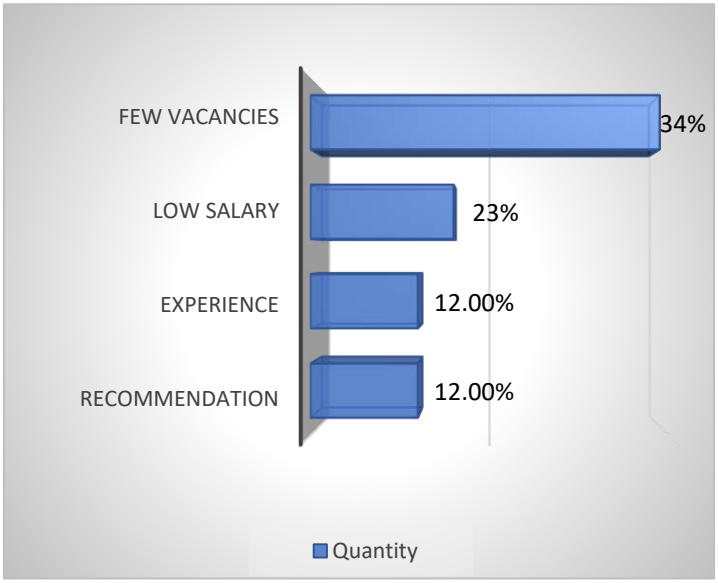
As it can be seen in graph 01, only 65.4% claimed to already be working, that is, a considerable portion (34.6%) is still outside the labor market.



Graph 1: Graduates' current occupation and acting field.

According to a survey conducted in the last quarter of 2019 by the consultancy IDados (2019), based on the National Continuous Household Sample Survey (PNADC), Brazil has 18.3 million people who finished college for 14.5 million openings with higher education course requirements. In other words, an enormous disproportionality between number of graduates and number of job openings available in the market. However, a positive point in the survey of those who said they were already working, according to graph 01, is that 78.9% are working in their field of expertise.

Regarding difficulties of insertion in the job market, as it can be observed in graph 02, four aspects were pointed out by 34.60% of the graduates who claimed not to be acting in the job market today: few vacancies (34%); low salary (23%); experience (12%) and recommendation (12%).



Graph 2: Difficulties in entering the job market.

The State University of Paraná Administration Course is in the city of Paranaguá, in the state of Paraná. It is important to highlight that besides this public university, there is also a private college in the city that offers Administration courses, as well as EAD offers. That is, the offer of professionals in Administration surpasses the demand in absolute terms. This situation ends up reducing salaries, makes the companies demand more experience from the candidates and, most of the times, opt for recommendation. *"I had some difficulties due to the local job market being small in my field"* (interviewed 25). *"With 130 competitors for 1 vacancy, no doubt there were difficulties to realize the pitch in a convincing and assertive way"* (interviewed 14). *"In a moment of recession, economic, political, and social crisis, the vacancies decrease, and the competition increases more and more"* (interviewed 13). *"Companies demand years of experience making it difficult to compete with professionals who already have it"* (interviewed 18).

It has become clear in some graduates talk that the higher education diploma does not ensure a job vacancy and that in many cases the training is in the background at the expense of lower wages for less qualified candidates. *"It's difficult, companies pay very low wages, currently they prefer to pay less for someone who has no training and can play a similar role"* (interviewed, 07). *"Companies require you to do a high workload for a very low salary offer"* (interviewed, 02).

Another difficulty reported by the graduates to get a vacancy relates to recommendations. *"The companies are local and usually hire people from the close personal circle"* (interviewed 10). It is important to highlight cases in which the vacancy was only filled due to recommendation. *"I only got it because I was recommended"* (interviewee 04).

Recommendation is widely accepted in companies. From the company's perspective, if the nominated person meets or exceeds the organization expectations, there are almost no disadvantages, however, in the case of an unsuccessful nomination, disadvantages fall largely on the person who recommended. In any case, it is notorious that recommendations diminish chances of entering the job market through recruitment and selection. In contrast to the adversities faced by the graduates during their process of entering the job market, the internship in some cases was cited as a great opportunity to attract vacancies. *"The doors only opened because before getting this fixed job, I managed to be part of an internship before"* (interviewed 26).

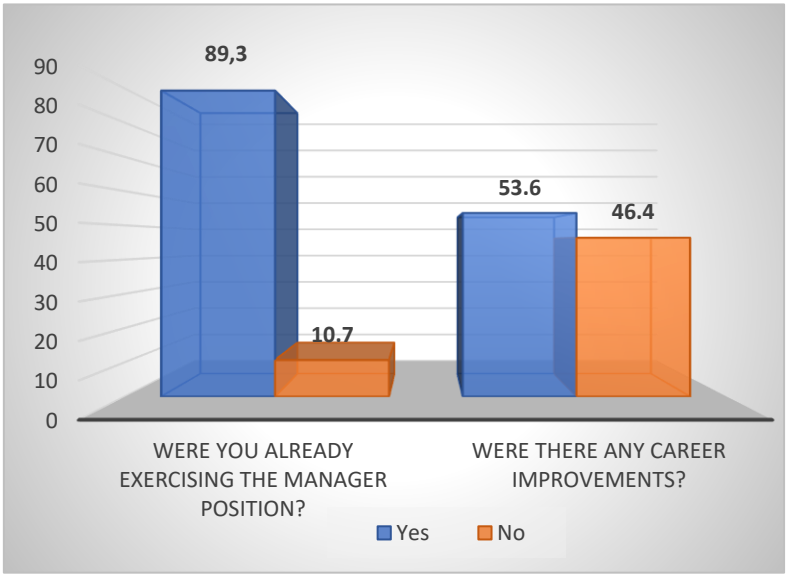
Internship can be considered as a fundamental instrument in the process of professional formation, helping students to understand the work environment and provide a possible effectiviness. In this sense, it has also been a strategic tool for companies that believe it is possible to find professional profiles among university contingent that meet business expectations (MURARI; HELAL, 2010). *"To enter, as an apprentice, there were not so many difficulties"* (interviewed 03). *"I had the opportunity through an internship"* (interviewee 54). *"I had no difficulties in getting an internship, nor in being admitted"* (interviewed 16).

Therefore, the internship continues to be an excellent means for students of Administration to increase their chances of insertion in the job market.

PROFESSIONALS WHO WERE ALREADY IN THE JOB MARKET WHEN THEY GRADUATED

As it can be seen in graph 03, from the graduates who were already inserted in the job market when

they graduated, 89.3% were already in management or supervision positions. From these, a little more than half (53.6%) declared a career improvement after the end of the course.



Graph 3: Fields in which graduates were already working.

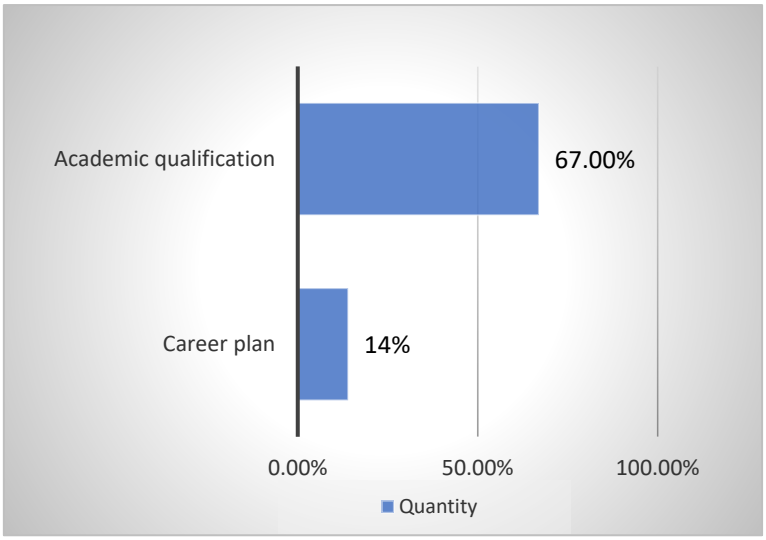
The fact that almost half of the respondents declared that they had not had any improvement in their careers, presumes some hypotheses:

- Companies do not have a career plan;
- The ascension obeys to other aspects besides training, such as time in each position;
- Within the occupied position there are no more possibilities of ascension;
- Recommendation.

Regardless of the reasons for not improving their careers, the fact is that if such a situation persists the tendency is the development of a feeling of frustration regarding work activities. This issue will be presented in graph 05.

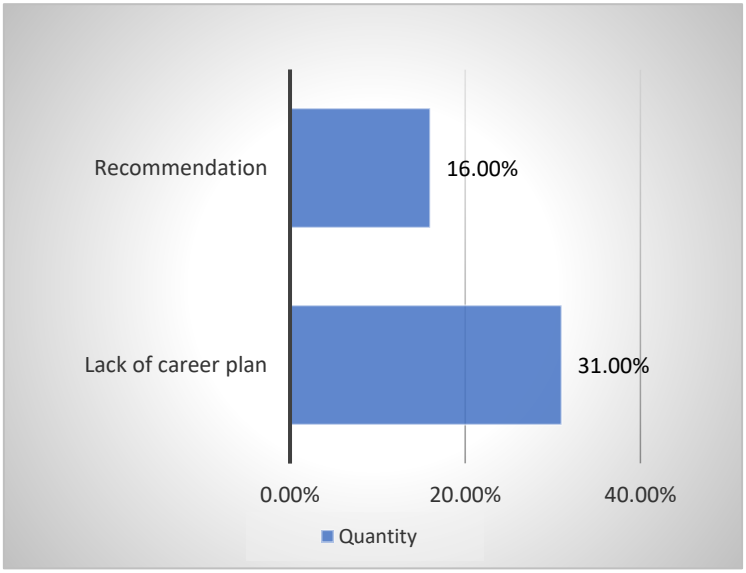
As it can be observed in graph 04, the main reason that led the graduates to have a career improvement was the academic background (67%). *"Surely the academic background made me more professionally prepared"* (interviewed 32). *"I had an improvement in my career by the knowledge obtained during the course and concluding it"* (interviewed 44). *"Academic training made me more prepared professionally"* (interviewed 44) (interviewed 28). *"I rose in my career due to my personal performance together with professional qualification"* (interviewee 28) (interviewed 53).

Besides academic training, the existence of a career plan in the company was fundamental on the career improvement, according to 14% of the interviewed, as showed in graph 04.



Graph 4: Reasons for career improvement.

According to graph 05, there were two reasons pointed out by the interviewees for their careers' stagnation: recommendation (16%) and lack of a career plan in the company (31%).



Graph 5: Reasons that did not lead to career improvement.

As previously mentioned, recommendation is widely accepted in companies with its advantages and disadvantages. *"Superior positions are filled much more by recommendation than by merit or schooling degree"* (interviewed 30). Recommendation can help the company to recruit and add good professionals, however, any carelessness on the part of the people management can make qualified employees progression process to management or supervisory positions unfeasible. *"Most of the management or supervision vacancies are already destined to recommended people by the company's own management"* (interviewed 41).

If on the one hand recommendation can be considered by some as a factor that hinders professional ascension, on the other hand the absence of a structured career plan within the companies harms the employees. *"If there is no career plan or if the company does not offer opportunities for professional growth,*

academic training is practically null, this happened to me, I graduated and nothing changed in my career" (interviewed 29). *"Many companies do not work with career plans, which unfortunately may make it impossible for graduates to reach a leadership or supervisory position"* (interviewee 50).

The Position and Salary Plan (PSP) is an extremely important element that seeks balance of the organization's salaries and at the same time the employees' satisfaction. However, its implantation must be done with management participation, observing that they are responsible for the collaborators' motivation and productivity (PONTES, 2000). Therefore, the Position and Salary Plan is a basic instrument for effective career management in an organization, consisting of some steps: role analysis, position and salary description, position evaluation, salary research, compensation policy and salary structure construction (MARRAS, 2009).

In this sense, a well-structured career plan enables employees' growth, values qualification, commitment, as well as results obtained, and above all contributes to the organization development.

CONCLUSION

This study has evaluated the trajectory of the graduates from a public university Administration course when they enter the job market, by considering opportunities and threats faced by them.

Through the survey, it was possible to verify that although the professional qualification is a fundamental condition, it does not in itself guarantee an entrance to the job market. Among other reasons, we can list economic crisis, unemployment, higher labor force than the offer of vacancies, and recommendations.

Regarding unemployment, it is important to note that according to the IBGE (2020), the first quarter of 2020 closed with 12.9 million people unemployed in Brazil and an unemployment rate of 11.9%. Thus, the problem ends up pushing wages down, which is even one of the concerns noted in the survey with interviewees.

Despite the fact the graduates have known that entering the job market, in some cases, takes some time, and the opportunities for Administrators are innumerable; the economic scenario that now presents itself has threatened a good portion of new professionals who have found more difficulties than opportunities when trying to enter the job market.

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Development of Virtual Textile Chemistry Laboratory in Learning Making Cellulose-Based Regeneration Fibers Based on Learning Paradigms in the Industrial Revolution 4.0 Era

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Abstract

This study aims to design and create a virtual chemical textile laboratory model as an effort to improve students' understanding of learning Textile Chemistry, especially on the subject of making cellulose-based regenerative textile fibers that have a high level of abstraction and complexity. Theoretical learning in the form of verbal symbols, empirically is not representative enough to explain the concept of the system that is needed, so that the possibility is not affordable (likely to inaccessible) by students which effected to the lessen of learning experiences. These conditions have implications for the lack of student understanding of these processes which is indicated by the acquisition of low learning outcomes. The specific target of this research is to produce a virtual laboratory device as a simulation medium for learning textile chemistry on the subject of making effective cellulose-based regenerative fibers. Furthermore, the model developed is validated to get input from experts related to the technology used, design and process content in the developed model. The validation results show that this model is suitable for use in the study of textile chemistry and can be used to improve students' understanding of the material for making cellulose-based regenerative textile fibers. In the limited trials that have been carried out, there are some features, image choices, and some simulations that need to be refined to avoid students' misinterpretations of the planned chemical process concept. Students involved in the trials are more motivated to continue learning related concepts that have been learned. In subsequent studies this model will be tested on a broader scale to measure its effect on the mastery of concepts and its ability to improve learning outcomes in textile chemistry courses, on the material for making cellulose-based regenerative fibers.

Keywords: Virtual Laboratory of Textile Chemistry, Learning to Make Cellulose-Based Regeneration Fiber, Industrial Revolution Era 4.0

INTRODUCTION

One problem that is often faced by students in studying Chemistry is because Chemistry has a high degree of difficulty due to the abstract and incremantal characteristics of chemistry. Likewise the study of Textile Chemistry, where in general, students are difficult to digest and master the chemical process and the process of forming fibers that are abstract and complicated. Based on previous research results, the data

found that the highest level of difficulty faced by students is in studying material related to chemical processes and the mechanism of cellulose-based regenerative fiber formation which has a high level of abstraction and complexity. Theoretical learning in the form of verbal symbols empirically is not representative enough to explain the concept of the system that is needed, so that the possibility is not affordable (likely to *inaccessible*) by students which effected students' learning experiences. These conditions have implications for the lack of student understanding of these processes which is indicated by the acquisition of low learning outcomes.

Fiber is known for thousands of years BC as in 2,640 BC China has produced silk fiber and 1,540 BC has established the cotton industry in India. One fiber that has a lot of demand is cotton fiber, because of its excellent quality and very comfortable when it is used. The high demand causes the limited availability of cotton fiber, as well as the limited land that can be planted with cotton trees, so we need a replacement fiber that can be produced with a higher level of productivity than cotton fiber, which is regenerative fiber. Regenerative fibers are artificial fibers formed from polymers that come from nature, which are made by polymerizing chemical compounds to form fibers that are sprayed through a *spinneret.*

The first commercially regenerated synthetic fiber was rayon fiber, which was made from cellulose modified from wood pulp, later known as viscose rayon. In subsequent developments, this fiber becomes the most produced regenerative fiber because of its characteristics that are being able to match the quality of cotton fibers. Cellulose-based regenerative fibers were developed into several types, namely viscose rayon, acetate rayon, cuproamonium rayon and hi tenacity rayon (high strength rayon) [13].

The mechanism of regenerative fiber formation from cellulose material to rayon fiber involves a long and quite complicated process, as the following picture shows:

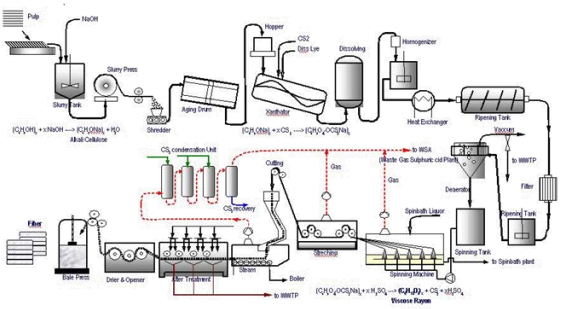

Figure 1. Mechanism of the Rayon Fiber Manufacturing Process
Source: http://texfiber.blogspot.com/p/viscose. html

Based on the facts above, students can master the Chemistry Textile learning, especially in the discussion of cellulose-based regenerative fibers that are considered difficult, efforts should be made to improve their learning activities. This condition is the background of the emergence of new innovations in chemistry learning, one of which is through the development of innovative learning media, by utilizing computer technology, both in the learning process and laboratory activities.

Development of media that can support the effectiveness of the learning process is very urgent to do, not just to improve learning outcomes in the classroom, further there are projections to prepare students to

enter and compete in the era of the Industrial Revolution 4.0 based on the ability to explore the digital fields, virtual intelligent and automation. This is in line with the characteristics of the Industrial Revolution 4.0 described by Roblek et al. [12], that the fourth Industrial Revolution Period was marked by full use of the automation and digitalization processes, and the use of information technology and electronics (IT) in manufacturing and services. Other identifications about the characteristics of the Industrial Revolution 4.0 are described by the website of *Sumber Daya Iptek & Dikti,* [14] as an era that emphasizes the patterns of digital economic, artificial intelligence, big data, robotic, etc. or known as the phenomenon of disruptive innovation. While Thai and Anh [15] revealed that the 4.0 Industrial Revolution had made it possible in the development of computers, hardware, software and global networks, as well as creating a premise. This shows that we know the emergence of a comprehensive industrial revolution has changed all aspects of global socio-economic life. This condition is a challenge for LPTK which has a mission in producing qualified educational staff who are ready to compete. This is an urgent mission to do. Biot [2] provides an overview of the mission that universities must carry in entering the Industrial Revolution 4.0 era, namely that the university need to produce and disseminate the latest knowledge for the interests of students, industry and society. This means that the university carries the mandate to produce and disseminate the latest knowledge as a necessity of students, industry and society. Furthermore, Liao et al [9] signaled all University Colleges in the world to take part and contribute to this new challenge (Industrial Revolution 4.0 era), through laboratory experiments or application-oriented industries (for example Digital software development). Therefore, in facing these challenges, teaching in higher education is also required to change, in order to produce quality future generations. Biot [2] identified the qualifications of graduates demanded in the Industrial Revolution 4.0 era, is that they (graduates) have intelligence in solving complex issues involving multiple sciences, and respecting the public interest. This condition is certainly not easy to realize, and requires support from educational resources oriented to the goals achievements. The development of educational resources in the era of digital technology needs to be managed as close as possible together with the anticipation of changes in disruptive innovation that will affect the relevancy between the higher education output and development needs in the industrial era 4.0. In line with this, Xing and Warmala [16] suggested that the Industrial Revolution 4.0 was marked by the convergence of humans and machines, this would reduce the distance between subjects humanities and social sciences or science and technology. This will certainly require more interdisciplinary teaching, research and innovation.

One logical consequence that can be taken in realizing this Industrial Revolution 4.0 oriented teaching is by developing innovative learning tools. This is similar with Biot [2] who argues that in conducting education for our students, involves special efforts in developing new pedagogical tools which aimed to encourage multidisciplinary approaches. Further, educators in this information age should have sequential, sensing, and visual teaching styles. Educators should encourage the students to be an active learners, easy to learn by observing and drawing generalizations in the form of conclusions about what is being learned. Thus, a lecturing method, one-way communication and teacher centered approach will not suit the students. [5] as for this reason Multimedia learning in the form of virtual chemistry textile laboratories on learning to make cellulose-based regenerative fibers was developed.

Gunawan et al. [6] argue that a computer simulation that allows important functions of laboratory experiments to be carried out on a computer is called a virtual laboratory. In practice, virtual laboratories

are not defined as leaning units but rather learning space, for virtual experiments. This is important to remind the lecturers that they need to explain the learning objectives to their students. The aim is to enable students to develop skills in problem solving learning and to control themselves according to their professional needs in the future. Virtual laboratories must provide sufficient freedom for individual experiments or experiments outside the limits set by the curriculum.

Virtual laboratories are defined in various literatures in various ways, for example Noor and Wasfy define virtual laboratories as "leverage modeling, simulation, and information technologies to create an immersive, highly interactive virtual environment tailored to the needs of researchers and learners". While Blázquez et al. [3] suggested that a Virtual Laboratory (VLab) is an interactive virtual space that incorporates all the technological, pedagogic and human resources for carrying out practical activities, is adapted to the needs of students and teachers in a virtual learning environment.

METHODOLOGY

The method developed in this study is the Educational Research and Development in the form of developing a Virtual Laboratory of Textile Chemistry at learning making Textile Fibers Cellulose-Based Regenerative. The research was carried out in two stages, starting with a preliminary study to find a form of product needed, then developing it through several stages of assessment (expert validation /*expert judgment* and limited trials), then it was revised until a final product design was deemed ideal.

This research is carried out in two main stages of research, namely:

1. The first stage aims to design and create a *Virtual Laboratory* of Textile Chemistry as a simulation media to learn cellulose-based regenerative textile fibers. The steps taken in this study refer to the research and development approach as the following below:

a. Gathering various information (preliminary studies) relating to the learning model in the Textile Chemistry course, specifically on the subject of Cellulose-Based Regenerative Fiber.
b. Conduct an analysis of the learning model that has been identified at the time of the previous study, which is related to: teaching approaches, teaching methods, instructional media and evaluation systems that are applied
c. Making the planning of Textile Chemistry course learning programs by focusing on optimizing the use of virtual laboratories in learning process
d. Designing learning software that will be developed on the virtual laboratory of textile chemistry device, which includes: a. Making flow-charts, b. Making the Storyboard, and c. Making Manuscript
e. Developing devices of virtual laboratory in the study of Textile Chemistry, which includes activities:

1) Arranging components of Textile Chemistry subject matter in a systematic and structured manner,
2) Processing key elements of design device in the virtual laboratory form of typography, symbolism, illustration and animation in one visual composition interesting and informative.
3) Developing learning tools of virtual laboratory by applying animation components in the form of audio effects, visual effects and the illusion of motion.
4) Editing and rendering the developed Virtual laboratory of Chemical Textile.

5) Developing the initial form of the product using the appropriate application program, for example: Macromedia Flash, Lectora Inspire, Ulead GIF Animator5, Corner-A ArtStudio and etc.

2. The second stage aims to test the result quality of Virtual Laboratory. The activities undertaken are:

a. Validating (*expert judgment*) products from media experts and material experts.
b. Revised the first stage of the results of the validation of the media experts and material experts.
c. Conduct one-on-one trials for prospective students of interactive learning multimedia user.
d. Conduct final revision of software products in the form of virtual laboratories.
e. Produced the product of Virtual Laboratory of textile chemistry that have been validated and are ready to be tested / implemented in learning Textile Chemistry in the subject of Regenerative Textile Fiber Cellulose based, and will be tested for reliability in improving learning outcomes in second year research.

Based on the foregoing, the stages of this study are described in the form of a chart as follows:

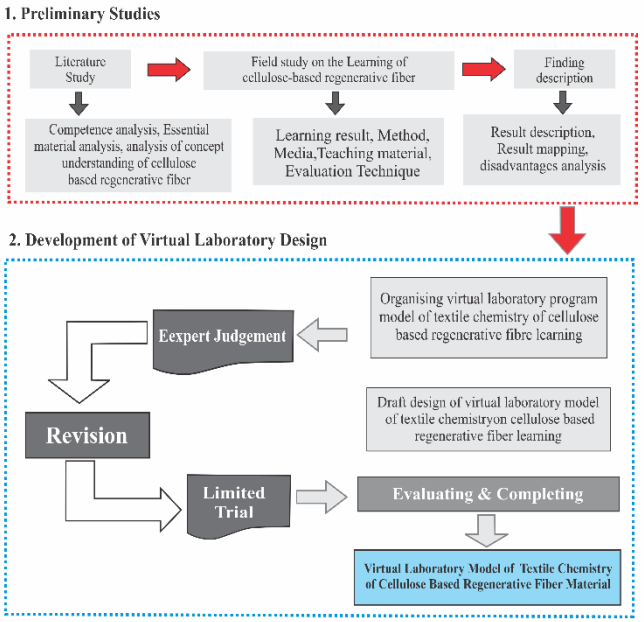

Figure 2. Development Research Stage Using Modification of R&D Research

RESULTS AND DISCUSSION

From the research and development that has been conducted, the results found in each stage in accordance with the research and development procedures described as following:

A. Analysis Phase

1. General Analysis

There are things that must be considered in developing multimedia, especially animation-based interactive multimedia which are: easy navigation, Cognition content, Media integration, Aesthetics, and overall function

Related to the criteria of a multimedia, a field survey was also carried out to the students to analyze the multimedia needs that will be developed in terms of users. Based on the field survey, the following results were found: Multimedia must be interactive, the material in multimedia learning uses language that

is easily understood by students, and provides illustrations or images that are commonly seen in daily life, development of navigation in multimedia is expected provide a simple links which make it easier for students to see the material they want and are responsive to commands of the students, multimedia packaging is made by emphasizing the interactive aspect, not boring, using language that is easily understood, and provides intelligent solutions in solving a problem contained in the material, multimedia display is expected to be displayed in a form that is much in demand and favored by students, and it related to the desired experience of the students, multimedia is expected to provide an easier learning experience in understanding the materials.

2. The Software

In the process of developing this textile chemical virtual laboratory media, it requires the support of several softwares, including:

Adobe Flash CS6, as the main software for developing multimedia, **Adobe Photoshop,** is used to do editing and images manipulation that will be used in the textile chemistry virtual laboratory media, **MDM Zinc** is additional software to make adjustments on products made from Adobe Flash. With this software, it is possible for the product from Flash to be packaged into an executable installer to install the product on the computer.

3. The Hardware

Beside of software developers, minimum hardware is also needed to develop multimedia interactive learning. The minimum hardwares needed in this development are as follows: Processor: 2.0 GHz or faster processor tech-nology, Memory: 1 GB, Monitor: 1280 x 720 x 32-bit, Graphics Card: 128 Mb/32 Mb 5, and Hard Drive: 20 Gb

B. Design Phase

This stage is a process of making a multimedia interactive learning design by referring to the results of the needs analysis from the previous analysis stage. Based on the analysis that has been developed, we get a concept of "simple desktop". In this concept, the media is designed with a simple, easy to use, and attractive appearance, with simple animations. With an overview of such concepts and to simplify process of developing a virtual laboratory of textile chemistry media, then a user interface design is made at this stage.

C. Development Phase

After the design or planning stage is completed, the next stage is multimedia development. In the develop-ment of multimedia, it is divided into several small stages, namely the stage of making interfaces, coding, movie test, publishing and finally packaging. Each stage is described as follows:

1. Development of User Interfaces

Some examples of interfaces from multimedia learning that have been developed are as follows:

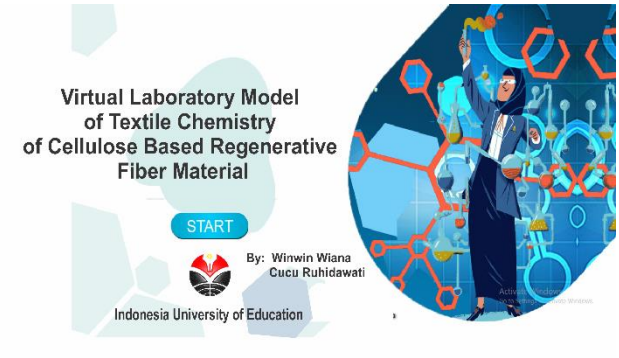

Figure 3. Home of Textile Chemistry Virtual Laboratory

Figure 4. Home Opener Vitur of Textile Chemistry Virtual Laboratory

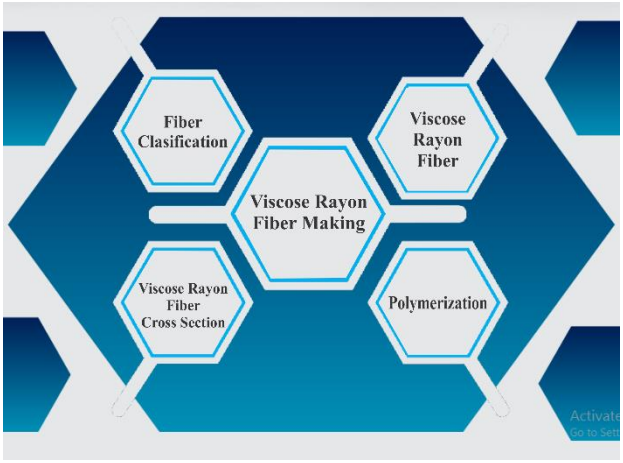

Figure 5. Main Menu of Textile Chemistry Virtual Laboratory

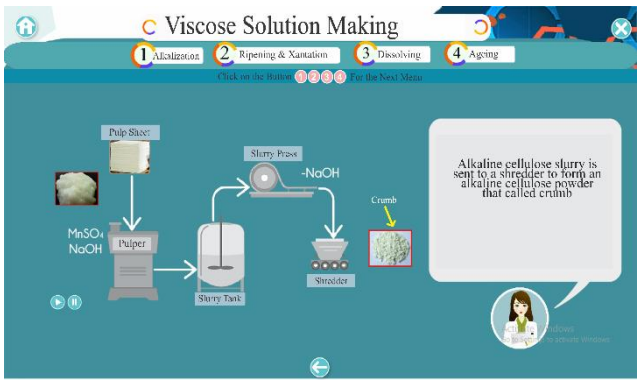

Figure 6. One feature of Textile Chemistry Virtual Laboratory (in the Content of Creation viscose solution on alkali-zation process)

2. Encoding

Objects in the form of buttons or Movie Clip that have been previously made on the interface display cannot perform any function. Therefore, at this stage the code is given to these objects so that the objects function as we wish. Code in Adobe Flash is called ActionScript and this multimedia development used Action Script *3.0.* By giving an ActionScript to the interface that has been made before, it is possible to create interactive and dynamic multimedia, for example giving ActionScript to the button to give the function of switching to another view and ActionScript to create simple animations.

3. *Movie Test*

After the process of *ActionScript* is completed, then the next step is Movie Test on Adobe Flash which will produce a *SWF* file, which is a SWF file extension. The purpose of this movie test is to see whether the objects in multimedia that have been given ActionScript can perform its functions as expected. If there are functions that are not yet suitable, then improvements are made to both the interface and the *ActionScript* of the objects concerned. This stage is done repeatedly until the appropriate function is obtained.

4. *Publishing*

In the previous stage the *SWF* files have been generated. To run this *SWF* file, you need a Flash Player that must be installed on the computer that will run it. Due to the possibility that the computer that will run textile chemistry virtual laboratory media does not yet have a Flash Player which means that this multimedia will not be able to run, then an alternative is needed so that all computers can run it without having to install the Flash Player first. Another alternative to overcome this problem is to package the SWF files into an installer that can be executed directly without having to install Flash Player first.

5. Packaging

This stage is the stage of virtual media packaging textile chemistry laboratory that has been created. At this stage, the SWF files and other related files are packaged into an installer to make it easy to install multimedia on another computer. Packaging or packaging of this multimedia into the installer uses the MDM Zinc program which has a build installer facility. The packaging process continues with the process of writing the installer file onto a CD, this is intended to facilitate the installation process of a textile chemistry virtual laboratory media on another computer.

D. Validation Stage

1. Validation by Media Experts

Validation of the textile chemistry virtual laboratory media is carried out by lecturers whose field of study is related to multimedia. The aspects seen in this validation are the existence of the Navigation Key, Multimedia Display and the easy use of multimedia. The results of multimedia validation by media experts can be seen in the following table:

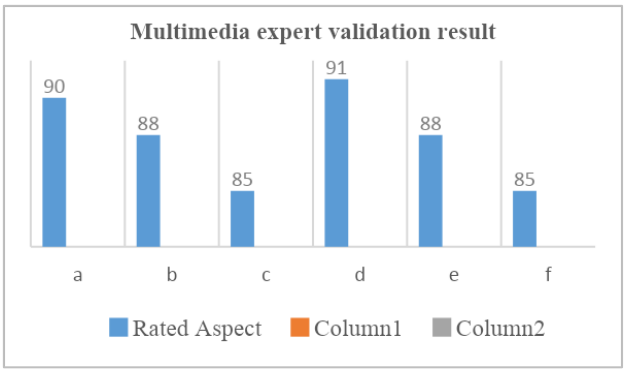

Figure 6. Multimedia Expert Validation Result Diagram

Description:

A: Navigation Keys in Multimedia are easy to operate

B: The illustrations presented make it easy to understand the material

C: Attractive display of learning multimedia

D: Learning media is easy to understand

E: Easy use of multimedia

F: Multimedia interactivity

From the diagram, it can be seen that multimedia validation by multimedia experts obtained an average percentage of eligibility of 87.83% which can be categorized as Very Eligible, because the value obtained is in the range of 81-100%

Virtual laboratory is a visual-based media that functions as a tool in the learning process and is expected to influence and make a better learning environment. Empirically, based on various researches that have been carried out in various parts of the world prove that the use of the learning media in the teaching and learning process is able to arouse the desire and learning interest, increase motivation in learning activities, and even it is able to bring good psychological influence to students, as supported by Levie & Lentz [8], who argue that learning media, especially visual media, are able to attract students' interest and attention to concentrate on the material being discussed. The existence of this interest provides a great possibility in the achievement of learning objectives

2. Validation by Material Experts

Validation of Animation-based Interactive Multi-media material is carried out by lecturers whose field of study is Design Technology. The aspects seen in this validation are general aspects, learning aspects, and material substance aspects. Validation results can be seen in the following table:

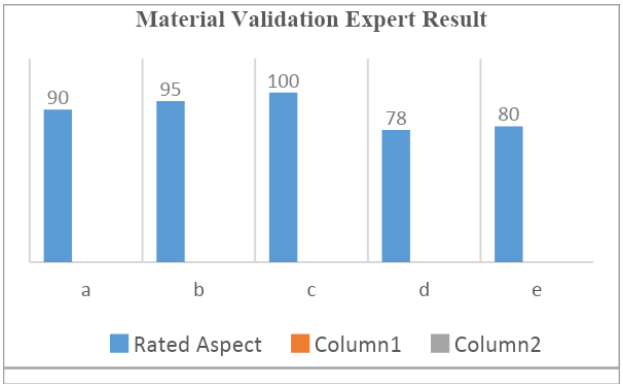

Figure 7. Diagram of Material Expert Validation Results

Description:

A: The suitability of the material with the Core Competencies and learning indicators to be achieved

B: Suitability of the concepts presented

C: The material is presented systematically according to stages of the process of making regenerative fibers

D: The format of presentation of the material is interesting, so that it can motivate students to learn

E: The illustrations used are clear, relevant and support the concepts taught

Graph above shows the results of validation of the virtual laboratory media by material experts, which are obtained on average the percentage of eligibility of 88.60% which can be categorized Very Good, because it is in the range of 81-100%.

The feasibility aspect of the material in the virtual laboratory media generally contains the feasibility of the media developed in terms of the material and the truth of the concepts presented. One of the things that need to be considered in this aspect is the relationship between basic competencies and learning indicators with the material presented. Arsyad [2] revealed that a learning media must have a clear focus on learning objectives. Learning objectives include abilities that are expected to be mastered by students after the learning process is done. In addition to being able to accommodate the learning indicators that will be achieved, the material presented must also contain accurate data, so that it can broaden students' insights and not cause misconceptions.

The illustrations presented in the virtual laboratory-based learning media are designed as closely as possible to the reality, so that they can support the concepts that are presented correctly. Verbal stimulation provides better learning outcomes as for the activities of remembering, recognizing, linking facts and concepts. Further, verbal stimulation provides better learning outcomes as for the learning that involves sequential memories. This statement is supported by Paivio's dual code theory [10] which explains that the human cognitive system consists of two subsystems including visual and verbal systems. An information that is presented visually and verbally will be better remembered then presented in only one way.

Related to the ability of virtual laboratory media in supporting the learning process, Leow & Neo [7] states that besides deepening student understanding, elements in media such as video and animation help students get more detailed information so that the capacity to be stored in brain memory is also increased. In another review, Bruner [4] said that learning occurs more determined by the way a person organizes messages or information, the learning process will occur through enactive, iconic, and symbolic stages. The implication of cognitive theory in virtual laboratory is that it can presents learning material in the form of images or icons, as well as with texts with a varied display so that students' understanding of a concept is more profound that can be stored in memory for a relatively long time [4].

3. Validation by Prospective Users

Validation by prospective users is carried out in the form of device trials, to determine user ratings of the use level of virtual laboratory of Textile Chemistry media, before the products produced are implemented in the field. And the following data are obtained:

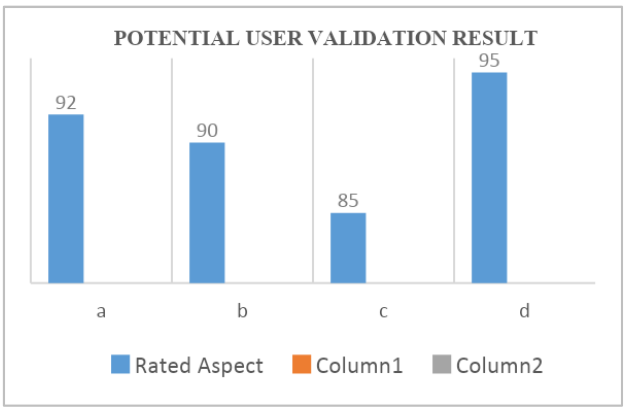

Figure 8. Diagram of Prospective User Validation Results

Description:

A: Easy to operate the navigation button
B: Media Display of virtual textile chemistry laboratory
C: Easy use of virtual textile chemistry laboratory
D: Media interactivity of virtual textile chemistry laboratory

Results of media validation the virtual textile chemistry laboratory by prospective users shown in the table above describes the average percentage of media usage by users, which is 90.50% which is categorized as Very High, because it is in the range of 81-100%. This means that interactive multimedia that is developed is easy to use and operate by the user, so that it can be implemented in further research, to measure the effectiveness of its use.

In terms of easy use of the media, there are still students who feel that virtual laboratory-based learning media are not easy to operate. While in aspects related to the ease of students understanding the material, students generally think that the virtual textile chemistry laboratory media that they operate are able to

provide new experiences in learning, and are able to guide them in understanding the material displayed, so they are very enthusiast to do it.

E. Multimedia Revision Phase

There are some improvements that must be made to the virtual textile chemistry laboratory that have been developed including:

1. Specification of the title formulation at the initial interface, should better describe the contents of the multimedia optimally.
2. The user manual aspects of the interface should be more complete, and contain all technical aspects, so that it will be more informative and easier to understand, so that it will be easier for students to operate.
3. An introduction about the purpose of lectures needs to be displayed.
4. One of the multimedia expert validators suggested adding back sounds to each tutorial display, but students as users thought that the addition of back sounds would interfere with concentration when operating the virtual textile chemistry laboratory media.

CONCLUSION

Based on the results of research on the development of virtual laboratory media on the learning of textile chemistry in the production of cellulose-based regenerative fibers, data were found that the learning media developed were suitable to be used. The conclusions are obtained based on the eligibility requirements that have been met, among others; virtual chemistry laboratory media on cellulose-based regenerative fiber manufacturing material which was developed was valid with a very high category, namely by obtaining a validity percentage of 87.83% from media experts and a percentage of validity of 88.60% from textile chemistry experts. Apart from that, the learning media based on virtual textile chemistry laboratory on cellulose-based regenerative fiber manufacturing material that was developed was also declared practical, which was based on the results of observations of students' activities and responses. The results of student activity observations obtained the category of very good/ very practical with a percentage of 90.5%, which shows that the developed media is easy to operate and provides a good stimulus for students to learn.

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Perception Model for Selecting Patentable Technologies

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Abstract

With the development of new technologies, it is necessary to develop new tools for verification and assessment for their protection by the institutions. Therefore, this study aims to build and validate the perception model for selecting patentable technologies. In relation to the methodology, a structured questionnaire was applied with the members of the National Institutes of Science and Technology (INCT), and structural equation modeling was used to examine the relationships between latent variables. The results show that five hypotheses were tested, all of which were tested and validated. Two complementary models were developed, the first being, to better adjust the model, the market construct was removed. The second model analyzed the four constructs, but it was noticed that, without the market construct, the adjustment indices are more adequate, according to what is presented in the literature as recommended indices. Thus, it is noted that the proposed model can contribute to improving the process of appreciating the technologies produced by Universities.

Keywords: assessment of technologies; structural equation modeling; technologies; patents.

1. Introduction

A country's innovation and technological development depends, both on trained human resources and on consistent investments. Brazil has adopted the strategy that academic research can generate knowledge that can be transformed into technological innovations, and these innovations can contribute to job creation, resource generation or reduction of production costs, resulting in social and economic gains for a country (FELIPE, 2007; BERNARDI et al., 2010).

In addition, to analyze the technology management process, which allows the best use of new technologies for organizations that develop and apply this new knowledge, there are two perspectives: one that seeks the development of new products, but focused on the context of the firm ; and another that involves technologies generated in institutions that do R&D, but do not implement, in a primordial way,

new technologies in the form of products, these being universities and research institutions (GARNICA; TORKOMIAN, 2009).

In the process of analyzing patents or developed technology, it may happen that the technology is not adequate or is inopportune, that is, it appeared late or long before the market maturity (ADRIANO; ANTUNES, 2017).

Assessing the technological potential, patentability and also the commercial potential of inventions developed at universities corresponds to a difficult process, which is often subject to evaluation errors, which can be detrimental when sorting or selecting products and processes built through research in universities (GAMA et al., 2013).

This research is justified by the search for the construction of a model that helps to understand how the process of assessment for protection of technologies can be carried out. Therefore, this research aims to build and validate the perception model for selecting patentable technologies.

2. Technology Selection

Building and managing an IP portfolio is an important means for a successful innovation and TT program. TT offices assist in the creation of strategic processes and the development of tools that assist in the commercialization, protection and management of technologies. However, the newly created offices at Universities, as they have small technology portfolios, do not allow them to develop tools and strategies to assist in the commercialization of the technologies created, which are often at an incipient stage of development (GAMA et al., 2013).

It is important to emphasize that the concern with technological management aimed at the academic environment is related to research activities that result in new knowledge that is likely to be transformed into technologies that can be commercialized in the market (GARNICA; TORKOMIAN, 2009).

For this reason, to assess the chances of implementing technologies in the market, it is necessary to check the following factors: the stage of development, the feasibility of protecting the invention and the nature and complexity of the market. These factors may or may not be complementary. Patentability indicators can guide decisions opposed to those arising from market indicators, and vice versa. An invention may be suitable for patent protection, but have no market potential. On the other hand, it may be commercially viable, but not be able to protect it due to the state of the art (GAMA et al., 2013).

The improvement of the impact assessment processes of new technologies can bring benefits to companies, as well as to public research institutions, by increasing the quality of their products (technologies) and services, and decreasing efforts for their production. But the effective participation of the potential of human resources is necessary to contribute to the generation of patentable products and processes with high added value (BERNARDI et al., 2010; FELIPE, 2007).

A patent is only valuable when used, it is an intangible product that produces tangible products, and its life cycle in the market is geared to the life cycle of the products that are generated by this patent, but there is a moment that it must be obsolete, therefore, the need to evaluate the commercialization potential of technologies developed by companies and universities (ADRIANO; ANTUNES, 2017).

However, it is understood that one of the main problems faced by academic NITs corresponds to the very

incipient stage of technologies that are developed in universities, as these are usually closer to the level of a discovery than to a finished product. In addition, it showed that American NITs have been developing tools over the years that facilitate and bring a little more precision to the evaluation process (GAMA et al .; 2013).

Still, Gama et al. (2013) highlight that there are relevant factors to carry out the selection process (screening) or prioritization of technologies, which are: title, inventors, stage of development, ease of protection and market.

2.1 Market

With regard to the market, this factor allows to verify the market needs to analyze whether the technologies developed surpass those already existing in this, in addition to seeking to evaluate the products already existing on the market and to analyze how innovation surpasses these products or competes with them (GAMA et al., 2013).

However, for Kotler (2000), companies that plan to promote their new products must decide when is the best time to enter the market, since it is necessary to identify their needs and gather information to develop or insert new products in it.

In addition, the insertion of a technology in the market can occur through the transfer of technology, which has the characteristic of transmitting knowledge, designed by a party that owns the technology, to third parties, such as private or public companies, educational institutions and research groups (SILVA; VIEIRA JÚNIOR; LUCATO, 2013).

In view of this, the following hypothesis can be evidenced for the market analysis:

H1: The market has a positive influence on the development stage.

2.2 Protection Facility

The ease of protection emphasizes the analysis of the geographic location of the market and whether patent protection worldwide is necessary and/or can be obtained, as this will allow to verify the protection costs of a single technology in different markets (GAMA et al ., 2013).

Still, the protection granted by the patent is not eternal, organizations that do not innovate continuously can be overtaken by companies that innovate with new products and processes. In turn, the granting of the patent allows the author to have exclusive exploitation, making it impossible for third parties to produce or use the products and processes resulting from this patent during a certain period (PORTER, 1986; TEH; KAYO; KIMURA, 2008).

Based on the information above, the following hypothesis arises:

H2: The ease of protection positively influences the market.

H3: The ease of protection positively influences ownership and inventors.

2.3 Development Stage

The development stage makes it possible to verify whether the researcher already has results that show the viability of the technology and the capacity of this technology for commercial purposes (GAMA et al., 2013).

In addition, it is understood that in the process of developing a new product there is the generation and selection of ideas, in which the product is developed and marketed, with the purpose of deciding whether those selected ideas should be developed or abandoned (DUTRA; GARCIA , 2011).

In turn, Gama et al. (2014) explain that this stage of development also involves the risk that an organization may suffer if it carries out the licensing of the technology produced, making it possible to analyze the decision to protect or not this technology.

Based on the presented theory, the following hypothesis is analyzed:

H4: The stage of development positively influences the ease of protection.

2.4 Ownership and Inventors

Ownership allows you to know if there is dependence on any other patented technology, and there may be restrictions on the office's ability to license it. Besides that there may be other inventors external to the institution and financial obligations or not of the Institutions of Science and Technology (ICT) with the institution that financed (or co-financed) the research, which can decrease the financial return to ICT and make the less attractive licensing (GAMA et al., 2013).

Still, patent ownership is a subject that must be considered in the context in which the development of new relationships between universities and companies occurs within the scope of their cooperation and possible emergence of inventions (GARNICA; OLIVEIRA; TORKOMIAN, 2006).

Regarding the inventors, Gama et al. (2013) explain that these are related to ownership, as it is related to the employment relationship of the inventor (s). This factor allows to verify if there is fragmentation of the know-how associated with the technology between several people, as this can make it difficult to transfer this know-how to the licensed company, which makes the chances of licensing less.

In turn, ownership is also important for the management of intellectual property, as it determines the rights and obligations of co-owners in matters related to the exploitation of results that involve research carried out jointly between two or more institutions (MACEDO; BARBOSA, 2000).

H5: Ownership and inventors positively influence the stage of development.

3. Methodology

The study is characterized as quantitative exploratory, with the population of researchers from the National Institutes of Science and Technology (INCT). The analysis was carried out through the application of a structured questionnaire (Appendix 1).

This questionnaire, contained in the appendix, was approved by the Research Ethics Committee (CEP), with opinion number 2.412.977 and the Certificate of Presentation for Ethical Appreciation - CAAE No.: 79910617.8.0000.5546 was assigned.

Data were collected between May 2019 and March 2020, through the application of the questionnaire, with 258 questionnaires being collected, a result that exceeds the value of a 95% CI and an error of 6%, which corresponds to 255.

In addition, the model studied for the selection of technologies involves four variables, as described in Table 1. The structural equation model (SEM) and factor analysis were used to test the hypothesis

relationships and the AMOS software to analyze the hypothetical models. In addition, the relationships of the constructs were tested separately, to then analyze the relationship between them.

Table 1. Proposed Structural Model

Observable Variables		Theoretical Reference	Latent Variables
TI01	There are other inventors and owners outside the institution	Gama et al., 2013; Garnica; Oliveira; Torkomian, 2006	Ownership and Inventors
TI02	Dependence on some other patented technology granted or required		
TI03	There are financial and copyright obligations of the Science and Technology Institutions (ICTs) with the institution that financed (or co-financed) the research		
TI04	There is an internal technology sponsor		
TI05	There is fragmentation of know-how associated with technology among several people		
ED01	There is a technology differential in relation to the State of the Art	Gama et al., 2013; Dutra; Garcia, 2011; Gama et al., 2014	Development Stage
ED02	The potential of technology for industry		
ED03	Technical and functional data (access to data, information, expertise and know how) are available		
ED04	The information shows that the product/process/service has a novelty, inventive act or activity and industrial application, in the form of LPI		
ED05	The technology presents technological, economic, social or environmental risks of production		
FP01	Assess current and public domain patent portfolio of potential competitors	Gama et al., 2013; Porter, 1986; Teh; Kayo; Kimura, 2008	Protection Facility
FP02	Measure technological prospecting from the perspective of the state of the art		
FP03	Claims to verify whether they facilitate or hinder technology protection		
FP04	There was a search for anteriority from the perspective of the unionist priority (novelty requirement)		
FP05	The product/process has distribution channels for dissemination and commercialization		
M01	Houve levantamento das necessidades de mercado	Gama et al., 2013; Kotler, 2000; Silva; Vieira Júnior; Lucato, 2013	Market
M02	The technology presents strategies for marketing the product / process		
M03	The technology has the potential to be inserted in the market		
M04	The technology was developed / licensed through direct and / or assisted negotiation with technology transfer companies		
M05	The technological solution was implemented by a technological order contract for a specific case		
The scale used was the Likert agreement of 5 points: 1 - Totally disagree; 2 - Disagree; 3 - Indifferent; 4 - I agree; 5 - I totally agree.			

Source: Elaborated by the authors (2020)

The univariate procedures for outliers were performed, and this analysis is carried out by identifying cases that are far from the average. Atypical observations can be excluded when scores are repeated in more than two variables and also when there is repetition in atypical multivariate observations (HAIR Jr. et al., 2009).

In the case of univariate analysis, there was no outlier, but in multivariate analysis, questionnaires 105, 132 and 207 were considered outliers; therefore, they were disregarded in the analysis, and the sample analyzed in the models became 255 respondents.

In addition, the normality test was applied using asymmetry and kurtosis measures (KLINE, 2005), as highlighted in Table 2. Regarding asymmetry measures, it is understood that if it is unbalanced or is detached to one side, it is recommended that values above | 3 | indicate an asymmetric distribution, that is, they are not accepted. In kurtosis measures, score values up to 10 are accepted, since they guarantee normality (HAIR Jr. et al., 2009; KLINE, 2005). It can be seen that the assumption of normality of asymmetry was achieved, since the values varied between -0.285 and -1.223. Regarding kurtosis values, these ranged between -1.168 and 1.766.

Table 2. Normality test for skewness and kurtosis

Variables	Skewness		Kurtosis	
	Statistic	Standard Error	Statistic	Standard Error
TI01	-0.958	0.152	-0.178	0.302
TI02	-0.523	0.152	-0.886	0.302
TI03	-0.758	0.152	-0.425	0.302
TI04	-0.323	0.152	-1.075	0.302
TI05	-0.674	0.152	-0.563	0.302
ED01	-1.212	0.152	1.265	0.302
ED02	-1.223	0.152	1.749	0.302
ED03	-1.007	0.152	0.625	0.302
ED04	-1.359	0.152	1.766	0.302
ED05	-0.577	0.152	-0.988	0.302
FP01	-0.901	0.152	0.417	0.302
FP02	-1.057	0.152	1.112	0.302
FP03	-0.729	0.152	0.061	0.302
FP04	-1.013	0.152	0.715	0.302
FP05	-0.379	0.152	-0.706	0.302
M01	-0.647	0.152	-0.442	0.302
M02	-0.488	0.152	-0.728	0.302
M03	-1.047	0.152	0.853	0.302
M04	-0.285	0.152	-0.924	0.302
M05	-0.114	0.152	-1.168	0.302

Source: Elaborated by the authors, based on the results of SPSS (2020).

In the analysis of linearity, scores between 0.0 and 0.4 show a bad correlation, 0.4 and 0.6 highlight low correlation, between 0.6 and 0.8 suggest medium correlation, from 0.8 to 0.9 indicate good correlation and between 0.9 to 1.0 show high or excellent correlation (HAIR Jr. et al., 2009). With regard to the correlation analysis shown in Table 3, it is understood that high correlation values were not obtained, with the highest value being 0.567.

Table 3. Pearson correlation for linearity analysis

Constructs	TI	ED	FP	M
Ownership and Inventors	1			
Development Stage	0.420**	1		
Protection Facility	0.333**	0.567**	1	
Market	0.275**	0.369**	0.512**	1

Source: Elaborated by the authors, based on the results of SPSS (2020).

Note: (**) The correlation is significant at the 0.01 level (2 ends).

Regarding the multicollinearity test, it can be seen in Table 4 that multicollinearity problems were not detected, since for Hair Jr. et al. (2009) the tolerance varies between 0 and 1; therefore, these values should be between 0.1 and 1, showing a small degree of multicollinearity.

Table 4. Multicollinearity test

Constructs	Variables	Tolerance Value	VIF*
Ownership and Inventors	TI02	0.676	1.480
	TI03	0.584	1.712
	TI04	0.626	1.597
	TI05	0.651	1.535
Development Stage	ED01	0.589	1.697
	ED02	0.484	2.067
	ED03	0.595	1.681
	ED04	0.546	1.831
	ED05	0.610	1.641
Protection Facility	FP01	0.406	2.464
	FP02	0.472	2.121
	FP03	0.684	1.463
	FP04	0.636	1.573
	FP05	0.625	1.600
Market	M01	0.399	2.504
	M02	0.411	2.436
	M03	0.620	1.613
	M04	0.387	2.583
	M05	0.385	2.595

Source: Elaborated by the authors, based on the results of SPSS (2020).

Note: (*) Variance Inflation Factor.

Table 5 highlights the results of the KMO statistic and the Barlett sphericity test, which showed that they are suitable for application, since, according to the KMO interpretation scale used by Hair Jr. et al. (2009), for a KMO interval equal to or greater than 0.8, the adequacy of the sample is admirable.

Table 5. KMO and Bartlett test

Kaiser-Meyer-Olkin measure of sampling adequacy		0.816
Bartlett's sphericity test	Approx. Chi-square	1896.204
	GL	190
	Sig.	0.000

Source: Elaborated by the authors, based on the results of SPSS (2020).

In addition, there are adjustment quality indices that must be observed when modeling structural equations, these being the CMIN/DF (chi-square on degrees of freedom), CFI (comparativefit index), GFI (goodnessof it index), TLI (Tucker-Lewis index) and RMSEA (root mean error of approximation) (MARÔCO, 2010). Table 6 shows the following comparative adjustment measures.

Table 6. Adjustment index

	Measures	**Recommended values**
Absolute	Degrees of Freedom Chi-square (χ2/ GL)	χ2/GL < 5 Kline (2005)
	Goodnessof Fit (GFI)	GFI > 0,9 Hair Jr. et al. (2009)
	Root Mean Square Error of Approximation (RMSEA)	RMSEA < 0.08 Hair Jr. et al. (2009)
	Standardized Root Mean Square Residual (SRMR)	SRMR < 0,1 Kline (2005)
	Adjusted Goodness of Fit (AGFI)	AGFI > 0.8 Hair Jr. et al. (2009)
Incremental	Tucker-Lewis Index (TLI)	TLI > 0.95 Bagozzi e Yi (2012)
	Normed Fit Index (NFI)	NFI > 0,9 Byrne (2010)

Source: Elaborated by the authors (2020)

4. Results

With regard to the results found, questionnaires were applied with the members of the INCT, with 258 questionnaires being collected, a result that exceeds the value of a 95% CI and an error of 6%, which corresponds to 255. Regarding the profile of the researchers, the information that is described below was collected.

Table 7. Gender of researchers

Genre	Research	%
Male	177	68,6
Feminine	80	31
Other	1	0,4
Total	258	100

Source: Elaborated by the authors (2020)

Table 7 shows that the majority of researchers who answered the survey questionnaire are male, 68.6% (177), followed by female with 31% and only one researcher as gender another 0.4% (1).

Table 8. Researchers' education

Education	Researchers	%
Doctorate degree	245	95
Master's	11	4,2
Specialization (lato sensu)	1	0,4
University graduate	1	0,4
Total	258	100

Source: Elaborated by the authors (2020)

Regarding the education of the researchers, it can be seen in Table 8 that the majority of researchers have a PhD, 95% (245), 4.2% (11) have a Master's degree, 0.4% (1) have a Specialization and 0 , 4% (1) have an undergraduate degree.

Table 9. 10 Institutions affiliated to Researchers

Institution	Researchers
University of São Paulo (USP)	34
Federal University of Rio de Janeiro (UFRJ)	24
Oswaldo Cruz Foundation (FIOCRUZ)	14
Brazilian Agricultural Research Corporation (Embrapa)	9
Federal University of Ceará (UFC)	8
Federal University of Sergipe (UFS)	6
University of Brasilia (UnB)	6
National Institute of Industrial Property (INPI)	5
Fluminense Federal University (UFF)	5
Federal University of Paraíba (UFPB)	5
Total	116

Source: Elaborated by the authors (2020)

Regarding the institution to which the researcher is linked, Table 9 shows the 10 institutions that

presented more than 4 researchers. It was noticed that most researchers are linked to the University of São Paulo (USP), 34. In addition to USP, 22 researchers are linked to the Federal University of Rio de Janeiro (UFRJ), 14 to the Oswaldo Cruz Foundation (FIOCRUZ), 9 to the Brazilian Agricultural Research Corporation (Embrapa) and 8 to the Federal University of Ceará (UFC).

Table 10. INCT Area

INCT	Researchers	%
Health	79	31
Exact and Natural	54	21
Engineering and Information Technology	39	15
Agrarian	24	9
Ecology and Environment	20	8
Nanotechnology	17	7
Human and Social	16	6
Energy	9	3
Total	258	100

Source: Elaborated by the authors (2020)

In turn, Table 10 shows that 31% (79) of the researchers are from the Health area, 21% (54) are Exact and Natural, 15% (39) are from Engineering and Information Technology, 9% (24) are from Agrarian, 8% (24) from Ecology and Environment, 7% (17) are from Nanotechnology, 6% (16) are from Human and Social and only 3% (9) from Energy. The Health area had the highest number of respondents to the questionnaire, and this can be explained due to the fact that this health INCT has the largest number of institutes and the largest number of researchers (INCT, 2008).

Table 11. Category in the Research Project

Category	Researchers	%
Member	104	40
Coordinator	86	33
collaborator	68	27
Total	258	100

Source: Elaborated by the authors (2020)

Table 11 highlights the category in which the researchers participated in the research project, with the majority participating as a member, 40% (104), followed by 33% (86) who participated as coordinator and 27% (68) who participated as collaborator.

4.1 Model Validation

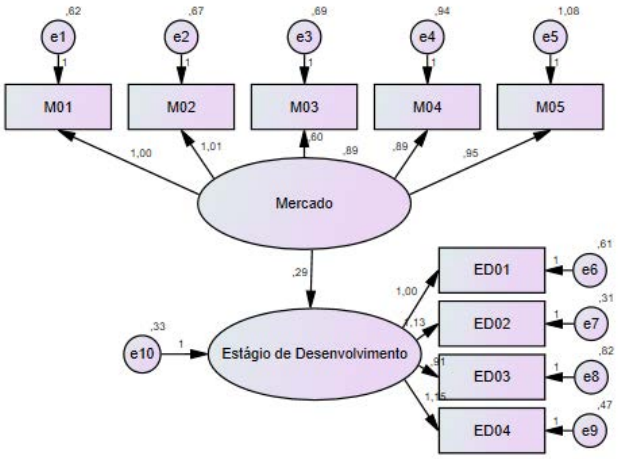
To understand the effects of the research variables and their relationship to the selection of patentable technologies, some models of structural equations (SEM) were used to test the hypothesis relationships.

Therefore, the relationship of each construct was tested separately, to then analyze the joint relationship of these constructs.

4.2 Model H1 - There is market influence on the stage of development

The first tested model sought to analyze the relationship between the market and the development stage, the result of which shows that these constructs have a positive and significant relationship (β = 0.29; p = 0.000), as can be seen in Figure 1.

Figure 1. Model H1: Market and Stage and Development



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 12 showed the adjustment indexes obtained, which show the values that demonstrate the model's validity. It is noticed that the adjustment measures are slightly below the expected indexes, as highlighted in this table.

Table 12. H1 adjustment indexes

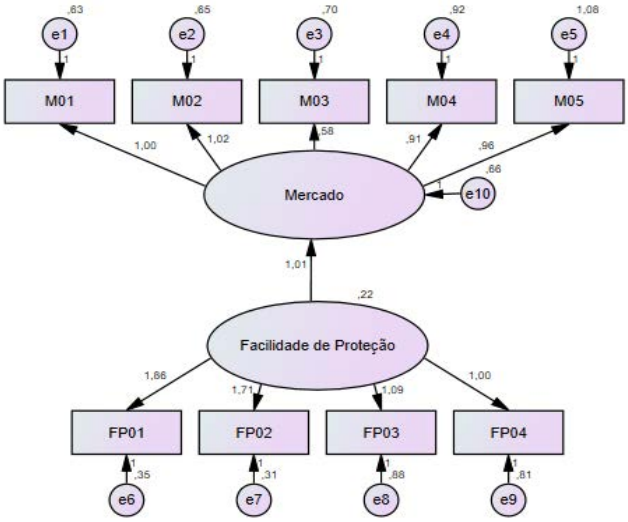
Model	Absolute				Incremental	
	χ2/GL < 5	GFI > 0.9	RMSEA < 0.08	AGFI > 0.8	NFI > 0.9	CFI > 0.9
	7.078	0.866	0.154	0.769	0.786	0.809

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.3 Model H2 - The influence of ease of protection on the market

In the second model, the relationship between the construct of easy protection and the market was verified. It can be seen, in Figure 2, that there is a positive and significant relationship (β = 1.01; p = 0.000).

Figure 2. Model H2: Ease of Protection and Market



Source: Elaborated by the authors, based on the results of SPSS (2020).

The indices indicate that they are not very suitable for the parameters proposed in the literature, which are highlighted in Table 6.

Table 13. H2 adjustment indexes

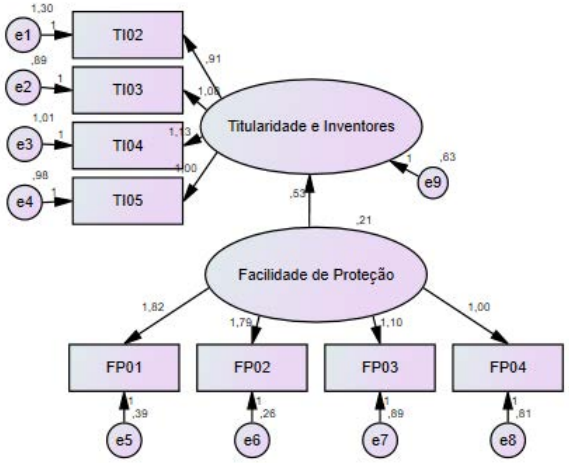
Model	Absolute				Incremental	
	χ2/GL <5	GFI > 0.9	RMSEA < 0.08	AGFI > 0.8	NFI > 0.9	CFI > 0.9
	7.162	0.865	0.155	0.766	0.788	0.809

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.4 Model H3 - The influence of ease of protection on ownership and inventors

Regarding the ease of protection and ownership and inventors constructs, it was found that there is a positive and significant influence (β = 0.53; p = 0.002), as highlighted in Figure 3.

Figure 3. Model H3: Protection Facility, Ownership and Inventors



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 14 shows that the adjustment measures are adequate for most indexes.

Table 14. H3 adjustment indexes

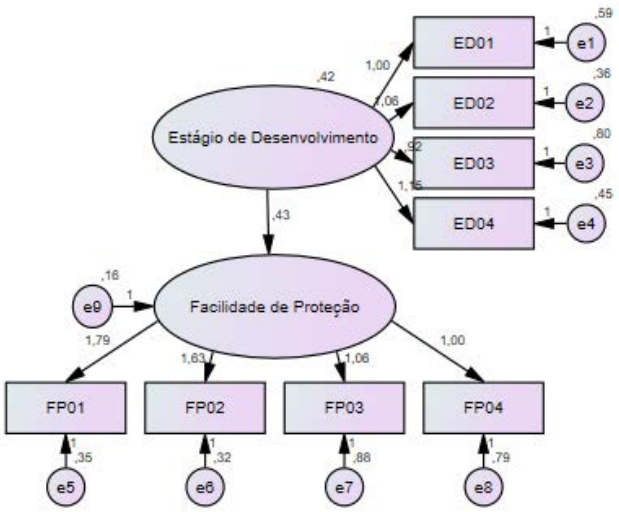
Modelo	Absoluto				Incremental	
	χ2/GL < 5	GFI > 0.9	RMSEA < 0.08	AGFI > 0.8	NFI > 0.9	CFI > 0.9
	2.184	0.961	0.068	0.927	0.920	0.954

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.5 Model H4 - The influence of the development stage on the ease of protection

The analysis regarding the development stage and ease of protection confirmed that it has a positive and significant influence (β = 0.43; p = 0.000), as can be seen in Figure 4.

Figure 4. Model H4: Development Stage and Ease of Protection



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 15 showed that the adjustment indices, which indicate the quality of the model, are mostly adequate.

Table 15. H4 adjustment indexes

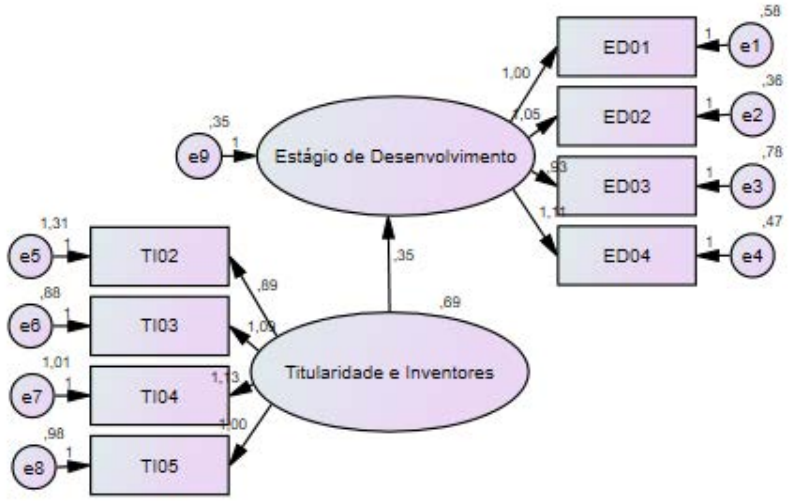
Model	Absolute				Incremental	
	χ2/GL < 5	GFI > 0.9	RMSEA < 0.08	AGFI > 0.8	NFI > 0.9	CFI > 0.9
	2.725	0.945	0.082	0.913	0.918	0.946

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.6 Model H5 - The influence of ownership and inventors on the stage of development

Figure 5 showed that there is a positive relationship between the constructs ownership and inventors, and the stage of development (β = 0.35; p = 0.001).

Figure 5. Model H5: Ownership and Inventors, Development Stage



Source: Elaborated by the authors, based on the results of SPSS (2020).

The adjustment measures of the H5 model are adequate to the indices, as seen in the results highlighted in Table 16.

Table 16. H5 adjustment indexes

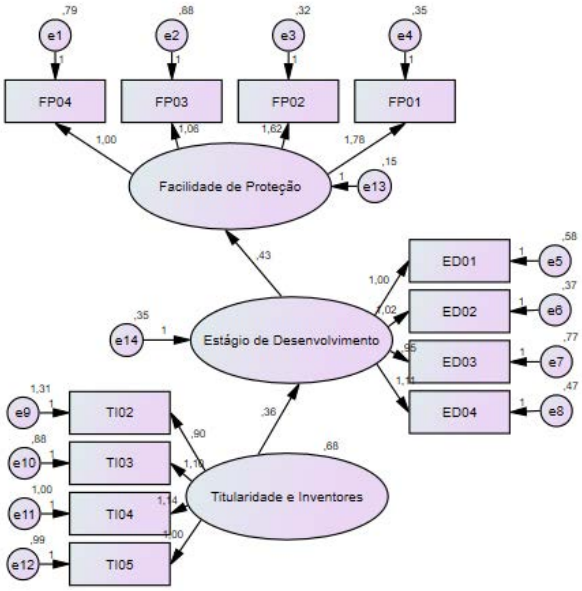
Model	Absolute				Incremental	
	χ2/GL <5	GFI > 0,9	RMSEA < 0,08	AGFI > 0,8	NFI > 0,9	CFI > 0,9
	2,383	0,961	0,073	0,927	0,916	0,949

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.7 Complete Models

In complete model 1, shown in Figure 6, the three constructs were analyzed together; only the market construct was withdrawn.

Figure 6. Complete Model 1



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 17 showed the adjustment indexes for this model, verifying that the values are mostly adequate for a good adjustment of the model.

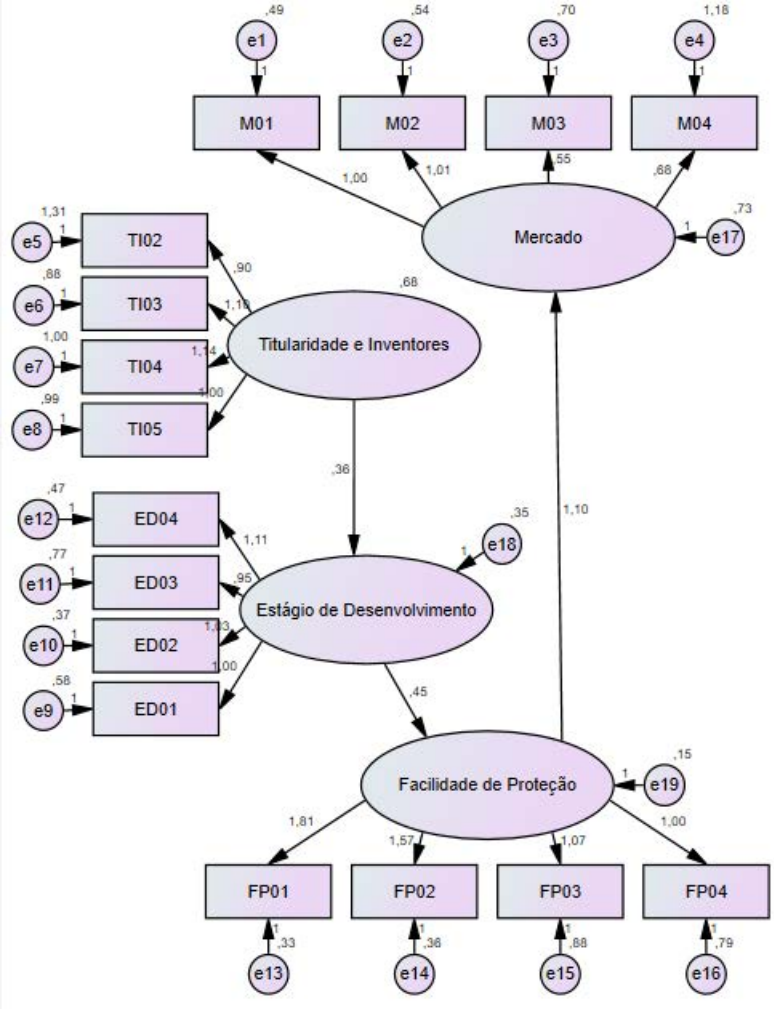
Table 17. Adjustment indexes of the complete model 1

Model	Absolute				Incremental	
	χ2/GL < 5	GFI > 0,9	RMSEA < 0,08	AGFI > 0,8	NFI > 0,9	CFI > 0,9
	2,205	0,934	0,068	0,901	0,877	0,928

Source: Elaborated by the authors, based on the results of SPSS (2020).

In addition, the complete model 2 was created, shown in Figure 7, which jointly analyzes the four constructs.

Figure 7. Complete Model 2



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 18 shows the adjustment indexes for this model, verifying that some values are slightly below the stipulated for a good adjustment of the model.

Table 18. Adjustment indexes of the complete model 2

Model	Absolute				Incremental	
	χ2/GL < 5	GFI > 0,9	RMSEA < 0,08	AGFI > 0,8	NFI > 0,9	CFI > 0,9
	2,482	0,893	0,076	0,855	0,822	0,884

Source: Elaborated by the authors, based on the results of SPSS (2020).

5. Conclusion

It was noticed, throughout this study, with the application of the questionnaire that most of the respondents are doctors and it was evidenced that some of these are linked to the University of São Paulo (USP) and are members of the INCT in the Health area, showing the growth in health-related research.

Regarding the model, the four constructs were analyzed and adjustments were made to obtain an adequate model of perception for the selection of patentable technologies. In view of this, it can be verified which variables influence the assessment process to protect technologies.

The structural equation model, through which three constructs were analyzed together, showed that the construct stage of development influences the ease of protection and the construct ownership and inventors influences the stage of development.

However, a new model was created analyzing the four constructs, highlighting that the construct of protection eases the market. However, it was noted that even though the model had a positive and significant influence, the adjustment indices showed a value slightly lower than that of the literature, different from the indices analyzed in the three-construct model that presented the most adequate values.

This model shows how much it is necessary to pay attention to ownership and stage of development so that this favors the ease of protection of what is being developed, since it is necessary to check if there is any pending of some other patented technology, if the researcher already has results that evidence the viability of the technology created.

In addition, it was noted that the market construct was not considered important in the adjustment of the model, since it presented adjustment rates slightly lower than recommended in the literature; in addition, it is understood that the insertion of technologies in the market can and must come through the technology transfer process, that is, it comes after the process of protecting this technology.

Thus, it was understood that the model built with the four constructs allows the variables that influence the assessment process to protect technologies to be verified, in order to facilitate the selection of technologies that can be patented and later marketed on the market.

6. Acknowledgement

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Appendix

Appendix 1.

Dear Researcher

I am Cleide Ane Barbosa da Cruz, student of the PhD in Intellectual Property Science at the Federal University of Sergipe, I am under the guidance of Professor Dra. Ana Eleonora Almeida Paixão. I would like to request that you participate in a survey by filling in some questions. The data collected will be used in my thesis research, entitled “Perception Model for the Selection of Patentable Technologies”. This study will enable the development of a tool for screening patentable technologies. Participation in this study is voluntary and you are free to withdraw your consent at any time and thus no longer participate in the study, without causing any harm to you. Your identity and privacy will be preserved. The information in this research will be disclosed only in scientific events or publications, with no identification of the volunteers.

It is important to note that the project was approved by the Human Research Ethics Committee, process number: 2,412,977.

If you have any questions, please contact me by e-mail: cleideane.barbosa@bol.com.br.

Identificação do(a) Pesquisador(a):

1. Gender:
( ) Male
( ) Feminine
( ) Other

2. Degree of Education:
( ) University graduate
( ) Specialization (lato sensu)
( ) Master's
( ) Doctorate degree

3. The institution to which the researcher is linked?

_____

4. What area of the INCT did you participate or participate as a member?
( ) Agrarian
( ) Energy
( ) Engineering and Information Technology
( ) Exact and Natural
( ) Human and Social
( ) Ecology and Environment
( ) Nanotechnology
( ) Health

5. Which category did you participate in the research project?
( ) Coordinator
( ) Member
( ) Collaborator

Instructions: Regarding the following items, rate disagreeing or agreeing with what you consider important to be analyzed in the technology screening process at Universities.
1 - Strongly Disagree
2 - Disagree
3 - Indifferent
4 - Agree
5 - Strongly Agree

ITEM: Ownership and Inventors (GAMA et al., 2013; GARNICA; OLIVEIRA; TORKOMIAN, 2006)

Items	Classification
There are other inventors and owners outside the institution	1 2 3 4 5
Dependence on some other patented technology granted or required	1 2 3 4 5
There are financial and copyright obligations of the Science and Technology Institutions (ICT) with the institution that financed (or co-financed) the research	1 2 3 4 5
There is an internal technology sponsor	1 2 3 4 5
There is fragmentation of know-how associated with technology among several people	1 2 3 4 5

ITEM: Development Stage (GAMA et al., 2013; DUTRA; GARCIA, 2011; GAMA et al., 2014)

Items	Classification
There is a technology differential in relation to the State of the Art	1 2 3 4 5
The potential of technology for industry	1 2 3 4 5
Technical and functional data (access to data, information, expertise and know how) are available	1 2 3 4 5
The information shows that the product / process / service has a novelty, inventive act or activity and industrial application, in the form of LPI	1 2 3 4 5
The technology presents technological, economic, social or environmental risks of production	1 2 3 4 5

ITEM: Protection Facility (GAMA et al., 2013; PORTER, 1986; TEH; KAYO; KIMURA, 2008)

Items	Classification
Assess current and public domain patent portfolio of potential competitors	1 2 3 4 5
Measure technological prospecting from the perspective of the state of the art	1 2 3 4 5
Claims to verify whether they facilitate or hinder technology protection	1 2 3 4 5
There was a search for anteriority from the perspective of the unionist priority (novelty requirement)	1 2 3 4 5
The product / process has distribution channels for dissemination and commercialization	1 2 3 4 5

ITEM: Market (GAMA et al., 2013; KOTLER, 2000; SILVA; VIEIRA JÚNIOR; LUCATO, 2013)

Items	Classification				
There was a survey of market needs	1	2	3	4	5
The technology presents strategies for marketing the product/ process	1	2	3	4	5
The technology has the potential to be inserted in the market	1	2	3	4	5
The technology was developed/licensed through direct and/or assisted negotiation with technology transfer companies	1	2	3	4	5
The technological solution was implemented by a technological order contract for a specific case	1	2	3	4	5

The use of the Socrative application to enhance student attention: electroencephalography data of attention levels

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Abstract

The use of the Socrative App (instant response feedback app) was investigated as a tool to enhance attention in the development of Meaningful Learning for Engineering students in a Physics discipline. The subjects, students of Engineering, are evaluated in their learning by using a printed list of exercises comparatively when they perform a single exercise in the Socrative App. This study presents favorable results to the use of this application, since it encourages engagement in the classroom, motivated by the use of this technology, as well as increased attention in the absence of distracting elements in a list with several exercise options.

Keywords: Attention. Meaningful Learning. Socrative App.

1. Introduction

Applications ranging from experience simulators to information managers, through instant messengers and social networks, join immediate feedback applications to enhance the teacher's teaching and, consequently,

the students' learning. A new meaning is given to the classroom, as the teacher starts to follow the results of the questions answered by all students present or not. Depending on their answers, different paths can be taken in the teaching processes developed by the teacher.

Mobile devices, in this context, move from communication and entertainment electronics to auxiliary teaching tools. Related studies confirm these arguments. Alencar et al. (2015) used the WhatsApp application as a teaching support tool in which students worked on their argumentation through writing. Honorato et al (2015) worked with a virtual simulator for the development of concepts about vectors in the teaching of Physics. The results of these researches demonstrate the importance of innovating and reinventing the classroom with appropriate methods in the use of these technologies. According to Valente (1999), methodological innovations require changes in the teaching and learning processes, which are much more profound, specifically in relation to the classroom, as this will have to be rethought in its structure, as well as in the pedagogical approach. This all goes hand in hand to modernize the teacher's teaching and stimulate meaningful learning for his students. According to Vettori and Zaro (2016), applications of this nature favor the engagement and also the attention of students, as they reflect on the paths that were taken to achieve and reach an answer. This also allows the resumption of questions, the raising of doubts and the dialogue with the teacher, since the teacher has on his computer (or mobile device) the answers in real time using the same application in the teacher's version.

Attention, in this sense, is a fundamental condition for the construction of meaningful learning that is discussed by the theories of Ausubel (1983) regarding the elaboration and the use of potentially significant materials. Studies in Neuroscience and Neuroeducation, according to Zaro et al (2010), state that students' attention is more intense when technological resources are used in the classroom, as the brain reacts to different external stimuli and, in this case, such stimuli are related by internal stimuli as the intrinsic motivation of each individual. Vettori and Zaro (2016), highlight that this motivation includes the fact that technology is “part of the mind and even the body” according to one of the research subjects.

The objective of this work is to understand how attention is favored with the use of the Socrative App in the classroom, its implications and the development of meaningful learning. We verified the effectiveness of this application, using an electroencephalogram (EEG) device known as Neurosky , validated as acceptable for this type of research according to the works of Velloso (2014) and Schuh (2016). In his doctoral thesis, for example, Velloso (2014) investigates how the subjects' attention levels increase with the use of learning objects to learn content. On the other hand, Schuh (2016) shows how it is possible to use Neurosky for the mobility of electric wheelchairs. In this study, the different levels of attention of students were compared when using the Socrative App with and without its presence. We measure students' attention levels in two situations. In the first, students resolved five questions on a printed list. In the second, a single question in the Socrative App.

2. Theoretical Fondation

2.1 Meaningful Learning

According to Ausubel (1983), learning is significant when it makes some sense to the learner (a term used

by Ausubel). In the process of learning information, you must interact and anchor on relevant concepts that exist in the cognitive structure of the learner. Therefore, the apprentice's learning process must rely on the use of previous organizers (PO) to anchor new learning. OPs are elements that must be previously presented in relation to new content, serving as a bridge between what the student knows and what he needs to know for meaningful learning to occur. This, in turn, will lead the student to the development of subunits, which will enable the construction of future learning. According to Moreira (1999), subunits are specific knowledge existing in the knowledge structure of the individual, which allows giving meaning to a new knowledge that is presented or discovered by him. For Ausubel (1983), there are two basic conditions for meaningful learning to occur. The first, the didactic material that must be potentially significant. The second, the apprentice's willingness to learn.

Potentially significant material is not in a book or class, but in the person, who is already predisposed to learn. For Moreira (1999), it is not exactly about motivation, or liking the material. For some reason, the learner must be willing to interact the new knowledge interactively with his previous cognitive structure, modifying it, enriching it, elaborating it and giving meanings to that knowledge. Consequently, the material prepared by the teacher will be potentially significant, as it will enable the learner to relate the contents to their cognitive structure in a non-arbitrary and non-literal way.

The basic idea of David Ausubel's (1983) theory of Meaningful Learning is that if it were possible to isolate a single factor as the most important for cognitive learning, it would be what the learner already knows, that is, the knowledge already existing in its cognitive structure with clarity, stability and differentiation; consequently, teaching should take such knowledge into account and, for that, it would be necessary to ascertain it in advance. The key concept of the theory is the concept of meaningful learning itself. Naturally, meaningful learning is meaningful learning; however, Ausubel's original proposal goes far beyond this tautology (MOREIRA, 1999).

Therefore, meaningful learning presupposes the reconstruction of existing concepts into new improved concepts. For this to happen, it is necessary to verify these previous concepts that the apprentice brings with him.

Ausubel (1983) presents as a basic idea that the teacher knows what the learner already knows so that, starting from the existing cognitive structure, to reach new and more elaborate knowledge than the previous concepts. In this sense, it is necessary to verify such knowledge in advance and, thus, verify the new knowledge. When the student is able to differentiate between previous knowledge and new knowledge when he finds stability and differentiation between new meanings, we can say that there was significant learning. Moreira (2009) highlights that in the interaction that characterizes meaningful learning, new knowledge must relate in a non-arbitrary and substantive manner (not literally) with what the student already knows.

In this sense, the cognitive structure is a set of subunits and their interrelations. For meaningful learning to occur, it is necessary that relevant subsunitors are available and that the student has the ability to relate new knowledge to previous knowledge. According to Moreira (2009), even if he has adequate knowledge, it will not help if the student does not know how to relate this knowledge to solve a problem.

2.2 Attention

Attention has a diversity of coming concepts. For each area of knowledge that studies it, attention has a view from researchers about what it is and what its function is in the human mind.

In the work "The neuropsychology of attention", Cohen, Sparling -Cohen and O'Donnell (1993) highlight that the word attention is an integral part of people's regular and everyday vocabulary. Thus, attention should be understood as a collection of cognitive processes that produce recognizable results and not as a single process. According to Velloso (2014, p.45), attention has a diversity of coming concepts. For each area of knowledge that studies it, attention has a view from researchers about what it is and what its function is in the human mind.

In the work "The neuropsychology of attention", Cohen, Sparling -Cohen and O'Donnell (1993) highlight that the word attention is an integral part of people's regular and everyday vocabulary. Thus, attention should be understood as a collection of cognitive processes that produce recognizable results and not as a single process. According to Velloso (2014, p.45), The cognitive sciences study attention as a set of mental processes, whether conscious or not. In turn, neuroscience understands attention as a certain physiological brain state.

Attention, therefore, has a fundamental role in the acquisition and construction of knowledge, since the processes involved in this part of the subject focus on what they want to learn.

Corbetta (1998) stresses that it is the role of attention to select the source of relevant sensory stimuli at the expense of others. In this model, attention can be seen as a process that acts on information from one or more senses.

Ladewig (2000) points out that, in the learning process, attention subsequently passes through three distinct stages: cognitive, associative and autonomous. In the first stage, the cognitive, the subject tries to understand the concepts. At this stage, there is a great burden on the mechanisms of care. In the associative stage, the subject develops knowledge; in this stage, the attention needs are minimized in relation to the previous one. Finally, in the autonomous stage, the related skill is developed, and the attention requirements are minimal, allowing the subject to redirect his attention to other focuses.

According to Velloso (2014), the analysis of the relationship between learning and attention makes clear the fundamental role of the latter in the development of the former and also indicates a cyclical and feedback process, in which attention generates learning to enhance the development of knowledge involved in the process or to build new knowledge, indicating a bidirectional cause and effect relationship.

Zaro et al (2010) highlight the work developed in the doctoral thesis of Tokuhama- Esppinosa in which the author discusses brain functioning and, in particular, the importance of attention and its role in the learning process. Tokuhama- Espinosa (2008) states that learning involves both focused attention and peripheral perception and that the human brain is designed more for oscillations than for constant attention. The relationship between attention and learning is significantly close. Tokuhama -Espinosa (2011), highlights that "if you don't pay attention you don't have a memory. If there is no memory, there is no learning. If we do not keep students with a good level of attention, there will be no learning".

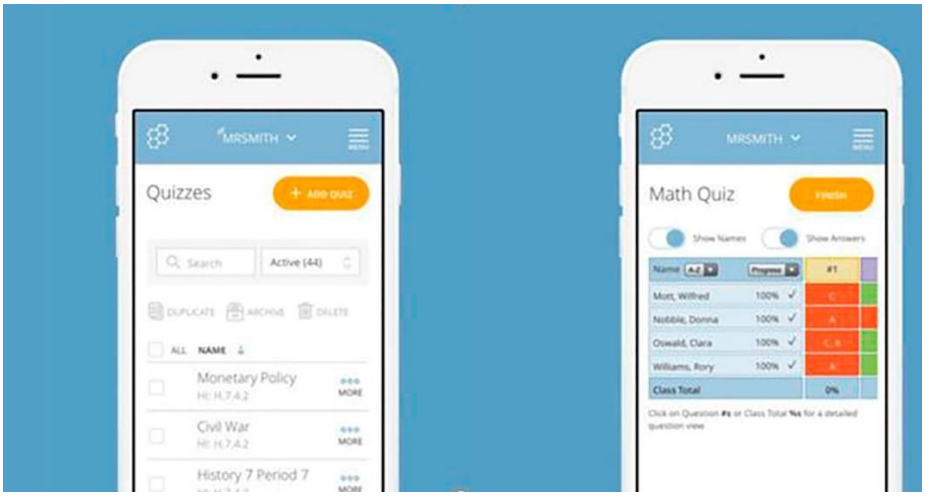
2.3 Socrative Aplication

The Socrative is a classroom application that provides effective engagement of students, allowing the

teacher to follow in real time the development and learning of a class. It is possible, from this application, to quickly evaluate students with previously planned activities or with quick questions to obtain an immediate view on the understanding of the subjects being worked with a class. From the results that appear immediately on the teacher's mobile device (or personal computer), it is possible to think and direct new paths for student learning.

Socrative can be used as a data collection tool to organize content according to students' prior knowledge in order to achieve, when possible, meaningful learning. It is a facilitating way for the teacher to think about how to develop these learnings, to plan, through the answers, and to investigate possible paths to be taken, identifying, based on the answers, the existence of conceptual errors, problems of interpretation and basic mathematics, which are necessary for the development of new knowledge. Figure 1 shows the illustrative image of the application and its functionalities.

Figure 1. Socrative application



Source - Adapted from Socrative App by the authors, (2020).

The Socrative is therefore a tool that assists the teacher in the task of getting instant feedback of the answers provided by students previously selected issues for some classroom activities. Students solve the questions in their notebooks, for example, and choose the answers (or provide them) through their devices and, in real time, the teacher observes the chosen or elaborated answers on his own mobile device (or computer). The teacher decides which directions to take to improve the dynamics of the classroom and consequently the learning of his students. This dynamic runs through a working method that can favor and expand the learning that is being built in the classroom with the use and facilities created by Socrative.

3. Methodology

The research is experimental, exploratory and has a qualitative and quantitative approach. The research subjects were six volunteer students from different engineering courses at a private university in the city of Porto Alegre, capital of the Brazilian state called Rio Grande do Sul. There were four female students and two male students. These students took a course in General Physics (Mechanics) and are aged between 19 and 21 years. The research subjects authorized the publication of their data and had their names preserved

in anonymity. They were named by the word "student" followed by a letter and a number (Student A1, for example).

In order to measure the attention levels of the research subjects, three Neurosky EEG headset devices were purchased. The devices have Bluetooth technology, which allowed, through a specific application, to obtain data regarding the levels of attention of the subjects during the performance of Physics exercises. Most measures were obtained with the Android smartphone due to the stability of the Bluetooth signal, something that was not possible with an Apple smartphone (iPhone 7). To obtain these measures, we looked for the Effective Learner application that can be used with the headset available in the virtual stores of Apple (iOS) and Google (Android).

The collection of data on the individual attention of each student was carried out in two stages based on:

(1) Resolution of a Physics problem in a printed list with four exercises of the same content (without the obligation to respect the presented order);

(2) Resolution of a Physics problem using the Socrative App, different from those presented in the previous item, however, with the same content.

After collecting these attention data, the teacher provided feedback on each resolution made by the students. The measurements were carried out in the classroom during four meetings.

Finally, a free interview was carried out, followed by the application of a structured questionnaire with each subject. We sought to know the impressions of the two stages of data collection, respecting two central themes: distracting elements and difficulties encountered.

We emphasize that steps (1) and (2) were repeated three times with each student. For each stage, the first time was aimed at resolving questions of type V (true) or F (false) that did not last more than three minutes for each student. The second time, presented multiple choice questions and took between three and five minutes for each subject. The third and last time, lasting more than five minutes, involved questions with calculations. These calculation questions were resolved on paper and the result found was later entered into the Socrative App.

The data obtained representing the attention levels were collected by the EEG Neurosky device (hardware) and decoded by the Effective Learner application (software). This application takes ten measurements every minute, that is, one measurement every six seconds. Each measure averages between the predominant levels of care, from the lowest to the highest.

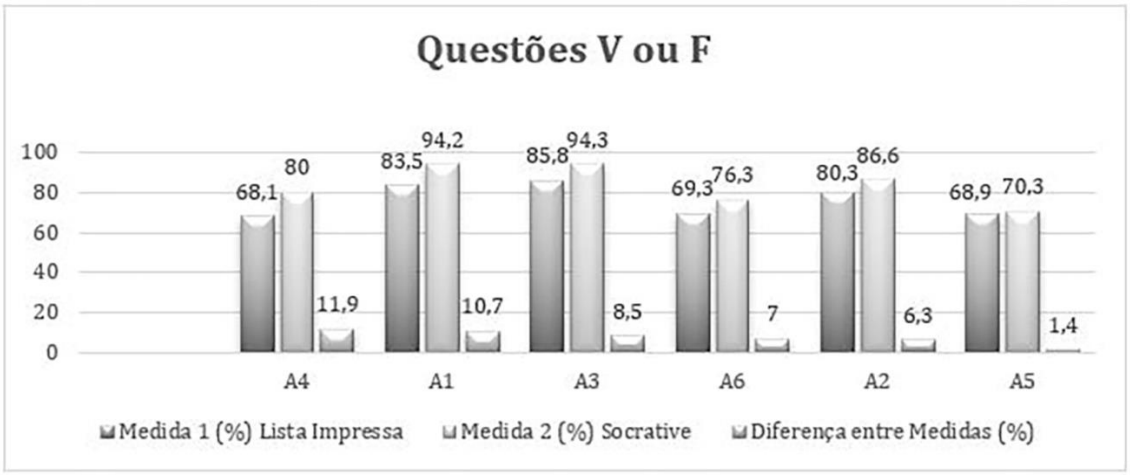
The measurements were performed in the classroom while the students resolved the questions proposed in steps (1) and (2). From the data collected, through the software, and the interview conducted together with the structured questionnaire, we sought to verify evidence of significant learning. Such evidence was interpreted from the crossing between the different (oscillations) levels of attention with the impressions of the research subjects.

4. Results and discussions

We present the quantitative results of the measures of the levels of attention reached by each student. The last column of each graph represents the percentage difference between measures 2 and 1. It is possible to notice that all of these values are positive, that is, there was an increase in attention in all measurements

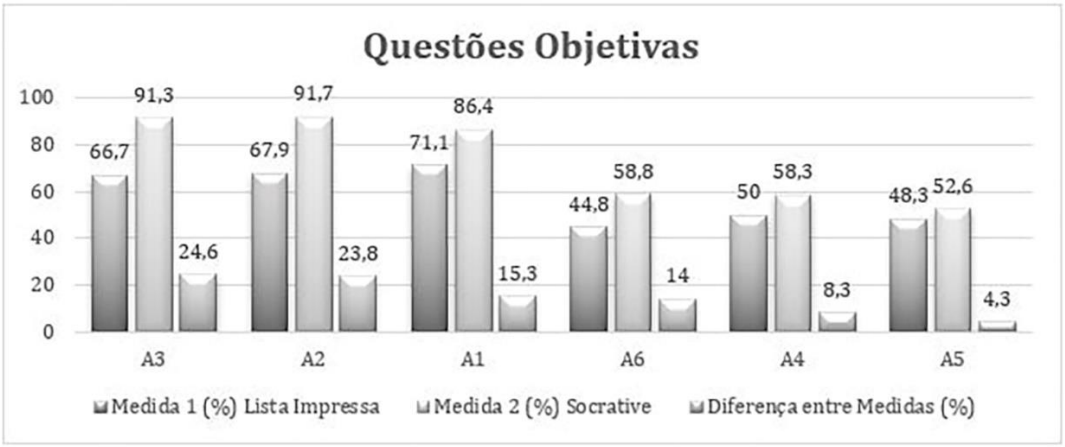
performed.

Graph 1 - First group of measures: questions of V (true) or F (false)



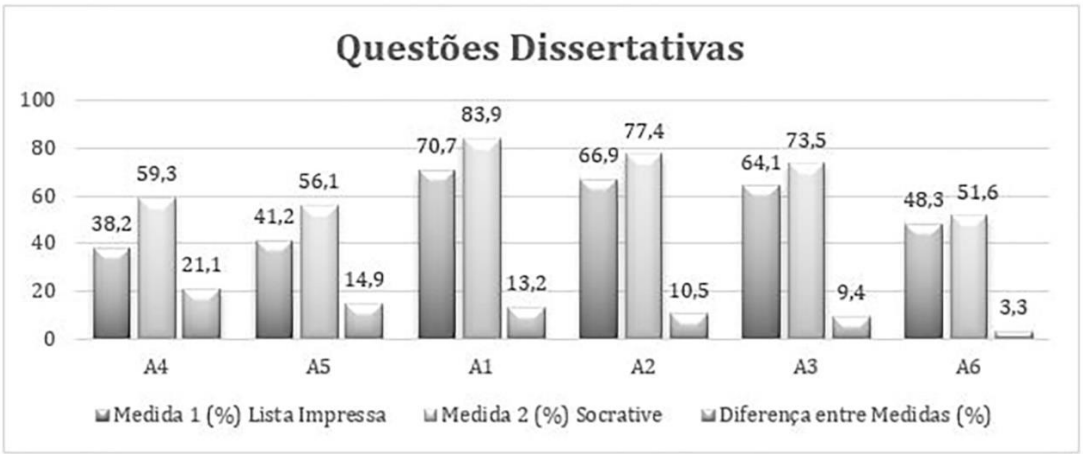
Source: Authors, (2020).

Graph 2 - Second group of measures: objective questions



Source: Authors, (2020).

Graph 3 - Third group of measures: essay questions



Source: Authors, (2020).

Table 1 shows the percentage differences (minor and major) per student between the first measure (printed list) and the second measure (Socrative) for each group of measures.

Measuring Group	Smallest% difference per student	Biggest difference% per student
1 the	1.4 (A5)	11.9 (A4)
2 the	4.3 (A5)	24.6 (A3)
3 the	3.3 (A6)	21.1 (A4)

Source: Authors, (2020).

In almost all measures, the relationship between the levels of attention and the perceptions of students during the resolution of questions was evident. In the two specific situations mentioned above, attention levels are lower when students solve a printed list with four exercises. All students state that they sought the easiest question when they received the printed list to solve the four exercises available in each. This curiosity about the easiest question affects the final results of the attention levels. Due to this search for the easiest question, the resumption of readings between questions leads the subject to a movement that involves, at first, mechanical learning. There is, by the subject, a search for previous knowledge that can be differentiated and integrated to the new challenges, that is, an attempt to find something similar to what has already been worked on previously, something that is familiar. Not finding, the subject chooses the question that seems most convenient to solve. Therefore, the number of questions available in a list is one of the possible distracting elements for a student. Thinking about personal problems or something that is not related to the issue, significantly changes the levels of attention, too, according to the reports. However, when students face some difficulties related to the knowledge to be tested, attention levels again fall

However, the drop in attention levels is also associated with the subjects' difficulties in differentiating and integrating new knowledge to those existing in their cognitive structures. Student A6 had the biggest percentage difference in the second group of measures, because according to his report “there was distraction with the proportional relations” that made him feel challenged and motivated to solve the questions in the printed list. At Socrative, however, it obtained a high level of attention which increased the difference with the printed list.

Regarding the difficulties encountered, we highlight the problem of interpreting the phenomena, knowledge gaps and differentiation / reconciliation of concepts. When it comes to the difficulties in interpreting the phenomena, Moreira (2009) states that representations, concepts and propositions are types of meaningful learning that refer to everything that has been learned by the subject. Physical phenomena, therefore, will be interpreted when the student is able to recognize them in a non-arbitrary and non-literal way.

In this case, when presenting knowledge gaps, such as not knowing mathematical proportional relations between quantities, the student A5, for example, presented lower records of his levels of attention. There is, therefore, an indication that the lack of knowledge reduces the subject's attention, for trying and failing to resolve a question in thought. Consequently, the chances of building meaningful learning are reduced. A final situation, however, is the difficulty of differentiating and reconciling concepts.

If the student is unable to differentiate and integrate concepts, when solving questions of any kind, it means that his learning can still be at a mechanical level. However, when resolving issues on Socrative, we find that levels of attention are higher during the development of meaningful learning. First, student A5 appears with the smallest percentage difference in the levels of attention measured in the first and second groups. We can say that this student has possible problems with significant propositional learning, since it is necessary to articulate ideas based on conditional structures. When mentioning that the questions "were very similar", the A5 student realizes some difficulties in establishing a differentiation between the existing knowledge in his cognitive structure with the new knowledge proposed through sentences. In addition, A5 was unable to establish proportional relations between the quantities involved in the questions, which allows us to conclude that in addition to the difficulties with significant propositional learning, the student presents problems related to conceptual conceptual learning. Concepts are the basis for understanding. However, this scenario of difficulties was partially overcome by feedbacks on the issues in the printed list. Added to this is the student's understanding that Socrative makes him more aware and without dispersion. This can be seen by the increase in the percentage differences of the first and second groups. However, in the third group of measures, the percentage difference was greater (greater than 14%), which demonstrates that the A5 student is able, despite the levels of attention being less than 60% in the third group of measures, to include in his cognitive structure some elements that suggest evidence of significant learning to a greater degree.

Then, student A6 mentions the existence of some personal problems that affected her attention while solving the questions on the printed list. However, the results with Socrative and the levels of attention were higher with this one. There are indications of significant conceptual learning. According to A6, Socrative makes her more focused and less tense and this is reinforced by her understanding that the teacher's feedbacks favor new understandings.

Student A4, who obtained the highest percentage differences in the first and third groups, presented significant correlated subordinate learnings, as there was a modification and delimitation of the existing subunits. Like A5, student A4 attributes to teacher feedback and Socrative as elements that favor her attention. In our understanding, attention was also favored by the progressive transition between the new prior knowledge that took her from mechanical learning to meaningful learning.

Student A3, although he did not mention difficulties, was distracted by the different questions on the printed list and the same did not happen when solving the Socrative question.

5. Conclusion

The research presented in this article brings a number of important elements to be discussed in Education. The search for academic excellence involves teaching and learning. A teaching focused on student learning, capable of implementing methodologies that promote engagement in the classroom. Teaching that seeks a significant variety of audiovisual resources, laboratory materials and, mainly, the use of ICT. Mobile devices, in this sense, contribute significantly to the desired engagement by teachers from different areas of knowledge. Devices such as smartphones and tablets, for example, represent the technological world of youth that reaches universities across the country, regardless of social class. Teachers working in higher

education, private and public, confirm this statement. While some reject the use of these technologies in the classroom, there are those who accept their use and include these technologies in our routines, as they know the difference they can and make in student learning.

The results of this research are initial studies that confirmed the expectations and convictions of this quality education sought by teachers in all areas. The Socrative is an application that, through an active work methodology, enhances the attention of students to develop meaningful learning.

From the analyzes carried out it is a fact that the levels of attention fluctuate much more in the resolution of exercises in a printed list in relation to Socrative. The least oscillating cases are present in the measurements obtained with students A1, A2 and A3. We maintain that these few fluctuations between the six levels of attention are directly related to more elaborate and in-depth meaningful learning for these students. In these, knowledge was already assimilated into their cognitive structures. The diversity of subunits that facilitate the understanding of the phenomena allows students A1, A2 and A3 to work with the complexity of subjects related to the mechanics of bodies and particles.

The engagement process with Socrative, free of distractors as a "polluted" list of questions to be evaluated, coupled with the teacher's feedbacks, enrich and sustain the knowledge of students A1, A2 and A3 which allowed us to observe the evidence of learning more elaborate changes throughout the research. These are possible to be observed by the constant availability of exercises that the teacher prepares for his students. These are questions elaborated from their previous knowledge. Such issues are rebuilt to new knowledge, increasingly complex, are contemplated to the extent that significant learning indicia to be checked by the teacher. Attention plays a fundamental role in this process. And this is favored when the material prepared by the teacher is rich in situations that lead him to think and reflect on the existing knowledge and the new knowledge provided by the teacher. The Socrative is therefore an integral part of the potentially significant material prepared by the teacher, as with the application, the student's attention is focused on a single issue. And, to promote student learning, it is not enough to have potentially significant material. There needs to be interaction between the teacher and his students in the classroom.

However, if the teacher does not produce potentially meaningful material, engagement and attention will be reduced. In order to keep attention levels high in this type of work, we suggest that the teacher always have a database with different types of questions and that involve all types of meaningful learning. Feedback should be a constant practice. The teacher needs to go beyond correction to the right answer in this feedback. It is also necessary to present the ways that invalidate the answers.

We intend, in future works, to extend and investigate attention in this and other teaching and learning contexts. This initial study can be extended to other forms of interaction between subject and object. The subject as the one who learns and object as what one wants to know and learn. The means of learning are varied. Movies, books and interactions between subjects are means by which it is possible to develop different forms of Meaningful Learning. In this sense, investigating attention with these different ways of learning is a necessity so that we can understand how a student builds his knowledge. And yet, what forms (videos, reading, software, etc.) that most favor a student's attention when he is in the learning process.

Finally, in future works, it is desired to increase the number of subjects to prove the relevance

of the findings of this investigation. In addition to this expansion, the intention is to investigate attention in the fields of neuroscience, seeking partners from different areas of science, such as biology and psychology. The existence of other factors that influence attention, such as human physiology and psychological states, are relevant according to studies published by these areas. One of the initial hypotheses would be to verify the relationship between the feelings of pleasure with the students' attention and the acceptance of the Socrative App, since there may be a close link between them. This is in line with related studies (FEUERSTEIN, 1980; SCHACTER, 1996; SCHULTZ, 2007) that highlight the role of dopamine, the neurotransmitter responsible for sensations of pleasure, attention and cognition, among others, which comes into play for internal motivations and external to individuals.

6. Acknowledgement

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Association between resilience and self-compassion in patients with fibromyalgia

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Abstract

Fibromyalgia is a chronic, non-inflammatory syndrome characterized by diffuse musculoskeletal pain and tender points in some body areas. Thus, studies based on fibromyalgia patients' experience are critical, as they end up having a loss in their personal relationships over time, personal chores, self-esteem, security, and motivation to life. The general objective of this study is to investigate the association between resilience and self-compassion in patients with Fibromyalgia. The present research has a quantitative, descriptive, and transversal design. This study will consist of Fibromyalgia patients from the Metropolitan Region of Rio Grande do Sul/Brazil. The sample was composed of 30 participants, over 25 years old, of both sexes, selected for convenience. These participants were invited based on contacts acquired in a social network of Fibromyalgia patients and care services for patients with the syndrome. The instruments used in data collection, all self-reported, were: Fibromyalgia Impact Questionnaire (FIQ), the Resilience Scale, and the Self-Compassion Scale. Descriptive analyzes were performed, showing the absolute value, the mean, and standard deviation. Association analyzes were also performed using the Spearman test and Linear Regression tests, with a significance level ≤0.05. There was no significant difference between resilience and self-compassion over the study period. The participants presented the resilience variable with values that were found in the expected average. The present study showed a moderate correlation between resilience and self-compassion. The decrease in the impact of fibromyalgia is associated with less use of the problem-solving strategy and an increase in the Mindfulness strategy. Mindfulness is the most apparent component of self-compassion in the study. Therefore, it is possible to identify in this research the low level of the variable resilience in patients with the syndrome.

Keywords: Fibromyalgia syndrome; resilience; self-compassion; Mindfulness.

1. Introduction

Fibromyalgia syndrome is defined as a chronic non-inflammatory painful syndrome, with an unknown etiology manifested in the musculoskeletal system. It is characterized by pain throughout the body, distributed in ligaments, joints, bones, and mainly muscles[1,2,3]. However, for Chaitow[4], fibromyalgia is characterized by a generalized pain disorder with a high level of sensitivity in points spread throughout the body. These points are called Tender Points, which are characterized by 18 pain points. In addition to intense muscle pain distributed in various parts of the body, known as diffuse pain, it also presents symptoms such as stress, fatigue, and sleep syndrome[5]. Fibromyalgia syndrome can have stressors influenced by genetics, emotional, and environmental aspects, which cause anatomical changes in the endocrine system, in addition to depression, irritable bowel, and temporomandibular disorder. This syndrome can also be characterized in a psychosomatic way, with modulations in relation to pain originating in the central nervous system and spinal cord[6].

Groddeck[7] believes that the illness process happens through an unresolved conflict: something repressed, with the symptoms as symbolic. The repressed reason must be prevented from reaching consciousness. Also, Fibromyalgia is often associated with anxiety and depression, which generate relevant

symptoms, such as non-restorative sleep, chronic migraine, short-term memory problems, irritable bowel syndrome, fatigue, and blurred vision as mentioned above[8].

It might become physically and emotionally exhausting to live part of the time in a framework of chronic pain. Pain can have severe consequences and significant losses in daily activities, compromising the individual's life, affecting not only him/her but also the family and close people. It is exhausting to live in pain. It requires great physical and mental effort. There is a search for cure and relief of symptoms that is difficult to find, which can then lead to hopelessness, sadness, and demotivation[9]. Sasdelli and Miranda[11] highlight the importance of empathy for the patient with Fibromyalgia, trying to understand what the pain represents to him/her and whether there is any secondary gain from the pain is essential. As the patient reports about his aches and representations, he/she starts to have more significant experience and understanding about what he/she feels, leaving the passive position of the experience and assuming a posture of growth. It is also considered that pain, in most cases, will be the person's eternal companion, who will subject him/her to some restrictions. Therefore, it is essential to give meaning to the process of becoming ill.

In search of this significance and importance of knowing how to live in these conditions, I aimed to study the resilience of fibromyalgia patients. The study of resilience in the psychological sphere is still recent, dating from the last four decades. It is still in the process of construction, presenting, then, controversies and inaccuracies. According to Benetti and Crepaldi[12], there is a great evolution in research and scholars' thoughts regarding resilience. Still, according to the authors, this phenomenon is treated as an individual personality trait, which recently began to be studied as a base parameter in the relationship that the subject establishes with people significant to him or her. Therefore, the conceptualization of resilience was defined, at first, by a set of personality traits and abilities that make people who go through traumatic experiences, invulnerable. So, they do not develop psychic diseases, making them resistant[13].

Resilience can promote a new meaning of life for the individual. It is considered an evolutionary and health concept characterized by the dynamic processes that integrate and organize human beings' adaptive experiences and functioning[14]. Job[15] says that resilience is developed throughout life. The individual has his/her first experiences with childhood resilience, assuming that the family context contributes to its future development. However, resilience can be a protective factor for individuals from psychological imbalances, since childhood, in situations of vulnerability, which go through cases of exposure to intrafamily, urban and school violence, loss of loved ones, and separations[16,17]. Therefore, individuals with the capacity to recover and have a healthy development in adulthood are considered resilient.

Corroborating the study, the question about self-compassion in fibromyalgia patients was present. Self-compassion is understood as an effective and adaptive emotional regulation tactic to deal with unwanted or unpleasant thoughts or feelings, painful or adverse life events, and, therefore, associated with emotional and psychological well-being. According to Neff[18], self-compassion means compassion towards yourself, within yourself, for a balanced view of yourself, as well as of your negative emotional experiences. Being self-compassionate is about being kind to yourself when challenged with your own personal, emotional weaknesses or eventual difficulties, being more and more associated with resilience[19].

The constitution of self-compassion helps individuals to solve problems that can reach resilience. More self-compassionate people do not blame themselves when they fail, becoming able to admit mistakes and modify behaviors, taking on new challenges. In this sense, high levels of self-compassion are related to the increase in feelings of happiness, curiosity, optimism, and connectivity, as well as the decrease in depression, anxiety, rumination, and fear of failure[20].

2. Method

The design was quantitative, descriptive, and transversal. A convenience sample was used to conduct the research. The minimum age of 25 years old was used as an inclusion criterion since it was decided to study an adult sample. Thirty women participated in this study, which was also opened to men, but no men volunteered. This study's population consisted of Fibromyalgia patients from the Metropolitan region of Rio Grande do Sul/Brazil. The exclusion criteria were people under 24 years of age, living outside the Metropolitan region of Rio Grande do Sul and without a medical report/diagnosis.

The data were collected online using the google forms platform. Participants filled out a brief sample characterization sheet with some personal data and three instruments, described below:

1. The Resilience Scale - this scale was developed by Wagnild and Young[21] and has been used to measure resilience assessed by levels of positive psychosocial adaptation in the face of significant life events[22]. It consists of 25 items, with a Likert-type answer, ranging from 1 (strongly disagree) to 7 (strongly agree). Scores range from 25 to 175, and high values indicate high resilience[22]. This scale was adapted and considered relevant to Brazilian culture[22].
2. Self-Compassion Scale - developed by Neff[23], and it comprises 26 items (each one evaluated by a five-point Likert scale) that aggregate the isolation facets of humanity, Mindfulness, identification, kindness to oneself, and severe self-criticism.
3. Fibromyalgia Impact Questionnaire (FIQ) - in 1991, Burckhardt et al.[24] proposed and tested an instrument to assess the quality of life specifically in fibromyalgia patients, the Fibromyalgia Impact Questionnaire (FIQ). This instrument comprises issues related to functional capacity, professional situation, psychological disorders, and physical symptoms. It consists of 19 questions, consisting of 10 items. The higher the score, the more significant the impact of fibromyalgia on quality of life. The authors concluded that the FIQ is valid for use in clinical and research situations. Furthermore, in Brazil, there is still no valid FIQ proposal.

This research project was submitted to the Feevale University Research Ethics Council. Its nature and objectives were clarified, as well as the benefits, risks, and the absence of burden to the participants. It is in accordance with the Regulatory Guidelines and Norms for Research Involving Human Beings, present in Resolution no. 466 of December 12th, 2012, of the National Health Council[25].

The study took place only after acceptance by the ethics committee under opinion number 3,962,449. The volunteers' participation was consented through the acceptance of the Free and Informed Consent Term - FICT. The term clearly indicated the research's objectives and procedures, guaranteeing the privacy, confidentiality of information, and how the data collected was used. Besides, the freedom to withdraw without a loss was ensured.

3. Results

The presentation of results is organized in three stages. In the first, the results of the sample characterization will be presented. Afterwards, the descriptive results of the psychometric instruments used will be presented. Finally, correlational analyzes between the dimensions of self-compassion and resilience will be presented.

The characteristics of the 30 participants who made up the final sample of this research will be described, being 100% female (n=30) with an average age of 44.07 (SD=9.60), ranging in age from 27 to 57 years. Regarding the diagnosis, the average time was 6.53 years (SD=5.11), with a minimum of one year and a maximum of 20 years. The group that received the diagnosis less than or equal to 4 years ago (n=12) represented 40% of the sample, and those who received it within 5 years (n=180) were 60%. The study of comparison of means of the variable time of diagnosis was carried out using the Mann Whitney test. Still, no significant difference was found concerning the resilience and self-compassion variables.

Regarding education, 10% of the sample had incomplete primary education (n=3), 30% completed high school (n=9), 20% incomplete higher education (n=6), and the majority of 40% with higher education complete (n=12). In the analysis of the comparison of this variable's means using the Kruskal-Wallis non-parametric test, no significant difference was found with the resilience and self-compassion variables.

The resilience variable analysis showed an average of 129.33 points (SD=15.64), with a minimum result of 88 and a maximum of 155 points. Considering that the instrument has a Likert scale of 1 to 7 points, the instrument's average was 5.17 (SD=0.62). In the classification of the resilience variable, it was identified that 26.7% of the sample has low resilience (n=8), 60% average resilience (n=18), and 13.3% high resilience (n=4). This instrument has 5 dimensions, which increasingly appeared in the following sequence: Optimism (4.07; SD=1.05); Personal competence (5.07; SD=0.85); Self-discipline (5.12; SD=0.67); Autonomy (5.68; SD=0.91); Troubleshooting (6.01; SD=0.62). Thus, it is observed that the participants in our study with Fibromyalgia have, in general, higher levels of problem-solving and lower levels of optimism regarding the components of resilience. In the comparison of means of the variable resilience classification, using the Kruskal-Wallis test, a significant difference was found in the variables of self-compassion (p=0.004) and their dimensions of Over Identification (p=0.004), Isolation (p=0.013), Mindfulness (p=0.008), Self-Kindness (p=0.024) and Self-Criticism (p=0.019). The highest results of self-compassion are found in high resilience.

The variable self-compassion had an mean of 75.83 points (SD=18.96), with a minimum of 38 and a maximum of 114 points. The instrument has a Likert scale from 1 to 5, which had an mean of 3.03 points (SD=0.759). The instrument has six dimensions that are presented in an increasing way: Self-criticism (2.41; SD=1.02); Identification (2.59; SD=1.01); Isolation (2.95; SD=1.06); Self-Kindness (3.23; SD=0.830); Sense of humanity (3.61; SD=0.830); Mindfulness (3.67; SD=0.81). Therefore, it is observed that Fibromyalgia patients have, in general, higher levels of mindfulness and lower levels of self-criticism in relation to the components of self-compassion.

In the Fibromyalgia Impact assessment instrument (FIQ), which analyzes the period of the last seven days and presents a variation from 0 to 79 points, an overall mean of 46.47 points was identified

(SD=9.95), with a minimum score of 20 and a maximum of 66 points. Table 1 shows the descriptive analysis of the first part of the FIQ regarding functional capacity.

Table 1. Descriptive analysis of functional capacity

Variable	N	Min	Max	Mean	SD
Frequency of shopping	30	0	2	0.80	0.805
Frequency of laundry washing	30	0	3	0.97	0.809
Frequency of cooking	30	0	2	1.00	0.788
Frequency of doing the dishes	30	0	3	1.00	0.871
Frequency of cleaning the house (sweeping, wiping, etc.)	30	0	3	1.63	0.890
Frequency of making the bed	30	0	2	1.00	0.871
Frequency of walking several blocks	30	1	3	2.00	0.587
Frequency of visiting family or friends	30	0	2	1.40	0.814
Frequency of gardening	30	0	3	2.13	0.776
Frequency of driving a car or riding a bus	30	0	3	1.13	0.860

Table 2 shows the sample participants' perception concerning questions about the number of days they felt good, and days they could not perform their activities.

Table 2. Participants' perception of the last week

Variable	N	Min	Max	Mean	SD
In the past seven days, how many days have you felt good?	30	0	7	3.40	1.754
In the past seven days, because of fibromyalgia, how many days have you missed work (or stopped working if you work at home)?	30	0	7	2.37	1.991

Table 3 shows the participants' perception of their activity capacity, physical and emotional sensation, on a scale from 0 to 5, with 0 (not interfering) and 5 (very disturbing).

Table 3. Descriptive analysis of the participants' perception of activity capacity, physical and emotional sensation

Variable	N	Min	Max	Mean	SD
How much has fibromyalgia interfered with doing your job?	30	0	5	3,33	1,516
How much pain have you felt?	30	0	5	3,80	1,297
Have you felt tired?	30	2	5	4,43	0,858
How have you felt when getting up in the morning?	30	1	5	4,10	0,995
Have you felt stiff (or your body stuck)?	30	1	5	4,10	1,062
Have you felt nervous or anxious?	30	1	5	4,00	1,145
Have you felt depressed or discouraged?	30	1	5	3,87	1,106

In the correlation study carried out using the Spearman test, a moderate correlation was identified between the variables Resilience and Self-Compassion (rho = 0.636; p = 0.000). The impact of fibromyalgia demonstrated a correlation with resilience (problem-solving) (rho = 0.496; p = 0.026).

The optimism dimension of Resilience showed a correlation with Education (rho = -0.415; p = 0.022). A correlation was also found in the Self-Compassion's dimensions of Isolation of (rho = 0.363; p = 0.049), Self-Kindness (rho = 0.431; p = 0.017), Sense of Humanity (rho = 0.510; p = 0.004) and Self-Criticism (rho = 0.366; p = 0.047).

The dimension of Personal Competence of Resilience demonstrated correlation with the Self-compassion's dimensions of Identification (rho = 0.521; p = 0.003), Isolation (rho = 0.624; p = 0.000), Mindfulness (rho = 0.500; p = 0.005), Self-kindness (rho = 0.423; p = 0.020), Sense of humanity (rho = 0.540; p = 0.002) and Self-criticism (rho = 0.498; p = 0.005).

The Resilience's Self-Discipline dimension demonstrated a correlation with the Self-Compassion's dimensions of Identification (rho = 0.434; p = 0.016), Isolation (rho = 0.509; p = 0.004), and Mindfulness (rho = 0.362; p = 0.050).

Linear regression analysis was performed using the stepwise method, with a significance level ≤ 0.05, with the total FIQ - Fibromyalgia Impact Assessment as the dependent variable. Table 4 shows the analysis of the explanatory model.

Table 4. Multiple Linear Regression of the dependent variable FIQ - Impact of Fibromyalgia

	Nonstandard coefficients		Standardized coefficients			Collinearity statistics	
Model	B	Standard error	Beta	t	Sig.	Tolerance	VIF
(Constant)	16,605	14,837		1,119	0,273		
Troubleshooting	8,814	2,591	0,551	3,402	0,002	0,883	1,132

In the analysis presented in Table 4, the relationship (signal and intensity) between the Fibromyalgia impact variable assessed by the FIQ (dependent, explained) was directly verified with the problem-solving variable, which is a dimension of the resilience variable. An indirect relationship between the impact of fibromyalgia and the Mindfulness dimension of the Self-Compassion variable was also identified. In this model, an R square (R^2) of 0.376 was obtained. This coefficient of determination is a measure of the efficiency of the regression equation. It indicates that 37.6% of the variations in fibromyalgia impact can be explained by variations in resilience (problem-solving) and self-compassion (mindfulness). In this group, it is noticed that the decrease in the impact of fibromyalgia is associated with less use of the problem-solving strategy and an increase in the Mindfulness strategy.

4. Discussion

Fibromyalgia affects mainly women, reaching a level of 75 to 95% compared to men[5]. It affects mostly women in the age group between 30 and 60 years and may also appear during childhood and adolescence[1,2,3]. In this study, it was possible to verify that the respondents' average age was in the age

group of 44 years old, varying between 27 to 57 years old. The participants' average diagnosis time was 6 years, with 60% diagnosed more than 5 years, with a minimum period of 1 year and a maximum of 20 years. Through this study, no difference was identified between resilience and self-compassion for the time of diagnosis. Another point considered in which it could give some alteration in resilience and self-compassion would be the participants' academic formation. However, there was no significant difference between resilience and self-compassion for the study's time, even though the majority, around 40% with completed higher education.

This study aimed to investigate the association between resilience and self-compassion in patients with Fibromyalgia. However, most participants, being 60%, had medium resilience, and the minority (13.3%) showed high resilience. It appears, then, that most fibromyalgia patients, seen by this study, do not show a high level of resilience, which is based on optimism, personal competence, self-discipline, autonomy, and problem-solving. It is observed that the study participants with Fibromyalgia have, in general, higher levels of problem-solving and lower levels of optimism regarding the components of resilience. Barbosa[26] cites optimism as the ability to believe that situations will change and always remain positive and hopeful about the future, managing adversities that may arise. Thus, this study's participants have certain disbelief concerning the future and the possibilities to improve from the syndrome. On the other hand, they showed higher levels of troubleshooting together with self-efficacy, meaning the individual's belief in finding solutions to problems that may arise[26].

Comparing the means of the resilience classification, a significant difference was found in the variables of self-compassion and its dimensions of identification, isolation, mindfulness, self-kindness, and self-criticism. The highest results of self-compassion are found in high resilience. Therefore, it was found that Fibromyalgia patients have, in general, higher levels of mindfulness and lower levels of self-criticism concerning the components of self-compassion. For Neff[27], mindfulness means keeping the conscience in balance, accepting one's painful feelings and thoughts, instead of identifying oneself with them. Although the components of self-compassion are conceptually and phenomenologically distinct, they are interactive and interdependent. Therefore, being self-compassionate implies the well-being of the self, changing warmly when necessary. Being self-compassionate presupposes wanting well-being for the self, encouraging the change in a warm way when necessary, and correcting painful and dysfunctional behaviors.

The present study showed a moderate correlation between resilience and self-compassion. Also, the impact of fibromyalgia, there was a more significant relationship between resilience. A systematization of the characteristics that define resilience is given by the ease of adaptation of some aspects, such as identifying stressful situations, being realistic in assessing the capacity for self-action, and others before stressful factors. It is also recognized by the interpersonal skills and, in solving-problems efficiently, self-esteem and self-control, which allows individuals to face new experiences with a sense of competence[15,28].

5. Conclusion

It was observed that the study participants with Fibromyalgia have, in general, higher levels of problem-solving and lower levels of optimism regarding the components of resilience. It may show that dealing with

the difficulties of the syndrome in everyday life makes them more resistant to dealing with problems and competent to solve them. However, from a general angle, because they have lived with pain and specific difficulties for so long, optimism may become low.

Generally, higher levels of mindfulness and lower self-criticism levels were also identified concerning the components of self-compassion. It may mean that, over time, people with fibromyalgia start to value the here and now more, meaningful to mindfulness, that is, the present moment, than to think so much about tomorrow, because they do not know if they will be well or with ache. This study group showed that the decrease in the impact of fibromyalgia is associated with less use of the problem-solving strategy and an increase in the Mindfulness strategy, which was the most apparent component of self-compassion in the study, identifying in this research the low level of resilience of women with the syndrome. The study also showed correlations of resilience and self-compassion in patients with the syndrome, although sometimes low.

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Comparison between devices for homogenization and reduction of soybean grain samples

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Abstract

In the grain market the most diverse equipment is used for homogenization and reduction of the working samples. Thus, this paper aims to analyze the performance of devices used for sample homogenization and reduction for soybean classification. A sample composed of 8% of damaged soybeans with yellow and black coat was previously prepared. Samples were homogenized and reduced in bucket, crate, Boerner, 16:1 multichannel splitter and 4:1 multichannel splitter. The design used was completely randomized with five treatments (homogenizers) and one percentage of damaged grains (8%). Evaluations were subjected to analysis of variance and treatment means were compared to one another by Tukey test ($p \leq 0.5$) and to the mean of the original sample (8%) by Student's t-test. The devices Boerner, 16:1 multichannel splitter and 4:1 multichannel splitter were similar in the homogenization and reduction of the soybean sample. The crate and bucket showed the worst performance in the grain homogenization because they compromise the result of the product's qualitative analysis.

Keywords: Classification; *Glycine max*; homogenizers; official standard; quality.

1. Introduction

Over the years, soybean has stood out as the main crop in Brazil (Almeida et al. 2016; Carvalho et al. 2017). It is the crop with largest extension of cultivated area (Trautmann et al. 2014) and greatest economic expression, generating income and development in the regions of cultivation (Freitas 2011). In the 2019/20 season, the total production of soybeans in the country was around 120.09 million tons (CONAB 2020), which ranks Brazil as the world's largest producer of oilseeds.

There are elements that, combined, form the global competitiveness and determine the capacity of the soybean-producing country to maintain or expand its potential for participation in the world market. Among these elements, it is possible to cite price competitiveness, logistics, exchange rate policy, technology adopted and quality of products (Sampaio et al. 2012).

Evaluation of grain quality, checking for defects in soybean, allows to characterize the attributes, levels of damaged grains and also to determine the use according to the needs of each food chain associated (Lorini 2016).

Toxin detection process is complex and consists of three fundamental steps: collect the sample from the lot, prepare the material and collect subsamples for analysis, besides the quantification process (analysis) (Whitaker et al. 2011). There is a similarity in the process for classification of soybean grains, which also has three distinct stages: representative sampling of the grains of a lot, homogenization and satisfactory reduction into subsamples, which will be sent for classification (analysis), according to the parameters

established in the Normative Instruction nº 11/2007 of the Ministry of Agriculture, Livestock and Food Supply (Brazil 2007).

In an analysis, the sample should be obtained so that all grains that make up the lot have the same chance to be selected (Whitaker 2003). Sampling efficiency can be estimated by evaluating the variation of the results generated and by the adopted procedures of detection (Mallmann et al. 2013; Mallmann et al. 2014). For that, in the homogenization and reduction step, it is fundamental to use devices that keep the characteristics reliable, even at lower proportions, for the analysis of the attributes of the lot.

According to the norm of the International Standard Organization (ISO 2009), the composite sample must be fully homogenized before any procedure of division for analysis, and this norm establishes that the division of the working sample without previous homogenization leads to samples that do not represent the original lot.

In Brazil, the Normative Instruction (NI) MAPA nº 29/2011 (Brasil 2011a) recommends, as mandatory requirement to meet the certification of storage units, that it is necessary to have a homogenization system, without discriminating which device should be. The NI MAPA nº 11/2007 (Brasil 2007) establishes that the sample intended for classification should be homogenized and reduced by quartering, without mentioning which device would be recommended.

Given the above, this study aimed to analyze the performance of devices used to homogenize and reduce samples for the classification of soybean grains in storage units.

2. Material and Methods

The samples were prepared at the Laboratory of Postharvest of Plant Products of IF Goiano – Campus of Rio Verde – GO, Brazil, and at the Storage Unit of Caramuru Alimentos, municipality of Rio Verde, GO.

Damaged grains were simulated using soybeans with black coat (Figure 1), with moisture content of 10.7% (wet basis), which were added to the samples of product with yellow coat, with moisture content of 11.2% (w.b.), according to the method of ASAE (2003).

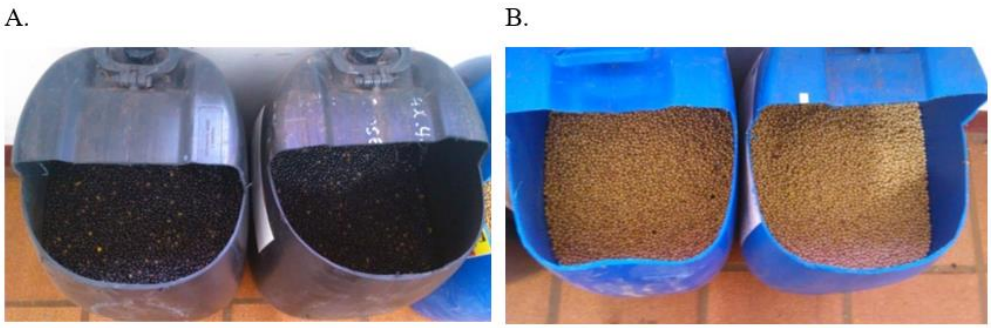

Figure 1. Samples of soybean grains with black coat (A) and yellow coat (B).

Soybeans with yellow coat and black coat were evaluated for bulk density, which was determined using a container with known volume (1 L), filled with grains of both coat colors in different lots, with a fixed falling height of 0.225 m. After filling and weighing, bulk density was determined based on the ratio between mass (kg) and volume (m^3) on semi-analytical scale. The results were 751.7 ± 1.90 kg m^{-3} and 748.7 ± 4.96 kg m^{-3} for yellow and black soybeans, respectively.

Procedures of uniformization and standardization of grain size were carried out by passing samples of soybeans with black and yellow coat through a sieve with 7.0-mm-diameter circular apertures.

Soybean samples were previously prepared with a level of 8% of damaged grains, represented by soybean with black coat.

Increments (primary sample) were prepared by taking the proportion of soybeans with yellow and black coat, and the samples were placed in a 2.10-m-long sampler with one opening stage.

The sampler had 14 intakes, with capacity for 0.9 kg of soybean. For the filling with grains, the sampler was positioned vertically with the intakes closed and the samples were proportionally inserted through the upper end, alternating a quantity of mass of soybean with black coat and another with yellow coat. The 8% level of damaged grains was achieved by adding 0.072 kg of soybean with black coat and 0.828 kg of soybean with yellow coat, divided into 14 parts, which corresponded to the number of intakes of the sampler.

Then, the manually-operated double-tube sampler was directly unloaded into a bucket. Each sampler unloaded was considered as an increment (a sampling point). For each replicate, a sequence of 11 increments was carried out to simulate 11 sampling points, as established in the NI MAPA nº 11/ 2007 (Brasil 2007), obtaining a composite sample of 9.9 kg.

The level of damaged grains (soybean with black coat) was evaluated using a minimum mass of 0.125 kg, according to NI MAPA nº 11/2007. For each device tested, 9 repetitions were performed.

Subsequently, these samples were homogenized and reduced in five devices: bucket with capacity for 12 kg, wooden crate (0.4 m wide x 0.6 m long x 0.2 m high), Boerner divider, 16 x 1 multichannel splitter, 4 x 1 multichannel splitter (Figure 2).

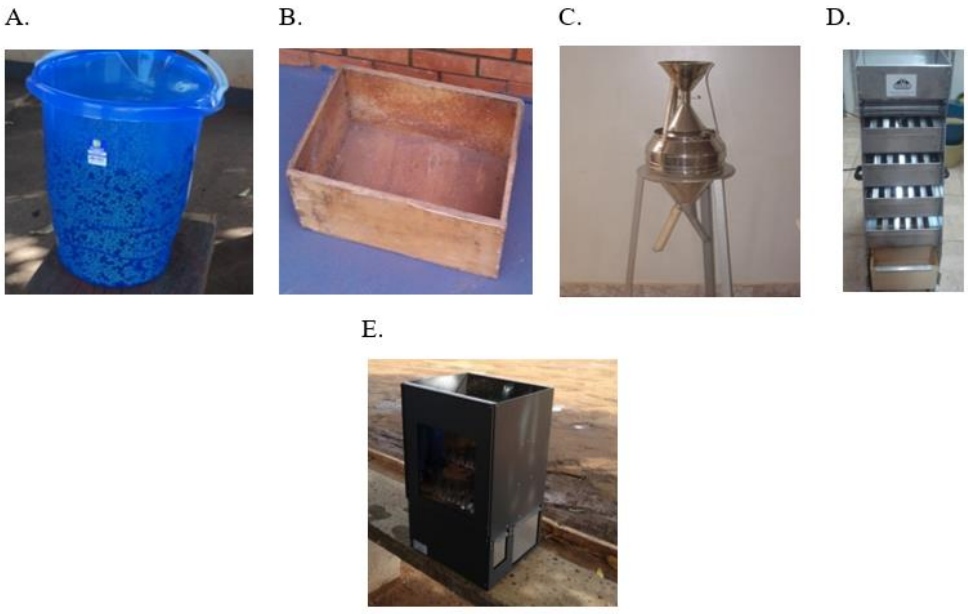

Figure 2. Illustration of the devices used for sample homogenization and reduction: (A) bucket; (B) wooden crate; (C) Boerner divider; (D) 16:1 multichannel splitter and (E) 4:1 multichannel splitter.

The 16:1 multichannel splitter is 0.32 m wide, 0.6 m long and 1.20 m high, consisting in the assembly of small splitters (stages), one below the other, from the discharge hopper of the device (Figure 3A).

The first and third splitters have 12 channels (six for the sample and six for the reject) with mean width of 25.39 mm, whereas the second and fourth splitters have 11 channels (six for the reject and five for the sample) with mean width of 25.30 mm and larger lateral channels, 39.18 mm. As the discharge hopper opens, the product crosses the first splitter, one part of it is intended for the sample and the other part is discarded, and so on until the subdivision to the container of the working sample, and the other part, of larger volume, for the reject (Figure 3A).

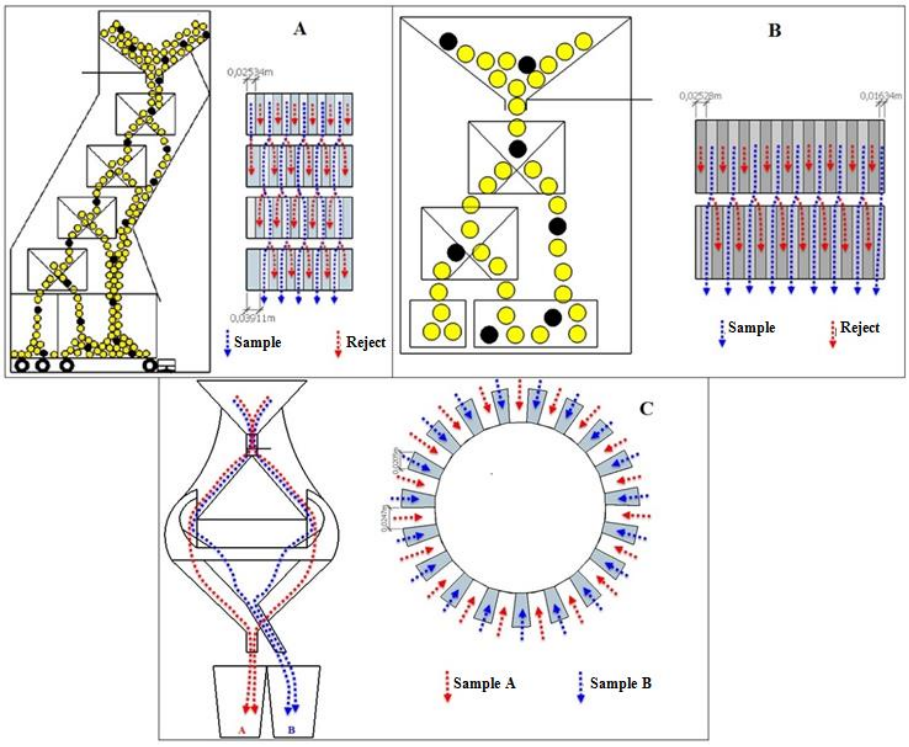

Figure 3. Scheme of homogenization, reduction and dimensions of the channels for the 16-channel splitter (A); 4-channel splitter (B) and Boerner divider (C).

The 4:1 multichannel splitter is 0.45 m wide, 0.41 m long and 0.64 m high, and consists in the assembly of two smaller splitters (stages), one on top of the other. The first one is formed by 18 channels (nine for the sample with mean width of 25.25 mm, plus a lateral channel with 16 mm width, and also nine channels for the reject with mean width of 25.25 mm), as illustrated in Figure 3B. This first splitter reduces and takes part of the sample to the reject, and the sample passes through a second splitter with 17 channels (9 channels for the sample and 8 for the reject), which also divides the grains, one part is discarded and the other part is used for the working sample. In this device, it is necessary to pass the grains more than once to reduce the working sample.

The Boerner divider has a hopper to pour the sample equipped with a valve that opens when one wants to perform the operation of homogenization. Grains pass through a funnel and randomly fall into an inverted cone which redistributes these grains along a diameter of 0.36 m, composed of a set of internal channels with 20.5 mm width and external channels with 24.7 mm width, which are directed to the internal and external funnels, and the samples are stored in containers. At least two homogenization procedures are

necessary (CANADA 2016) and only then the reductions are performed. Several passes are required depending on the final mass of the working sample (Figure 3C).

Figure 4 presents the sequence of procedures for homogenization and preparation of soybean grain samples.

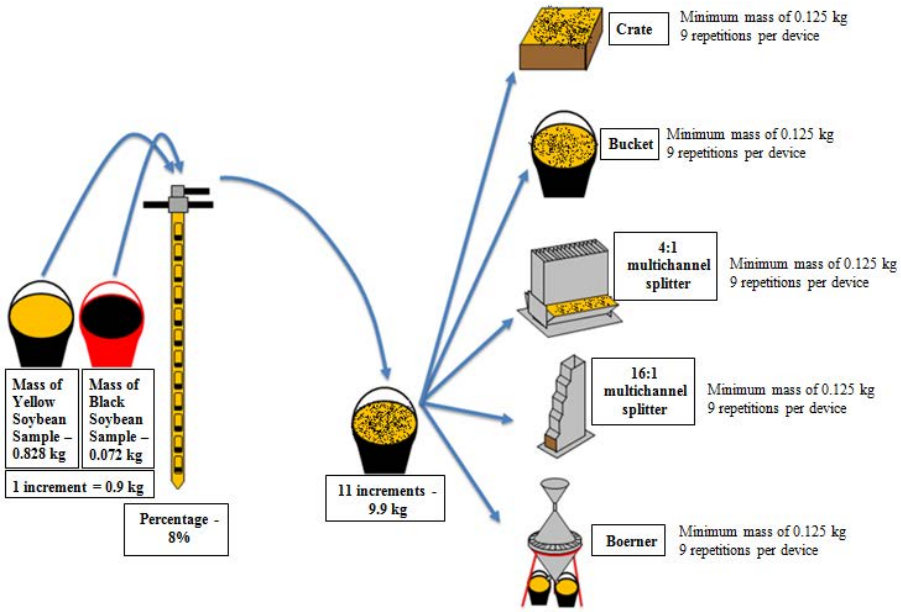

Figure 4. Schematic representation of the procedures of one repetition for homogenization of soybean grains.

For the Boerner divider and the 4:1 and 16:1 multichannel splitters, each sample was passed once for homogenization and then divided into three equal parts and put into buckets. Each bucket was considered as one replicate of the device. These samples were passed in the homogenizing device until a mass of at least 0.125 kg was obtained, according to the NI MAPA nº 11/2007, collecting three replicates for each device and each replicate with three subsamples which were identified, totaling nine replicates per device. For homogenization in the bucket, each replicate was manually homogenized always by the same operator, in the same container, and three subsamples were collected from each replicate, also totaling 9 replicates of at least 0.125 kg. For the crate, the sample was homogenized always by the same operator using a concave object with dimensions of 0.012 m x 0.006 m and in diagonal with 0.02 m depth. Such homogenization was carried out with horizontal movements in the longitudinal and transverse directions of the crate. After homogenization, the samples were collected using a concave object, weighed and identified.

After homogenization, the working samples with at least 0.125 kg, according to the NI MAPA nº 11/2007, were analyzed for the percentage of damaged grains (black coat).

Evaluations were performed in a completely randomized design, with five treatments corresponding to the homogenizers (bucket, crate, Boerner, 16:1 multichannel splitter, 4:1 multichannel splitter) and one percentage of damaged grains (8%), with minimum grain mass in the working sample of 0.125 kg, in nine repetitions. The results were compared to the original sample previously prepared with 8% of damaged grains.

The results were subjected to analysis of variance (ANOVA) and F test. Means of treatments (devices) were compared to one another by Tukey test and to the mean of the original sample (8%) by the two-tailed Student's t-test.

2. Results and Discussion

Table 1 presents the percentage of damaged grains collected after homogenization in the different devices evaluated for homogenization and division of samples.

Table 1. Means, coefficient of variation and p-value by t-test for damaged grains (% black soybean) collected in the samples after homogenization in the different devices evaluated.

Treatment	Means	C.V. (%)	t-test
Bucket	5.87 b	7.70	0.0000**
Crate	5.79 b	14.78	0.0001**
Boerner	7.89 a	10.38	0.690
16:1 Splitter	8.29 a	5.09	0.079
4:1 Splitter	8.37 a	11.30	0.283

Means followed by the same letter in columns do not differ at 0.05 significance level by Tukey test; C.V.: Coefficient of variation; (p-value) for the t-test; **Contrast relative to the original mean (8%), significant at 0.01 probability level by t-test (p-value).

It can be noted that the crate and the bucket did not differ with respect to the mean percentage of damaged grains by Tukey test at 0.05 significance level and showed greater discrepancies in comparison to the original sample prepared with 8% of damaged grains, both underestimating the actual value. Based on the t-test, the means of these two devices differed from that of the original sample prepared with 8% of damaged grains, at 0.01 significance level (Table 1).

The bucket and crate did not show satisfactory results for homogenization and reduction of the samples of damaged grains and are extremely dependent on handling. The operators may even be tendentious, although involuntarily, during the homogenization and collection of the working sample, which may lead to biased estimates.

The crate showed the highest CV among the devices used in the experiment, whereas the bucket and 16:1 splitter showed lower coefficients of variation. However, the bucket also showed a substantially lower mean compared to the original mean of 8%, and the Boerner and 4:1 splitter showed CV of 10.38% and 11.30%, respectively, and the most satisfactory means in comparison with the original value of 8%, being more adequate in the operations of homogenization and reduction, corroborating with Quirino et al. (2019). Lower percentages of damaged grains found in the bucket and crate indicate that these devices may cause loss for the parts involved in the commercialization, when used for homogenization and reduction of grains, despite using the sample size recommended by the NI MAPA nº 11/2007 (Brasil 2007).

The greatest difference from the original sample with 8% of damaged grains occurred for the crate (5.79%), which represents an error of 27.66%, followed by the bucket (5.87%), with error of 26.65% in comparison

to the expected mean.

These results were expected and show the inefficacy of utilization, in procedures of homogenization and reduction of composite sample, of methods that favor the interference in the handling by the operator, subject to the working environment conditions, physical fatigue during the work day, heterogeneity in the loads coming directly from the fields (Wagner & Esbensen 2014), and the subjectivity in the form of moving the grain mass and collecting the sample, in detriment of the representativeness of the working sample, which will be used to determine the quality of the original lot.

The devices Boerner, 16:1 multichannel splitter and the 4:1 multichannel splitter did not differ by Tukey test at 0.05 significance level and also did not differ from the mean of the original sample prepared with 8% of damaged grains by t-test at 0.05 significance level. In addition, these devices were the closest ones to the original sample, prepared with 8% of damaged grains (Table 1).

Although there was no difference between the Boerner and the 16:1 and 4:1 multichannel splitter, the mean of the Boerner device was closer to that of the original sample (8.0%), despite showing lower CV than the 4:1 multichannel splitter. Considering two decimal places, there were differences of 1.43% for the Boerner and of 3.62% and 4.58% for the 16:1 and 4:1 multichannel splitters, respectively (Table 1). The Boerner divider was the closest one and, like the 16:1 and 4:1 multichannel splitters, it also did not differ significantly ($p \leqslant 0.05$) by t-test from the mean originally prepared and expected. The Boerner divider has been the favorite for utilization in several scientific studies (Fonseca 2002; Al-Mahasneh & Rababah 2007).

The Boerner-type sample homogenizer and divider is the only device approved for homogenization and division of samples by the Canadian Grain Commission (CANADA 2016). The norm ISO 24333 (ISO 2009) indicates for grains not only the Boerner divider, but also the quartering iron (surface), quartering dividers (multiple grooves) with at least 18 channels, and also the mechanical centrifugal divider for small samples.

The RY 1075/94 norm XXII (SENASA 1994) of Argentina recommends that sample homogenization and division should be carried out using the Boerner device or a similar one that produces a similar result. The United States Department of Agriculture (USDA 2009) recommends the use of the Boerner homogenizer and divider or any other device that gives equivalent results when reducing the sample in size and accuracy level required.

The NI MAPA nº 29/2011 (Brasil 2011a) establishes that all storage units should have for certification a homogenization system. In addition, the current Normative Instructions in Brazil describe that the samples should be homogenized and quartered (Brasil 2007; Brasil 2011a). However, none of these instructions establishes the adequate equipment for this commercial operation, and these results may contribute to reviewing the norm. In Brazil, only the NI MAPA nº 54/2011 establishes and demands the use of homogenization equipment for the operations in which the official classification is mandatory (Brasil 2011b).

In relation to the use of devices which require less interference from the operators (Boerner and 4:1 and 16:1 multichannel splitters), the Boerner divider requires higher number of passes of the same sample to attain the required working mass, needs a longer time for homogenization and emits high level of noise in the operation room.

The 4:1 multichannel splitter requires higher number of passes than the 16:1 multichannel splitter and makes the work slower. However, both splitters emit a tolerable level of noise, much lower for the 16:1 multichannel splitter, which requires lower number of passes according to the size of the working sample used. Consequently, this device requires shorter time to prepare the sample.

5. Conclusion

The homogenizing and reducing devices Boerner, 16:1 multichannel splitter and 4:1 multichannel splitter are similar in the reduction and homogenization of soybean grain samples, using the sample size established by the NI MAPA nº 11/2007.

For commercial operations, we recommended the use of Boerner divider and multichannel splitters with reductions of 4:1 and 16:1.

The devices crate and bucket show unsatisfactory performance compared to the original sample with 8% of damaged grains and are not adequate for homogenization and reduction of grain samples, because they compromise the results of the product's qualitative analysis.

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Thailand Performance and Best Management Practices that saved lives against Covid-19: a comparison against ten critical countries

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Abstract

1,002,137 lives were officially lost by Covid-19 until 27th September 2020 (WORLDOMETERS, 2020), with countries eager to learn from successful nations against the virus. An international survey, published in April/20, by Silva (2020a, p. 600), concluded that although no country is prepared to face epidemics and pandemics, among the 16 countries investigated, Thailand, Finland, Australia, SK, Denmark, and Sweden are cases that Brazil could study so as not to repeat the scenarios of China, USA, Italy, and Spain. Thus, this study investigates the performance and the best management practices (BMP) adopted in Thailand to save lives against Covid-19, during the first 180 days facing the pandemic. The research is useful for the academy, government policymakers, and authorities. It is descriptive, with the application of an online questionnaire, bibliographic and documentary research, involving the study of official sites, articles, reports, manuals, and other technical documents. The Fatality Total Index (FTI) developed by Silva (2020b p. 563) was used to evaluate 21 countries. The main conclusions are: 1) the ten most critical are Mexico, Peru, Italy, Ecuador, Iran, Chile, UK, Belgium, Colombia, and Brazil; 2) Thailand`s FTI180 is very low, indicating that this country has learned from the lessons of the past, reason by which is the best at saving lives against the Covid-19; 3) for 86 respondents living in Thailand, wear a mask, not shake hands, not hug in public, wash hands, and not wearing shoes in the house, were the five most decisive cultural practices that saved lives; 4) for 96 respondents living in Thailand, the ten main policy measures adopted by the Thailand Government that saved lives against the Covid-19 are international travel control, public event cancellations, schools closures, restriction on internal movement, workplaces closures, public information campaigns, effective public-private collaboration, increase the medical and personal equipment capacity, support the expansion of the testing system, and wage subsidies for workers; 5) to save lives against Covid-19, 28 innovative products or services were identified in Thailand, with the majority led by Corporations, Universities, followed by Public Sector, Start-Ups, and Others.

Keywords: BMP; Covid-19; Culture; FTI; Leadership by example; Innovation; Policy.

1. Introduction

Since the last day of 2019, we are facing a new challenge, when a virus spread across the world from China, called by the World Health Organization (WHO, 2020) as Coronavirus disease, well known as Covid-19, from Severe acute respiratory syndrome coronavirus2 (SARS-CoV-2).

Until now, there is no effective vaccine or treatment against the Covid-19, reason by which, every nation is trying to adopt several measures to reduce the pandemic impact on its population and economy. Considering the number of total cases, three months since the last day of 2019, on March 31, 2020, the 10 most critical countries were the USA, Italy, China, Spain, Germany, France, Iran, UK, Switzerland, and Netherlands (SILVA, 2020a).

In that time (March/20), Silva (2020a): a) developed an international survey with 16 countries related to the evolution of new cases of Covid-19; b) showed 10 reasons by which Brazil (it was in the 19th place) could move the world; c) provided ten conclusions and recommendations, and some of them were: c1) Brazil could be among the most-affected country before the end of May 2020; c2) although no nation is prepared to face epidemics and pandemics (NTI, JHU, and EIU, 2019), among the sixteen countries, investigated, Thailand, Finland, Australia, South Korea, Denmark, and Sweden are cases that Brazil could study so as not to repeat the scenarios of China, USA, Italy, and Spain; c3) the research focused only the number of new cases per day, so it was recommended a study involving the fatal cases.

To complement Silva (2020a) survey, this research main goal is to investigate the performance and the best management practices (BMP) adopted in Thailand to save lives against Covid-19, during the first six months facing the pandemic. The specific objectives are a) define the ten most critical countries; b) compare the performance of Thailand with the ten most critical countries; c) identify the best management practices adopted in Thailand, taking into consideration cultural practices, main policy measures, and innovative solutions; d) present the ten best behaviors that a leader of a nation should adopt to inspire and get people support against the pandemic.

The research is relevant:

1) for government leaders, policymakers, or managers of health systems since they will know the best practices developed by Thailand against the Covid-19 during the first semester;

2) for academy it can be useful to develop strategies for preventing or controlling similar pandemic episodes in the future. In addition, for the behavior theory the study proposes ten attitudes considered crucial for a leader of a nation to get people support against the virus, opening new opportunities to grasp the impact of each behavior on the nation ability to save lives over the time;

3) although several authors have published relevant information about Covid-19 (BASHIR et al., 2020; CHAKRABORTY, AND MAITY, 2020; COWLING et al., 2020; CUI et al (2003); FLAXMAN et al., 2020; HA et al., 2020; LA et al., 2020; KAN et al. (2005); MAHATO, PAL, AND GHOST, 2020; SILVA, 2020; PANG (2003); PRATA, RODRIGUES, AND BERMEJO, 2020; ZAMBRANO-MONSERRATE, RUANO, AND SANCHEZ-ALCALDE, 2020; SAADAT, RAWTANI, AND RUSSAIN (2020); SVOBODA et al. (2004); YUNUS, MASAGO, AND HIJIOKA, 2020; WANG, NG, AND BROOK, 2020), there is a need to compare the performance of a benchmark country against critical nations, taking into consideration the real estimated number of Covid-19 fatal cases by one million

population during the first 6 months facing the pandemic, as well as to identify the benchmark country`s cultural aspects, policy measures, and innovative solutions adopted over the time.

2. WHO, SARS, and 20 leading countries with total fatal cases

The WHO is the global guardian of public health, with more than 7000 professionals in more than 150 countries working with over 300 topics, the most popular are Ebola, Nutrition, Hepatitis, and now Covid-19. In addition, according to WHO (2012), an epidemic of Severe Acute Respiratory Syndrome (SARS-CoV) appeared in Nov/2002 in southern China. According to WHO (2003), until August 7, 2003, it affected 8422 people from 32 countries with a total of 916 fatal cases (10,9%), most located in China (5327 cases; 349 deaths), HK (1755 cases; 300 deaths), Taiwan (665 cases; 180 deaths), Canada (251 cases; 41 deaths), Singapore (238 cases; 33 deaths), Vietnam (63 cases; 5 deaths), USA (33 cases; 0 death), Thailand (9 cases; 2 deaths), and Malaysia (5 cases; 2 deaths).

Since then, several authors (HOLMES, 2003; PANG, 2003; WATTS, 2003; BELL, 2004; INSTITUTE OF MEDICINE, 2004) provided information about the virus and also called the attention of the leaders about measures necessary to prevent, control, and respond to future global outbreaks.

After seventeen years, the WHO Office, in China, informed on December 31, 2019, the occurrence of people suffering from unknown pneumonia in Wuhan. On February 11, 2020, WHO announced as a new virus of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) with a popular disease name as Covid-19, and almost one month later, it was announced as a pandemic.

#	Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop
	World	33,297,501	+250,460	1,002,137	+3,852	24,621,170	7,674,194	65,337	4,272	128.6		
1	USA	7,320,669	+33,108	209,453	+276	4,551,321	2,559,895	14,100	22,085	632	104,322,093	314,722
2	Brazil	4,732,309	+14,194	141,776	+335	4,060,088	530,445	8,318	22,225	666	17,900,000	84,067
3	India	6,073,348	+82,767	95,574	+1,040	5,013,367	964,407	8,944	4,391	69	71,257,836	51,514
4	Mexico	726,431	+5,573	76,243	+399	521,241	128,947	2,631	5,620	590	1,665,057	12,882
5	UK	434,969	+5,693	41,988	+17	N/A	N/A	262	6,399	618	23,188,836	341,150
6	Italy	309,870	+1,766	35,835	+17	224,417	49,618	254	5,127	593	11,087,064	183,439
7	Peru	805,302	+5,160	32,262	+120	664,490	108,550	1,370	24,343	975	3,850,122	116,383
8	France	538,569	+11,123	31,727	+27	94,891	411,951	1,098	8,247	486	10,556,474	161,639
9	Spain	735,198		31,232		N/A	N/A	1,465	15,723	668	11,820,505	252,795
10	Iran	446,448	+3,362	25,589	+195	374,170	46,689	4,059	5,299	304	3,932,571	46,677
11	Colombia	813,056	+7,018	25,488	+192	711,472	76,096	2,220	15,938	500	3,636,868	71,293
12	Russia	1,151,438	+7,867	20,324	+99	943,218	187,896	2,300	7,889	139	45,100,000	309,010
13	South Africa	670,766	+1,268	16,398	+22	603,721	50,647	539	11,276	276	4,143,466	69,652
14	Argentina	711,325	+8,841	15,749	+206	565,935	129,641	3,604	15,704	348	1,905,361	42,065
15	Chile	457,901	+1,922	12,641	+50	431,704	13,556	888	23,904	660	3,228,414	168,535
16	Ecuador	134,747	+766	11,279	+6	112,296	11,172	355	7,610	637	418,785	23,651
17	Indonesia	275,213	+3,874	10,386	+78	203,014	61,813		1,004	38	3,207,055	11,695
18	Belgium	112,803	+1,827	9,974	+5	19,246	83,583	120	9,723	860	3,108,977	267,972
19	Germany	286,338	+1,313	9,534	+2	250,800	26,004	325	3,415	114	15,642,654	186,557
20	Canada	153,125	+1,454	9,268	+6	131,098	12,759	97	4,049	245	7,117,709	188,190

Fig. 1: The 20 most critical countries in terms of total deaths cases of Covid-19 on September 27, 2020
Source: Worldometers (2020)

Due to its fast transmission, after 271 days (Figure 1), since the first official case, at 23:59 (GMT) on September 27, 2020, the world officially exceed one million fatal cases, with 1st) USA (209,453), 2nd) Brazil (141,776), 3rd) India (95,574), 4th) Mexico (76,243), 5th) UK (41,988), 6th) Italy (35,835), 7th) Peru (32,262), 8th) France (31,727), 9th) Spain (31,232), 10th) Iran (25,589), 11th) Colombia (25,488), 12th) Russia (20,4324), 13th) South Africa (16,398), 14th) Argentina (15,749), 15th) Chile (12,641), 16th) Ecuador (11,279), 17th) Indonesia (10,386), 18th) Belgium (9,974), 19th) Germany (9,534), and 20th) Canada (9,268) among the 20 top countries leading the total number of fatal cases (WORLDOMETERS, 2020).

On the other hand, benchmark countries suggested by Silva (2020a) have the following position in terms of total fatal cases: 27th) Sweden (5888 deaths), 54th) Australia (872 deaths), 67th) Denmark (649 deaths), 78th) South Korea (401 deaths), 82th) Finland (343 deaths), and 133rd) Thailand (only 59 deaths), reason by which Thailand was selected to be firstly investigated.

3. Fatal cases indicators and Fatality Total Index (FTI)

According to Silva (2020b p.560), three authors (BALSARI, BUCKEE, AND KHANNA, 2020) stressed the importance of data, alerting that bad data could produce serious missteps, especially when models are produced and presented without appropriate expertise.

Nowadays, many organizations are developing indicators and collecting data related to the amount of fatal (or death) cases, such as a) tests per confirmed deaths; b) deaths per capita; c) total number of fatal cases by a total number of cases; d) case fatality rate (CFR); e) total number of fatal cases by 100 confirmed cases; f) the total number of fatal cases by a total number of recovered cases; g) the total number of fatal cases by 100,000 population; h) a total number of death cases by age, etc.

However, one of the limitation of these indicators is that they don't take into consideration the percentage of symptomatic cases reported (PSCR), and the % of symptomatic cases have been missed by the surveillance system over the time, reason by which Silva (2020b p. 563) proposed a new Indicator called Fatality Total Index (FTI), as shown in formula (1):

$$(1)\ FTI = [\ (TFC / XMPSCRnd) / 1MP / ND)\ ]$$

TFC = Total Fatal Cases

XMPSCRnd = The Average of the Median of PSCR related to the ND

1MP = one million of the population

ND = Nth day facing the Covid-19 since the first official case reported by the government

For Silva (2020b) and this research, the TFC is collected from the worldometer site <https://bit.ly/3dpMErI> since it is one of the most dynamic and updated sites about COVID-19.

The population of each country was collected from the United Nations Population Fund (2019), which shows the population of each country and other indicators for 2020.

The XMPSCRnd (Table 1) was calculated from the data provided by Golding, N. et al. (2020). Since each country was evaluated for six months (ND=180), it was used the median of PSCR related to the nth

day identified for each country, taking into consideration the delay of 13 days, by using the under-reporting estimates available in .csv file on the CMMI site <https://bit.ly/30N6qtj>.

For each country listed in Figure 1 plus Thailand, it was collected the MPSCRnd for 60, 70, 80, 90, 100, 120, 150, and 180 days, taking the average (XMPSCRnd).

And the results from Table 1 show that in terms of the Percentage of Symptomatic Cases Reported:

a) the best countries are: 1st) Thailand (74.04%), 2nd) Chile (71.31%), and 3rd) Russia (61.98%) with XMPSCRnd over 60%;

b) while other countries have the XMPSCRnd lower than 50%, especially Mexico (21th; 10.13%), France (20th; 14.35%), Italy (19th; 15.34%), UK (18th; 17.68%), and the USA (17th; 24.26%) with the lowest average.

Table 1: Twenty-one countries XMPSCRnd performance from 60 to 180 days

RANK	COUNTRIES	XMPSCRnd	MPSCR60	MPSCR70	MPSCR80	MPSCR90	MPSCR100	MPSCR120	MPSCR150	MPSCR180
1	THAILAND	77,04%	.	65,61%	66,44%	71,52%	76,90%	83,87%	87,20%	87,71%
2	CHILE	71,31%	73,88%	73,99%	75,47%	73,29%	61,08%	80,49%	72,27%	60,03%
3	RUSSIA	61,98%	43,40%	39,52%	53,31%	80,73%	89,14%	67,83%	62,62%	59,31%
4	SOUTH AFRICA	46,67%	40,78%	41,52%	37,34%	34,63%	41,06%	73,19%	55,81%	49,03%
5	ARGENTINA	42,68%	19,77%	24,92%	32,71%	42,65%	52,48%	62,95%	55,04%	50,93%
6	INDIA	39,51%	19,57%	23,21%	27,53%	29,27%	33,73%	47,77%	50,58%	84,44%
7	GERMANY	34,57%	37,13%	23,71%	17,55%	16,09%	17,21%	22,20%	46,60%	96,03%
8	PERU	32,81%	30,10%	34,55%	39,11%	41,23%	40,11%	26,60%	16,12%	34,64%
9	COLOMBIA	32,39%	25,04%	32,29%	34,81%	31,84%	27,88%	26,81%	34,40%	46,01%
10	IRAN	30,70%	27,51%	26,76%	31,35%	41,43%	46,45%	33,40%	17,08%	21,61%
11	BRAZIL	28,98%	10,41%	11,13%	13,29%	17,71%	24,54%	39,06%	51,05%	64,62%
12	SPAIN	28,09%	3,97%	5,59%	8,20%	7,43%	5,62%	26,00%	76,60%	91,34%
13	CANADA	27,34%	33,96%	23,02%	14,84%	12,14%	13,68%	15,89%	28,63%	76,55%
14	BELGIUM	26,39%	5,14%	6,07%	9,02%	12,43%	14,64%	19,66%	47,83%	96,35%
15	INDONESIA	25,86%	21,27%	23,67%	22,00%	21,24%	24,08%	28,66%	31,11%	34,82%
16	ECUADOR	24,87%	17,15%	17,75%	13,92%	17,48%	20,65%	19,19%	44,68%	48,11%
17	USA	24,26%	16,08%	13,24%	11,92%	12,03%	15,19%	22,34%	35,66%	67,59%
18	UK	17,68%	4,75%	4,48%	6,11%	9,21%	12,31%	15,43%	26,19%	62,99%
19	ITALY	15,34%	7,42%	9,87%	11,33%	12,06%	13,13%	13,53%	20,16%	35,22%
20	FRANCE	14,35%	5,24%	3,62%	3,86%	5,28%	6,70%	8,73%	24,11%	57,27%
21	MEXICO	10.13%	7,52%	7,89%	8,21%	8,35%	8,29%	9,53%	14,18%	17,06%

Source: Author (2020)

4. Best Management Practices (BMP)

According to the Cambridge Dictionary, management is the activity of overseeing a company, organization, department, or team of employees. Also, it defines as a group of people who control a company or organization.

To Drucker (1954), considered as the father of administration, management is a multipurpose organ that manages a business and manages managers and manages workers and work. The author gave importance to three jobs of management: (a) manage the business; (b) manage the manager; (c) manage the workers and work.

Management practice is considered by some authors as an entity of analytical instruments used to support the managers at work during the implementation of the selected management concept (DESSLER, 2004; SUTHERLAND and CANWELL, 2004; VAN ASSEN et al., 2009). Others consider the term as tools that are defined as a set of concepts, processes, and exercises (RIGBY, 2001).

According to Encyclopedia.com, Best Management Practices (BMP) are methods that have been determined to be the most effective and practical means of preventing or reducing the non-profit source of pollution to help achieve water goals.

For this research, Best Management Practices (BMP) is defined as those acceptable and effective management instruments able to achieve the goal(s) creatively and sustainably (adapted from GOMES DA SILVA, AND ASSUNÇÃO DE SOUZA, 2019 p. 702).

The instruments could be classified into 3 levels: International, National, and Regional/Local, as shown in Figure 2.

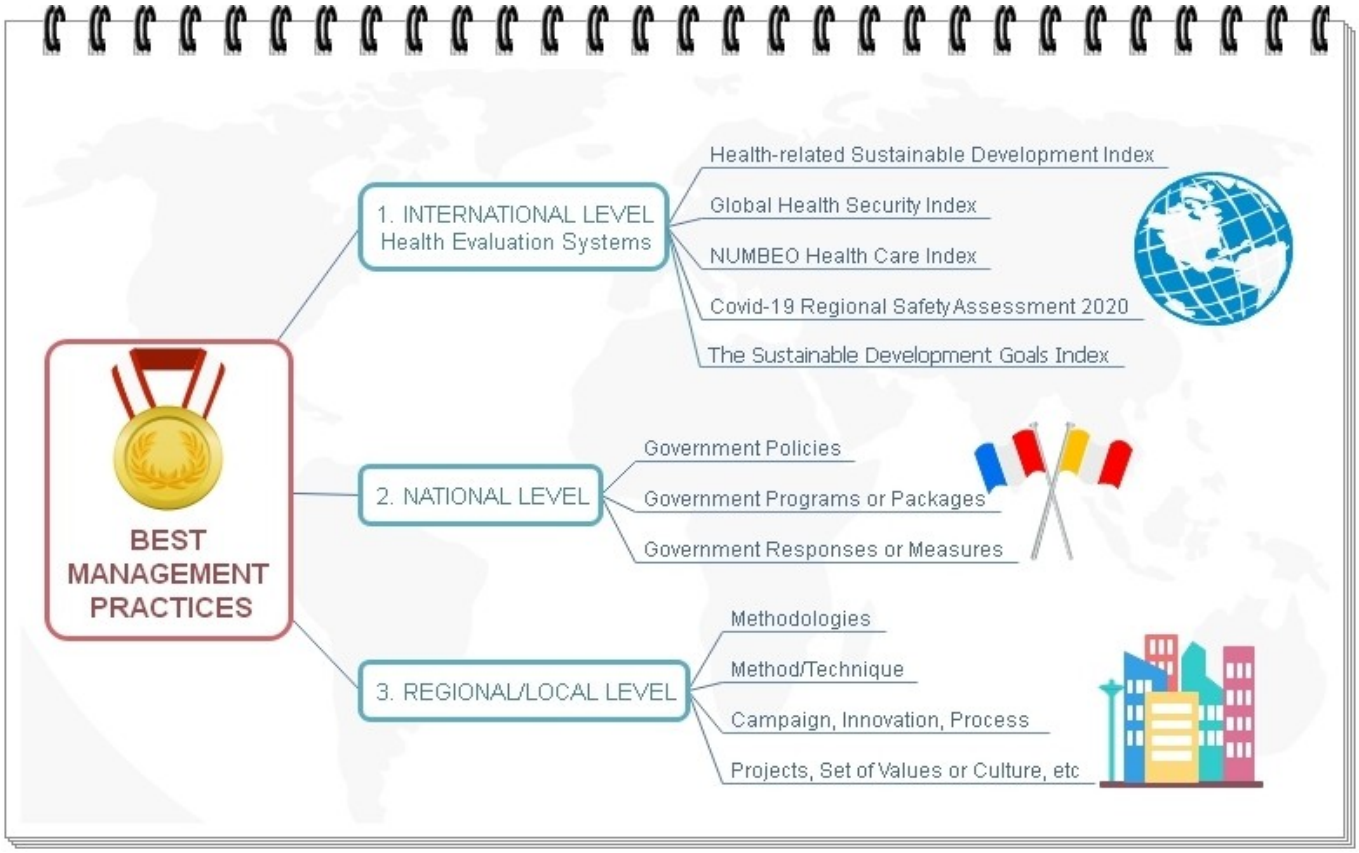


Figure 2: BMP instruments classification related to Health and/or Covid-19
Source: Author (2020)

At the International level, there are international evaluation systems;

At the National level, there are Government policies, package, responses or measures;

At the Regional/Local level, there are methodology, method/technique, innovation, process, campaign, project, a set of values, or culture (which also can be national) developed by many actors such as Universities, Startups, Companies, Governments, etc.

Examples of BMP to the International evaluation system focused on Health and/or Covid-19 are:

a) Health-related Sustainable Development Index (HSDG17) that evaluated 40 indicators of 195 countries from 1990 to 2017 (GBD 2017 SDG COLLABORATORS, 2018);

b) Global Health Security Index (GHSI19), a global assessment of the health security capacity of 195 countries, based on a questionnaire with 140 questions divided into 6 categories, 34 indicators, and 85 sub-indicators (NTI, JHU, and EIU, 2019).

c) NUMBEO Health Care Index (NUMBEO20) that estimates the overall quality of the health care system, health care professionals, doctors, cost, equipment, staff, with a total of 93 countries evaluated (NUMBEO, 2020);

d) Covid-19 Regional Safety Assessment 2020 (RSCOV20), one of several reports published by Deep Knowledge Group (2020) about the Covid-19 situation around the globe. It is designed to classify, analyze and rank economic, social, and health stability achieved in 200 regions, countries, and territories, by dividing them into 4 different Tiers: Tier 1 with 20 countries and 130 parameters, ranked highest in terms of regional safety and stability; Tier 2 has 20 regions with 60 parameters; Tier 3with 60 regions with 60 parameters; and Tier 4 with 100 regions that scored least favorably during a first-phase analysis, which suffer from a high level of data unavailability, reason by which is used only 40 parameters.

The framework has six top-level categories (each receives score from 0 to 100, which is multiplied by the weight) called: 1) Quarantine Efficiency (Weight=2.2); 2) Government Efficiency of Risk Management (Weight=2.2); 3) Monitoring and Detection (Weight=1.5); 4) Health Readiness (Weight=1.3); 5) Regional Resilience (Weight=1.3); and 6) Emergency Preparedness (Weight=1.5). The overall score is the sum of all categories scores reaching the maximum value of 1000.

e) The Sustainable Development Goals Index (SDGI20) and Covid-19, is the first global survey to evaluate each country concerning achieving the SDGs. It is also well known as SDG Index Report and Dashboards, and the version of last June 2020, is useful because also brings much information about Covid-19. According to Sachs et al. (2020, p. 24-25), the SDGI tracks 166 country performance on the 17 SDGs, as agreed by the international community in 2015 with equal weight to all 17 goals. The score signifies a country's position between the worst (0) and the best or target (100) outcomes, and the methodology has been peer-reviewed (SCHMIDT-TRAUB et al., 2017) and was audited by the European Commission Joint Research Centre (PAPADIMITRIOU, NEVES, and BECKER, 2019).

Examples of BMP related to National level government policies to combat the pandemic are: combat fake news, effective public-private collaboration, integration with mass media, international travel control, increase the medical and personal equipment capacity, improve intensive care unit structures, low-interest loans, schools closures, online training programs, public event cancellations, public information campaigns, public transport reduction, restriction on internal movement, reduction of bureaucracy, support the expansion of the testing system, tax relief, wage subsidies for workers, workplaces closures (PANG, 2003; SVOBODA et al, 2004; BALAJEE et al, 2017; HA et al, 2020; IMF, 2020; JONES, 2020; ROSER et al, 2020; OUR WORLD IN DATA, 2020a; WHO, 2020b).

Finally, examples of BMP related to Regional/Local levels to face Covid-19 are Hackathons, Donations Campaign, Development of Apps (Example: Tracking, On-Line Health Declaration), Robots, Sites, Maps, Products (Shields, Mask or Bio Masks), Temperature measurement (screen individual or crowds), Autonomous Vehicles, Distance Learning, Relief Funds, QR-Code Systems, Sterilizer, Chatbot, eCards, Ventilators, Video Conferences, Awards or Prizes, Booths, Center For Disease Control, BioChip, etc.

Some of Regional/Local BMP also can be done at National Level with the strong support of technologies such as Artificial Intelligence, Big Data, Blockchain, Blue Tooth, Cloud Computing, 3D printing, Deep-learning Algorithms, Internet, IoT, Infrared Technology, GPS, Nanotechnology, Open Source, Plasma air filtration, mRNA, Ultraviolet Rays, Sensors, Virtual Technology, Voice Recording, etc.

5. Methodology

The research is applied, useful for the academy, government policymakers, and authorities.

It is descriptive, with a qualitative and quantitative approach, based on bibliographic and documentary research, involving the study of articles, manuals, official sites, reports, and other technical documents.

To reach the specific objectives, the collection and data analysis were made in three phases:

Phase 1) to define the ten most critical countries

The 20 countries listed in Figure 1 are the sample to be investigated. Also, Thailand is included for further comparison.

The data were collected daily from the worldometers site from December 31, 2019, until September 27th, 2020. For each country, it was identified the official date where occurred the first case of Covid-19, and also the date when completed 180 days facing the pandemic (DTFC180). After that, the Formula (1) was applied for each country, and they are ranked in descending order by using the FTI180 Indicator.

The Table 2 (see section 6. Results) was created containing the following fields: Rank, Countries, Continent, SARS2003_TFC (Total Fatal Case of SARS in 2003)/TC (Total Case), START (Data of the first Covid-19 case reported), P2020 (Population per Million), PD20 (Population Density 2020), AGE>65 (Percentage of people over 65 years old in 2020), HBED/1K (Number of Hospital Beds per 1000 people), TFC180 (Total of Fatal Cases in 180 days), TFC1801M (TOTAL of Fatal Cases in 180 days per 1M people), FTI180 (Fatality Total Index in the 180th day taking into consideration the delay of 13 days).

Phase 2) to compare the performance of Thailand with the ten most critical countries

The comparative performance was made in two ways:

The first one compared the performance of each country by taking into consideration the Score of the five international evaluation system shown in Figure 2, focused on Health and/or Covid-19. All the scores are from 0 to 100 points, except the Score of Covid-19 Regional Safety Assessment 2020, that ranges from 0 to 1000, reason by which it was divided by ten, to normalize all scores for the same range.

The second one, focused on the Covid-19 Regional Safety Assessment 2020 (DEEP KNOWLEDGE GROUP, 2020) six top-level categories (Quarantine Efficiency; Government Efficiency of Risk Management; Monitoring and Detection; Health Readiness; Regional Resilience; and Emergency Preparedness), with each country Score. This international evaluation system was selected because is strongly related to Covid-19 with updated information.

Phase 3) identify the best management practices adopted in Thailand.

To this end, in June 2020, it was developed an electronic Survey <https://ufam.typeform.com/to/UL7R8M> containing an introductory video with 9 questions related to:

Q1) the country of the respondent, with 16 benchmark countries listed, selected by the author taking into consideration the FTI100. One of the countries is Thailand, the focus of this article, while other benchmark countries will be investigated in future articles.

Q2) eleven cultural practices that the respondent believes were decisive for the low rate of death in the selected country. Also, there is one option for those that don´t believe culture practice were decisive, and one option called "Other".

Q3) how much the respondent trust in official statistics released by the National Government about the number of deaths cases by Covid-19. A Likert Scale from 0 (Low trust) to 10 (High Trust) was provided.

Q4) what are the main policy measures adopted by the Country Government that saved lives against the Covid-19. Around 18 measures were provided for the respondent to select (multiple choice) and also one option called "Other" was included.

Q5) an opened question was created for the respondent inform (in case if know), the name of the most innovative product or service (test kit, telehealth equipment, robot, app, etc) that are protecting people in the Country against Covid-19. This question main aim is to identify some tips of possible products or services for the researcher intensify the search on the internet;

Q6) the age of the respondent;

Q7) a question to identify if the respondent is native or not of the country;

Q8) an open question to identify how long the respondent is living in the country;

Q9) an open question was created for suggestions or to inform e-mail, just in case the respondent is interested to receive the scientific article of this survey.

It was used the Typeform <https://www.typeform.com/> platform to create and manage the questionnaire, the author is a customer of the company, but due to the Covid-19, the use of the platform was free. Also, other software platforms were used such as Libre Office package, Edraw Max editor, Videorobot, Viddyoze, Piktochart, and Photoscape.

The main aim of this survey is to identify the perceptions of common people living in Thailand and to participate, the respondent must have 18 or more years old and living in the country for at least four months.

The pilot test was made from June 21st to July 21th, to improve the questionnaire (it was reduced one question) to make it more simple and easy to answer. After some improvement, the survey continues from the beginning of August until the 27th of September, 2020.

To invite people, it was used the Facebook paid service, called "Bost a post", an invitation message with the link of the questionnaire was written in English and send to the audience of Thailand.

Due to Covid-19 and cost limitations, it was tried to carry out sampling for convenience, where the researcher depends on the availability of the respondent to contribute in a volunteer way for the survey. As a result, a confidence interval or margin of error was not adopted, but it was hoped to get near 100 correct answers.

Finally, parallel to the online questionnaire survey, several searches on articles, sites of government, universities, journals, startups, and companies of Thailand were realized to identify the innovative products and services adopted in this country to protect and save lives against the Covid-19.

6. Results

6.1 The ten most critical countries

Table 2 shows the basic profile and the ranking of the most critical countries. For the comparative process, Thailand also was included. In short, the result of Table 2 shows that:

a) among the sample of 21 countries, Thailand was the first country to report the Covid-19, it has reported two fatal cases from nine of the first coronavirus SARS2003 pandemic. The order of countries that reported (Column START) the first cases of Covid-19 over the time in 2020 is: 1st) Thailand (13th/Jan); 2nd) USA (21th/Jan); 3rd) France (24th/Jan); 4th) Canada (27th/Jan); 5th) Germany (27th/Jan); 6th) India (30th/Jan); 7th) Italy (31th/Jan); 8th) UK (31th/Jan); 9th) Spain (31th/Jan); 10th) Russia (31th/Jan); 11th) Belgium (4th/Feb); 12th) Iran (12th/Feb); 13th) Brazil (25th/Feb); 14th) Mexico (28th/Feb); 15th) Ecuador (29th/Feb); 16th) Indonesia (2nd/Mar); 17th) Chile (3rd/Mar); 18th) Argentina (3rd/Mar); 19th) South Africa (5th/Mar); 20th) Peru (6th/Mar); and 21th) Colombia (6th/Mar);

Table 2: The most critical countries in descending order of FTI180

RANK	COUNTRIES	CONTINENT	SARS2003_TFC/TC	START	P2020 (Mil)	PD20	AGE>65(20)	HBED/1K	XMPSCRnd	TFC180	TFC1801M	FTI180
1	MEXICO	North America	NO CASE	28/02/20	128,9	66,44	6,86	1,38	10,13%	60800	471,68	15,3603
2	PERU	South America	NO CASE	06/03/20	33,00	25,13	8,70	1,60	32,81%	29068	880,85	14,1270
3	ITALY	Europe	0 / 4	31/01/20	60,50	205,86	23,30	3,18	15,34%	35277	583,09	9,1976
4	ECUADOR	South America	NO CASE	29/02/20	17,60	66,94	7,60	1,50	24,87%	10015	569,03	6,5710
5	IRAN	Asia	NO CASE	19/02/20	84,00	49,83	6,60	1,50	30,70%	19639	233,80	6,0105
6	CHILE	South America	NO CASE	03/03/20	19,10	24,28	12,20	2,11	71,31%	11181	585,39	5,4176
7	UK	Europe	0 / 4	31/01/20	67,90	272,90	18,70	2,54	17,68%	41135	605,82	5,3432
8	BELGIUM	Europe	NO CASE	04/02/20	11,60	315,56	19,30	5,64	26,39%	9718	837,76	4,8305
9	COLOMBIA	South America	0 / 1	06/03/20	50,90	44,22	9,10	1,71	32,39%	20052	393,95	4,7568
10	BRAZIL	South America	0 / 1	25/02/20	212,60	25,04	9,60	2,20	28,98%	114277	537,52	4,6212
11	FRANCE	Europe	1 / 7	24/01/20	65,30	122,58	20,80	5,98	14,35%	30165	461,94	4,4812
12	SPAIN	Europe	0 / 33	31/01/20	46,80	93,10	20,00	2,97	28,09%	28436	607,61	3,6956
13	USA	North America	0 / 33	21/01/20	331,00	35,61	16,60	2,77	24,26%	143366	433,13	3,5601
14	SOUTH AFRICA	Africa	1 / 1	05/03/20	59,30	46,75	5,50	2,32	46,67%	14149	238,60	2,7036
15	ARGENTINA	South America	NO CASE	03/03/20	45,20	16,18	11,20	5,00	42,68%	8353	184,80	2,0158
16	CANADA	North America	41 / 251	27/01/20	37,71	4,04	18,10	2,50	27,34%	8881	235,51	1,7092
17	RUSSIA	Europe	0 / 1	31/01/20	145,93	8,82	15,50	8,05	61,98%	13504	92,54	0,8668
18	GERMANY	Europe	0 / 9	27/01/20	83,80	237,01	21,70	8,00	34,57%	9201	109,80	0,6352
19	INDONESIA	Asia	0 / 2	02/03/20	273,50	145,72	6,30	1,04	25,86%	7169	26,21	0,4182
20	INDIA	Asia	3 / 0	30/01/20	1380,00	450,42	6,60	0,53	39,51%	33448	24,24	0,1595
21	THAILAND	Asia	2 / 9	13/01/20	69,80	135,13	13,00	2,10	77,04%	58	0,83	0,0053

Source: Author (2020)

b) among the 20 countries listed in Figure 1 with the highest number of fatal cases on 27th September 2020, most are located in Europe (7; 35%), followed by six countries (30%) of South America, three countries of Asia (15%), two countries from North America (10%), and only one country from Africa (5%);

c) for the first 180 days of facing Covid-19, the ten most critical countries are: 1st) Mexico (FTI180=15.3603); 2nd) Peru (FTI180=14.1270); 3rd) Italy (FTI180=9.1976); 4th) Ecuador (FTI180=6.5710); 5th) Iran (FTI180=6.0105); 6th) Chile (FTI180=5.4176); 7th) UK (FTI180=5.3432); 8th) Belgium (FTI180=4.8305); 9th) Colombia (FTI180=4.7568); and 10th) Brazil (FTI180=4.6212);

d) most (50%) of the ten critical countries is from South America, followed by Europe (30%), North America (10%), and Asia (10%);

e) no one of the ten top critical countries reported fatal cases of SARS2003, 60% of the nations without any case of that virus, which may indicate that since the first coronavirus pandemic in 2002/2003, these countries did not make a serious investment and preparations for the future return of the virus;

f) The ten most critical countries average of FTI180 is 7.62 (S=3.99; CV=69.87%), and the median equals 5.71, with Mexico, Peru, and Italy FTI180s values much higher than the average.

6.2 The Thailand performance against the ten most critical countries performance

Figure 3 shows the 7-day average of confirmed Covid-19 deaths per million people, not considering unreported cases. The performance of Thailand is much better than the ten most critical countries.

Besides, when the analysis considers the unreported cases, by taking into account the estimated number of total fatal cases, per million population during the first 180 days facing the pandemic, Thailand`s FTI180 value (Table 2) is only 0.0053, the lowest, indicating that this country is the best at saving lives against the Covid-19 when compared with the nations investigated.

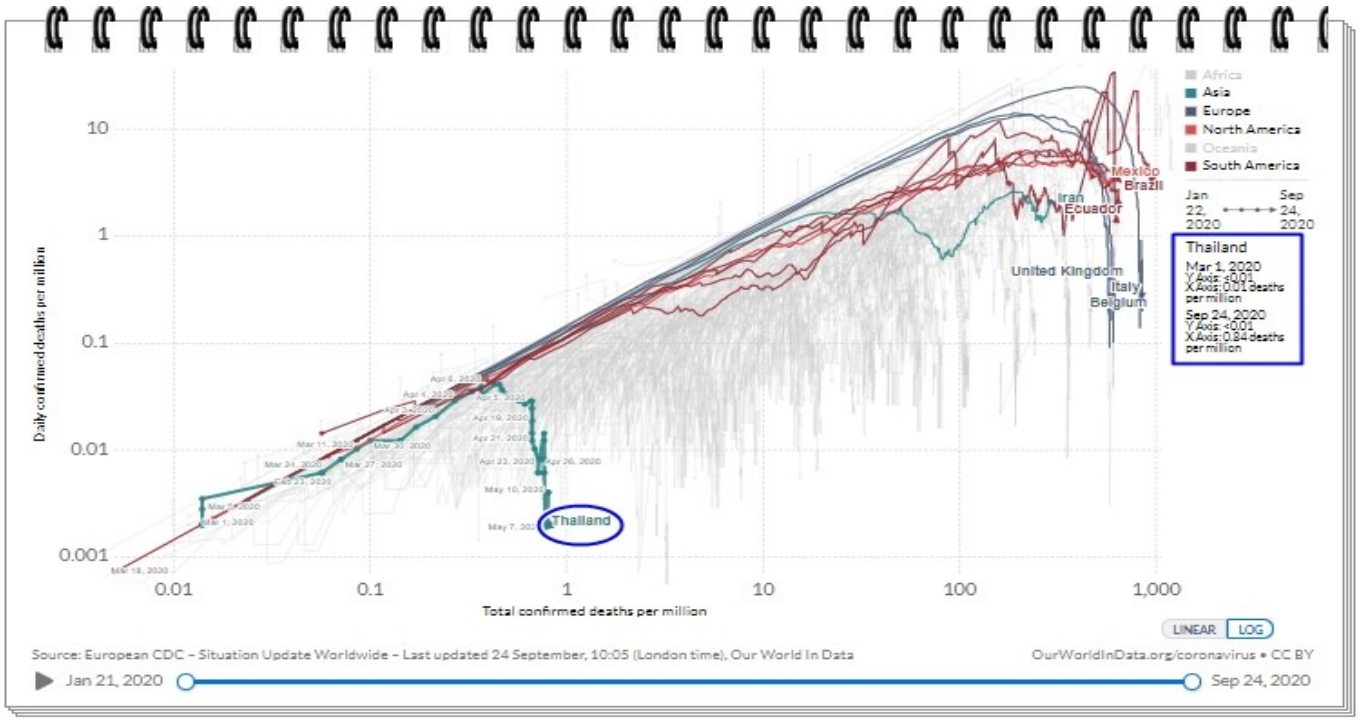


Figure 3: Thailand and ten most critical countries Daily vs. Total Confirmed Covid-19 deaths per million
Source: Our Data in World (2020b)

When the performance is related to the BMP`s International evaluation system, focused on Health and/or Covid-19, the five best performers (Table 3) are: 1st) UK (Average= 72.7), 2nd) Belgium (68.4), 3rd) Thailand (67.8), 4th) Italy (64.6), and Chile (64.2). On the other hand, 11th) Iran (54.7) and four countries from South America (Peru=56.9; Colombia=57; Brazil=60.7, and Ecuador=61.9) reached the lowest average score.

Table 3: Thailand and the ten most critical BMP´s International evaluation performance ranked by X

R	COUNTRY	CONTINENT	HSDG17	GHSI19	NUMBEO20	RSCOV20	SDGI20	X	S	CV %	MED
1	UK	Europe	80	77,9	74,46	51,3	79,8	72,7	12,2	16,7	77,9
2	Belgium	Europe	77	61	74,34	49,8	80	68,4	12,7	18,6	74,3
3	Thailand	Asia	59	73,2	77,95	54,1	74,5	67,8	10,5	15,5	73,2
4	Italy	Europe	70	56,2	66,59	53,3	77	64,6	9,8	15,2	66,6
5	Chile	South America	65	58,3	65,44	54,9	77,4	64,2	8,6	13,4	65,0
6	Mexico	North America	64	57,6	70,12	53,7	70,4	63,2	7,4	11,8	64,0
7	Ecuador	South America	64	50,1	70,59	50,5	74,3	61,9	11,2	18,1	64,0
8	Brazil	South America	68	59,7	56,29	47	72,7	60,7	10,1	16,6	59,7
9	Colombia	South America	66	44,2	67,24	36,7	70,9	57,0	15,5	27,1	66,0
10	Peru	South America	62	49,2	56,15	45,3	71,8	56,9	10,5	18,5	56,2
11	Iran	Asia	62	37,7	51,7	50,5	71,8	54,7	12,9	23,5	51,7

Source: Author (2020)

When the Performance of Thailand and ten critical countries are analyzed by each International evaluation system, Thailand performed best in NUMBEO Health Care Index 2020 (NUMBEO20 = First place – Table 4), the second place (Tables 5 and 6) in the Global Health Security Index (GHSI19) and the Covid-19 Regional Safety Assessment 2020 (RSCOV20).

Table 4: Thailand best BMP´s International evaluation performance

R	COUNTRY	CONTINENT	HSDG17	GHSI19	NUMBEO20	RSCOV20	SDGI20	X	S	CV %	MED
1	Thailand	Asia	59	73,2	77,95	54,1	74,5	67,8	10,5	15,5	73,2
2	UK	Europe	80	77,9	74,46	51,3	79,8	72,7	12,2	16,7	77,9
3	Belgium	Europe	77	61	74,34	49,8	80	68,4	12,7	18,6	74,3
4	Ecuador	South America	64	50,1	70,59	50,5	74,3	61,9	11,2	18,1	64,0
5	Mexico	North America	64	57,6	70,12	53,7	70,4	63,2	7,4	11,8	64,0
6	Colombia	South America	66	44,2	67,24	36,7	70,9	57,0	15,5	27,1	66,0
7	Italy	Europe	70	56,2	66,59	53,3	77	64,6	9,8	15,2	66,6
8	Chile	South America	65	58,3	65,44	54,9	77,4	64,2	8,6	13,4	65,0
9	Brazil	South America	68	59,7	56,29	47	72,7	60,7	10,1	16,6	59,7
10	Peru	South America	62	49,2	56,15	45,3	71,8	56,9	10,5	18,5	56,2
11	Iran	Asia	62	37,7	51,7	50,5	71,8	54,7	12,9	23,5	51,7

Source: Author (2020)

Table 5: Thailand second best BMP´s International evaluation performance (GHSI19)

R	COUNTRY	CONTINENT	HSDG17	GHSI19	NUMBEO20	RSCOV20	SDGI20	X	S	CV %	MED
1	UK	Europe	80	77,9	74,46	51,3	79,8	72,7	12,2	16,7	77,9
2	Thailand	Asia	59	73,2	77,95	54,1	74,5	67,8	10,5	15,5	73,2
3	Belgium	Europe	77	61	74,34	49,8	80	68,4	12,7	18,6	74,3
4	Brazil	South America	68	59,7	56,29	47	72,7	60,7	10,1	16,6	59,7
5	Chile	South America	65	58,3	65,44	54,9	77,4	64,2	8,6	13,4	65,0
6	Mexico	North America	64	57,6	70,12	53,7	70,4	63,2	7,4	11,8	64,0
7	Italy	Europe	70	56,2	66,59	53,3	77	64,6	9,8	15,2	66,6
8	Ecuador	South America	64	50,1	70,59	50,5	74,3	61,9	11,2	18,1	64,0
9	Peru	South America	62	49,2	56,15	45,3	71,8	56,9	10,5	18,5	56,2
10	Colombia	South America	66	44,2	67,24	36,7	70,9	57,0	15,5	27,1	66,0
11	Iran	Asia	62	37,7	51,7	50,5	71,8	54,7	12,9	23,5	51,7

Source: Author (2020)

For the Global Health Security Index 2019 Report (NTI, JHU, and EIU, 2019 p. 22-25), Thailand:

1) showed the sixth-best overall score among 195 nations investigated;

2) strongest categories are Sufficient and Robust Health System to treat the sick and protect health workers (2nd place with 70.5), Prevention of the Emergence or release of pathogens (third place with 75.7), Rapid response to and mitigation of the spread of an epidemic (the fifth place with 78.6), Commitments to improving national capacity, financing and adherence to norms (12th place with 70.9), and Early detection and report for the epidemic of potential international concern (15th place with 81).

Thailand has a strong field epidemiology training program and national laboratory system, scoring in the top tier for indicators of these capacities and demonstrating a robust electronic reporting surveillance system that functions at both national and sub national levels, rapidly collecting laboratory and epidemiological information. It demonstrates strength on prevention and response capability, scoring 75.7 and 78.8, respectively, in each of these categories and conducting regular event-based surveillance through a dedicated Situation Awareness Team embedded in the Ministry of Public Health's Emergency Operations Center (NTI, JHU, and EIU, 2019 p. 55). However, this report also calls attention to the category that Thailand needs improvements: overall risk environment and country vulnerability to biological threats (93rd place with 56.4).

For the Deep Knowledge Group (2020), responsible for the Covid-19 Regional Safety Assessment 2020 (RSCOV20), among the 11 countries investigated, Chile has the best performance, followed by Thailand, Mexico, Italy, and UK (Tables 6 and 7), while Colombia, Peru, Brazil, Belgium, and Iran showed the lowest performance respectively.

Table 6: Thailand second best BMP´s International evaluation performance (RSCOV20)

R	COUNTRY	CONTINENT	HSDG17	GHSI19	NUMBEO20	RSCOV20	SDGI20	X	S	CV %	MED
1	Chile	South America	65	58,3	65,44	54,9	77,4	64,2	8,6	13,4	65,0
2	Thailand	Asia	59	73,2	77,95	54,1	74,5	67,8	10,5	15,5	73,2
3	Mexico	North America	64	57,6	70,12	53,7	70,4	63,2	7,4	11,8	64,0
4	Italy	Europe	70	56,2	66,59	53,3	77	64,6	9,8	15,2	66,6
5	UK	Europe	80	77,9	74,46	51,3	79,8	72,7	12,2	16,7	77,9
6	Ecuador	South America	64	50,1	70,59	50,5	74,3	61,9	11,2	18,1	64,0
7	Iran	Asia	62	37,7	51,7	50,5	71,8	54,7	12,9	23,5	51,7
8	Belgium	Europe	77	61	74,34	49,8	80	68,4	12,7	18,6	74,3
9	Brazil	South America	68	59,7	56,29	47	72,7	60,7	10,1	16,6	59,7
10	Peru	South America	62	49,2	56,15	45,3	71,8	56,9	10,5	18,5	56,2
11	Colombia	South America	66	44,2	67,24	36,7	70,9	57,0	15,5	27,1	66,0

Source: Author (2020)

Table 7: The eleven countries performance according to Covid-19 Regional Safety Assessment2020

R	COUNTRY	CONTINENT	Quarentine Efficiency	Government Efficiency	Monitoring and Detection	Health Care Readiness	Regional Resiliency	Emmergency Prepareness	Final Score	Final Score Normalized
1	Chile	South America	99	**151**	92	63	80	63	549	54,9
2	Thailand	Asia	90	**144**	95	67	85	60	541	54,1
3	Mexico	North America	106	129	101	53	87	62	537	53,7
4	Italy	Europe	103	118	93	71	80	69	533	53,3
5	UK	Europe	103	102	81	70	78	79	513	51,3
6	Ecuador	South America	104	110	94	60	80	56	505	50,5
7	Iran	Asia	91	109	79	52	78	96	505	50,5
8	Belgium	Europe	98	107	85	75	83	49	498	49,8
9	Brazil	South America	96	99	82	67	77	49	470	47,0
10	Peru	South America	93	104	80	53	71	51	453	45,3
11	Colombia	South America	?	?	?	?	?	?	367	36,7

Source: Deep Knowledge Group (2020)

For the Deep Knowledge Group (2020), Thailand:

1) was the 47th best country (Figure 4) among the 200 countries, and territories analyzed;

2) is the 11th best country among 36 Asia and Pacific Region´s nations, and territories;

3) strongest category is Government Efficiency of Risk Management (Table 7; Score = 144), considered the 25th best country among the top 100 leaders in this category, followed by the category Regional Resiliency (Score = 85; 28th best among top 100), and the category Monitoring and Detection (Score = 95; 38th position among the top 100 countries), the category Health Care Readiness (Score = 67; 54th among the top 100 countries).

4) on the other hand, Emergency Preparedness (Score = 60; 68th place among the top 100 countries), and Quarantine Efficiency (Score = 90; 85th place among 100 best countries) are the categories that need further improvements.

Figure 4: Thailand performance categories in the Covid-19 Regional Safety Assessment 2020
Source: Deep Knowledge Group (2020, p. 183)

Table 8: Thailand lowest BMP´s International evaluation performance (HSDG17)

R	COUNTRY	CONTINENT	HSDG17	GHSI19	NUMBEO20	RSCOV20	SDGI20	X	S	CV %	MED
1	UK	Europe	80	77,9	74,46	51,3	79,8	72,7	12,2	16,7	77,9
2	Belgium	Europe	77	61	74,34	49,8	80	68,4	12,7	18,6	74,3
3	Italy	Europe	70	56,2	66,59	53,3	77	64,6	9,8	15,2	66,6
4	Brazil	South America	68	59,7	56,29	47	72,7	60,7	10,1	16,6	59,7
5	Colombia	South America	66	44,2	67,24	36,7	70,9	57,0	15,5	27,1	66,0
6	Chile	South America	65	58,3	65,44	54,9	77,4	64,2	8,6	13,4	65,0
7	Ecuador	South America	64	50,1	70,59	50,5	74,3	61,9	11,2	18,1	64,0
8	Mexico	North America	64	57,6	70,12	53,7	70,4	63,2	7,4	11,8	64,0
9	Peru	South America	62	49,2	56,15	45,3	71,8	56,9	10,5	18,5	56,2
10	Iran	Asia	62	37,7	51,7	50,5	71,8	54,7	12,9	23,5	51,7
11	Thailand	Asia	59	73,2	77,95	54,1	74,5	67,8	10,5	15,5	73,2

Source: Author (2020)

Concerning the two last international evaluation system, Thailand was in the last Position (Table 8) in the Health-related Sustainable Development Index (HSDG17) and the fifth position (Table 9) concerning The Sustainable Development Goals Index (SDGI20).

Among the 40 indicators of the Health-related Sustainable Development Index (HSDG17), evaluated from 1990 to 2017 (GBD 2017 SDG COLLABORATORS, 2018), Thailand:

a) fifteen best indicators were: FP needs to be met, mod (Score=99), Skilled birth attendance (98), Sanitation (98), Combat child sex abuse (92), Household air pollution (88), NTD prevalence (82), Non-intimate partner sexual violence (80), NCD Mortality (79), Child stunning (78), Poisoning mortality (76), Hygiene (74), Physical violence (74), UHC service coverage index (73), Heath worker intensity (71), and Under-5 mortality (71);

b) ten weakest indicators were: Hepatitis B incidence (Score = 24), Road Injury mortality (30), HIV incidence (39), Water (39), Occupation risk burden (41), Adolescent Birth Rare (45), Suicide mortality (46), WaSH mortality (46), Homicide (46), and Mean PM (47).

Table 9: Thailand fifth place in The Sustainable Development Goals Index (SDGI20)

R	COUNTRY	CONTINENT	HSDG17	GHSI19	NUMBEO20	RSCOV20	SDGI20	X	S	CV %	MED
1	Belgium	Europe	77	61	74,34	49,8	80	68,4	12,7	18,6	74,3
2	UK	Europe	80	77,9	74,46	51,3	79,8	72,7	12,2	16,7	77,9
3	Chile	South America	65	58,3	65,44	54,9	77,4	64,2	8,6	13,4	65,0
4	Italy	Europe	70	56,2	66,59	53,3	77	64,6	9,8	15,2	66,6
5	Thailand	Asia	59	73,2	77,95	54,1	74,5	67,8	10,5	15,5	73,2
6	Ecuador	South America	64	50,1	70,59	50,5	74,3	61,9	11,2	18,1	64,0
7	Brazil	South America	68	59,7	56,29	47	72,7	60,7	10,1	16,6	59,7
8	Peru	South America	62	49,2	56,15	45,3	71,8	56,9	10,5	18,5	56,2
9	Iran	Asia	62	37,7	51,7	50,5	71,8	54,7	12,9	23,5	51,7
10	Colombia	South America	66	44,2	67,24	36,7	70,9	57,0	15,5	27,1	66,0
11	Mexico	North America	64	57,6	70,12	53,7	70,4	63,2	7,4	11,8	64,0

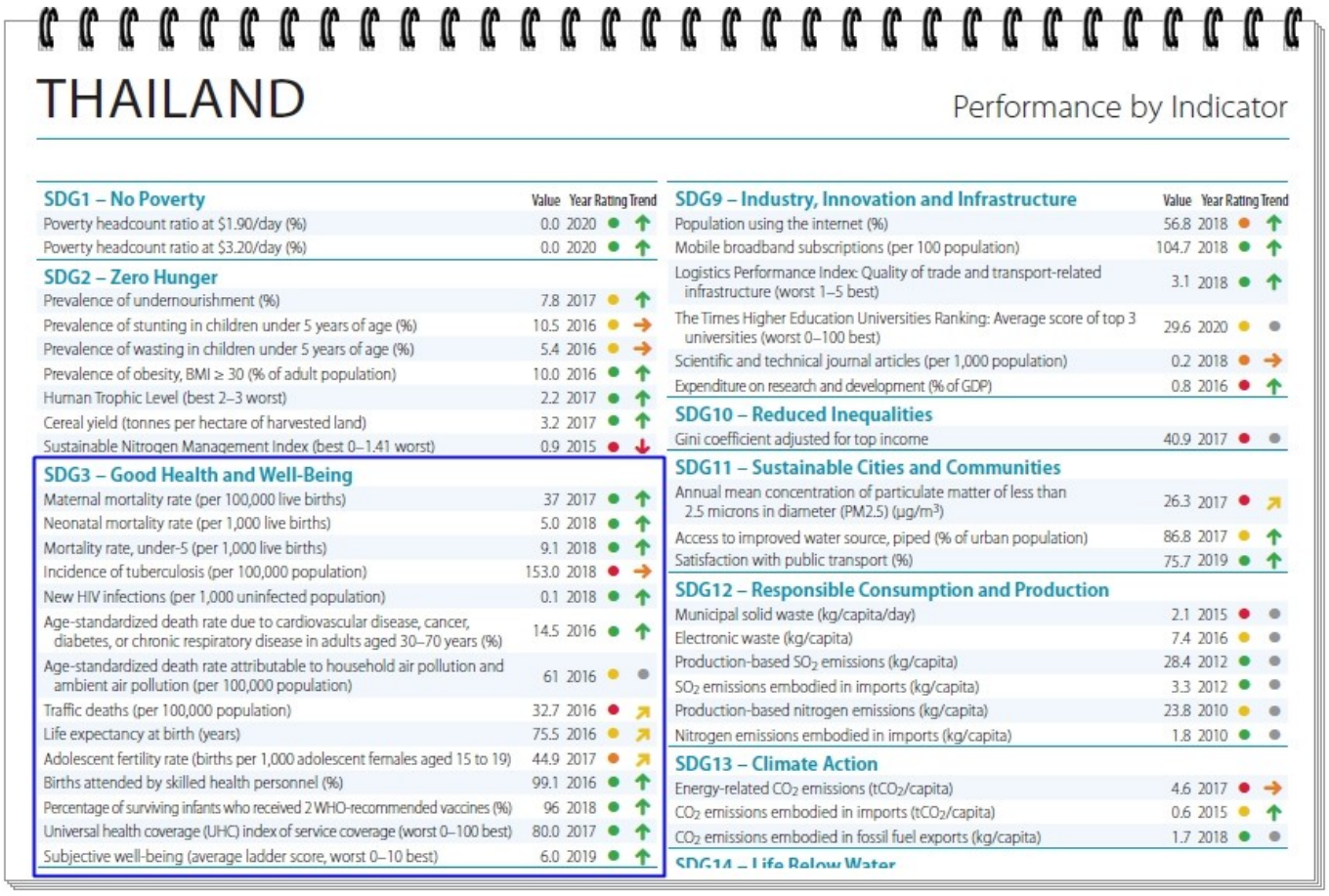
Source: Author (2020)

Finally, according to Sachs et al. (2020, p. 444-445), responsible for The Sustainable Development Goals Index (SDGI20) and Covid-19, among the 166 countries, Thailand:

a) was the 41st place (Score = 74.5), with the best results in SDG1 (No Poverty), SDG13 (Climate Action), SDG4 (Quality Education, but with trends showing decreasing), SDG11 (Sustainable Cities and Communities), SDG7 (Affordable and Clean Energy), SDG8 (Decent Work and Economic Growth), and SDG3 (Good Health and Well Being). On the other hand, the weakest results were in SDG9 (Industry, Innovation, and Infrastructure), SDG17 (Partnerships for the Goals, with trends showing decreasing), SDG2 (Zero Hunger), SDG10 (Reduced Inequalities), SDG14 (Life Bellow Water), SDG15 (Life on Land), and SDG16 (Peace, Justice and Strong Institutions);

b) has the trends of moderately improve the SDG3 related to Good Health and Well-Being and Figure 5 shows the nine indicators on track or maintaining SDG achievement (see the green arrow pointing up): Maternal mortality rate, Neonatal mortality rate, Mortality rate, under-5 (per 1,000 live births), New HIV infections (per 1,000 uninfected population), Age-standardized death rate due to

cardiovascular disease, cancer, diabetes, or chronic respiratory disease in adults aged 30–70 years (%), Births attended by skilled health personnel (%), Percentage of surviving infants who received 2 WHO-recommended vaccines (%), Universal health coverage (UHC) index of service coverage (worst 0–100 best), Subjective well-being (average ladder score, worst 0–10 best).



THAILAND

Performance by Indicator

SDG1 – No Poverty	Value	Year	Rating	Trend
Poverty headcount ratio at $1.90/day (%)	0.0	2020	●	↑
Poverty headcount ratio at $3.20/day (%)	0.0	2020	●	↑
SDG2 – Zero Hunger				
Prevalence of undernourishment (%)	7.8	2017	●	↑
Prevalence of stunting in children under 5 years of age (%)	10.5	2016	●	→
Prevalence of wasting in children under 5 years of age (%)	5.4	2016	●	→
Prevalence of obesity, BMI ≥ 30 (% of adult population)	10.0	2016	●	↑
Human Trophic Level (best 2–3 worst)	2.2	2017	●	↑
Cereal yield (tonnes per hectare of harvested land)	3.2	2017	●	↑
Sustainable Nitrogen Management Index (best 0–1.41 worst)	0.9	2015	●	↓
SDG3 – Good Health and Well-Being				
Maternal mortality rate (per 100,000 live births)	37	2017	●	↑
Neonatal mortality rate (per 1,000 live births)	5.0	2018	●	↑
Mortality rate, under-5 (per 1,000 live births)	9.1	2018	●	↑
Incidence of tuberculosis (per 100,000 population)	153.0	2018	●	→
New HIV infections (per 1,000 uninfected population)	0.1	2018	●	↑
Age-standardized death rate due to cardiovascular disease, cancer, diabetes, or chronic respiratory disease in adults aged 30–70 years (%)	14.5	2016	●	↑
Age-standardized death rate attributable to household air pollution and ambient air pollution (per 100,000 population)	61	2016	●	●
Traffic deaths (per 100,000 population)	32.7	2016	●	↗
Life expectancy at birth (years)	75.5	2016	●	↗
Adolescent fertility rate (births per 1,000 adolescent females aged 15 to 19)	44.9	2017	●	↗
Births attended by skilled health personnel (%)	99.1	2016	●	↑
Percentage of surviving infants who received 2 WHO-recommended vaccines (%)	96	2018	●	↑
Universal health coverage (UHC) index of service coverage (worst 0–100 best)	80.0	2017	●	↑
Subjective well-being (average ladder score, worst 0–10 best)	6.0	2019	●	↑

SDG9 – Industry, Innovation and Infrastructure	Value	Year	Rating	Trend
Population using the internet (%)	56.8	2018	●	↑
Mobile broadband subscriptions (per 100 population)	104.7	2018	●	↑
Logistics Performance Index: Quality of trade and transport-related infrastructure (worst 1–5 best)	3.1	2018	●	↑
The Times Higher Education Universities Ranking: Average score of top 3 universities (worst 0–100 best)	29.6	2020	●	●
Scientific and technical journal articles (per 1,000 population)	0.2	2018	●	→
Expenditure on research and development (% of GDP)	0.8	2016	●	↑
SDG10 – Reduced Inequalities				
Gini coefficient adjusted for top income	40.9	2017	●	●
SDG11 – Sustainable Cities and Communities				
Annual mean concentration of particulate matter of less than 2.5 microns in diameter (PM2.5) (µg/m³)	26.3	2017	●	↗
Access to improved water source, piped (% of urban population)	86.8	2017	●	↑
Satisfaction with public transport (%)	75.7	2019	●	↑
SDG12 – Responsible Consumption and Production				
Municipal solid waste (kg/capita/day)	2.1	2015	●	●
Electronic waste (kg/capita)	7.4	2016	●	●
Production-based SO_2 emissions (kg/capita)	28.4	2012	●	●
SO_2 emissions embodied in imports (kg/capita)	3.3	2012	●	●
Production-based nitrogen emissions (kg/capita)	23.8	2010	●	●
Nitrogen emissions embodied in imports (kg/capita)	1.8	2010	●	●
SDG13 – Climate Action				
Energy-related CO_2 emissions (tCO_2/capita)	4.6	2017	●	→
CO_2 emissions embodied in imports (tCO_2/capita)	0.6	2015	●	↑
CO_2 emissions embodied in fossil fuel exports (kg/capita)	1.7	2018	●	●
SDG14 – Life Below Water				

Figure 5: Part of Performance Indicators of Sustainable Development Goals Index 2020
Source: Sachs et al. (2020, p. 445)

6.3 The BMP adopted in Thailand to save people´s live against the Covid-19

From 21st June until 27th September 2020, two Boost Post with the invitation and link of the questionnaire reached 13.831 people living in Thailand, from which 96 (0.69%) respondents accepted voluntarily to participate in the survey.

6.3.1 Basic profile of the respondent

a) the respondents spent an average of 5min32s to watch the introductory video and answer all the nine questions;

b) most (94=98%) revealed the age, which average is 64 years old, the youngest respondent has 28 years old, and the oldest has 84 years old. This result may indicate that adult and old people are more motivated to participate in the survey;

c) one interesting result is that most respondent is not native (92=95.83%) of Thailand. Around 88 foreigners accepted to inform the time living in Thailand, with the average time being 11.53 years, and

the median 8 years. Only 12 foreigners are living in Thailand for less than one year, with the lowest time living there being four months. Maybe the reason for the low participation of native respondent could be the English barrier and/or the political situation of the country;

6.3.2 Cultural practices

Only eight respondents (8.33%) don´t believe that cultural practices were decisive to the low rate of Covid-19 in Thailand, while most (86=91.67%) believe in that.

From the group that believe (Figure 6), the most decisive cultural practices were:

First) wear a mask (97.67%);

2nd) not shake hands (86.05);

3rd) not hug in public (69.77%);

4th) wash hands (68.60%);

5th) not wearing shoes in the house (34.88).

On the other hand, the less decisive were:

12th) avoiding speak during public transport (19.77%);

11th) few foods eaten with bare hands (13; 95%);

10th) cleanliness of restaurants (19.77%).

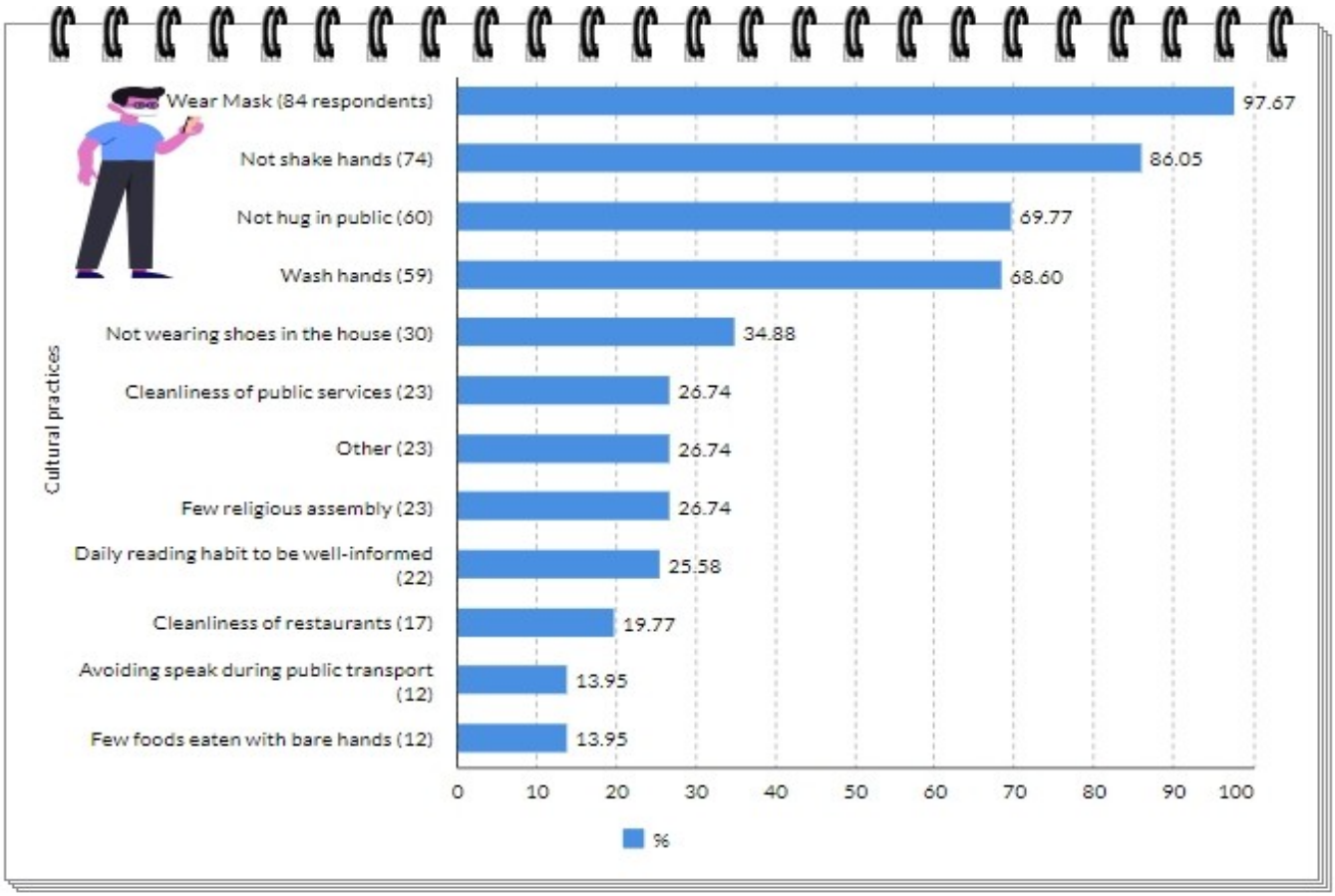


Figure 6: Cultural practices considered decisive to reduce the rate of Covid-19 deaths in Thailand
Source: Author (2020)

6.3.3 Ten golden behaviors that a leader of a nation should adopt to inspire and get people support

For effective national and regional efforts against any pandemic, cultural practices play an important role to get public cooperation or support, reason by which authorities and government managers should adopt the leadership by example, with intensive public information campaigns, especially in countries where wear masks, not shake hands, not hug in public, wash hands, not wearing shoes in the house are not cultural practices among most people.

For Kerissey and Edmondson (2020) to pass in the test during pandemic time, leaders are required to act with urgency, communicate with transparency, respond productively to missteps, engage in constant updating.

However, for leaders of a nation, the situation is much complex and demand leadership by example with the following behaviors to help people change and support government policies measures, programs, projects and actions:

1) hear carefully the scientists, WHO and intelligent services;

2) act fast for the national unity by integrating all ministries, media, companies, universities, army forces and main actors to fight the pandemic;

3) support the scientists and WHO;

4) follow the Covid-19 Safety Protocols;

5) encourage correct measures;

6) adopt clear communication and combat fake news;

7) avoid to spread medicines, drugs or treatments that are not proven effective against the virus;

8) praise and develop measures to protect the health workers, researchers and other professionals that are facing the Covid-19;

9) show empathy for sick people and for the families that lost parents over the time;

10) use diplomacy to create global cooperation against the virus;

For instance, in terms of total fatal cases, until 27th September, 2020, the USA and Brazil were the two main critical countries, with 351,229 total deaths, which represented 35.04% of all fatal cases reported by 215 countries (Figure 1).

After one month, in terms of total fatal cases, the USA and Brazil were still the two main critical countries, with 395,975 total deaths, which represented 33% of all fatal cases reported by 215 countries, calling the attention the two records of daily new cases of Covid-19 in USA reported on 29th (91.834) and 30th (101461) October, 2020.

In these two countries, wearing masks, not shake hands, not hug in public, and not wearing shoes in the house are not cultural practices among most people, reason by which presidents Trump and Bolsonaro should act in an exemplary way, instead of using the antithesis of the ten golden behaviours, as shown in Chart 1.

TEN BAD BEHAVIORS	SOURCES
1) Ignored early alerts and advises from scientists, WHO, and the intelligence services;	Duffy (2020), Poznansky (2020), Romano (2020), Graham (2020), CNN (2020), CNN, S.D. and I.K. (2020), Vargas (2020a), Vargas (2020b).
2) No initiative and leadership to act early to unite and organize the country against the virus;	Armstrong (2020), Barberia and Gómez (2020), Hamilton (2020), Haltiwanger (2020), Tisdall (2020a; 2020b), The Lancet (2020), and Ward (2020)
3) Attack scientists and WHO; 4) Don´t follow the Covid-19 Safety Protocols; 5) Sowing confusion and discouraging correct measures	The Lancet (2020), Horton (2020a), Tollefson (2020), Bernheim et al (2020), BBC News (2020a), Duffy (2020), Glick (2020), McDonald et al. (2020), NY Times (2020), Agência Brasil (2020), Human Right Watch (2020).
6) Spread more than 670 Fake News or distorted statement on Covid-19 (From Jan-Aug/20)	Ball and Maxmen (2020), Nature (2020b), Paz (2020) Statista (2020), CNN, D.D. and T.S. (2020), Collinson (2020), Paz (2020), Ricard and Medeiros (2020)
7) Discloses and forces the use of medicines (hydroxychloroquine and chloroquine) without proven efficacy against Covid-19; 8) Little ability to praise local authorities, health professionals and researchers for their hard work against the virus; 9) Lack of empathy to families that lost parents for Covid-19	Antonio Fernandes (2020), Bastos (2020), Bostock (2020), McCarthy (2020), Formoso (2020), Paz (2020), News, A.B.C (2020), Segundo, iG Ú. (2020), Euronews (2020), McDonald and Rieder (2020b), Samuels and Kelly (2020, Wessel (2020), Gragnari (2020), Tisdall (2020b)
10) Lack of diplomatic ability to create global cooperation. Ex: attack China without providing evidences, shooting down plans to buy vaccines from China, after health minister said it would be included in the Brazil's immunization program.	Nature (2020a), Horton (2020b), Agence France-Presse (2020), BBC News (2020b), Gonsalves and Yamey(2020), Reuters (2020), Paz (2020), The Independent (2020), McDonald et al (2020), Tisdall (2020a)

Chart 1: Ten bad behaviors adopted by President Trump and Bolsonaro during the pandemic Covid-19
Source: updated from Silva (2020b p. 544)

6.3.4 Trust in the National Government

All the 96 respondents rated from 0 to 10 the level of trust in official statistics released by the Thailand National Government about the number of deaths cases by Covid-19.

Figure 7 shows that the Average of trust is 7.2 (S=2.4; CV=32.6%) and the mean is 8, with most (68.75%) of them giving a rate equal or over 7 points, and 11.46% giving a rate lower or equal to 4.

Eleven (11.46%) respondents that rated 4 or lower this value are foreigners with an average of 7.55

years living in the country. On the other hand, concerning to the 66 (68.75 %) respondent that rated 7 or higher, they are living in Thailand 12.45 years as average, most (62) is foreigner, while four are native.

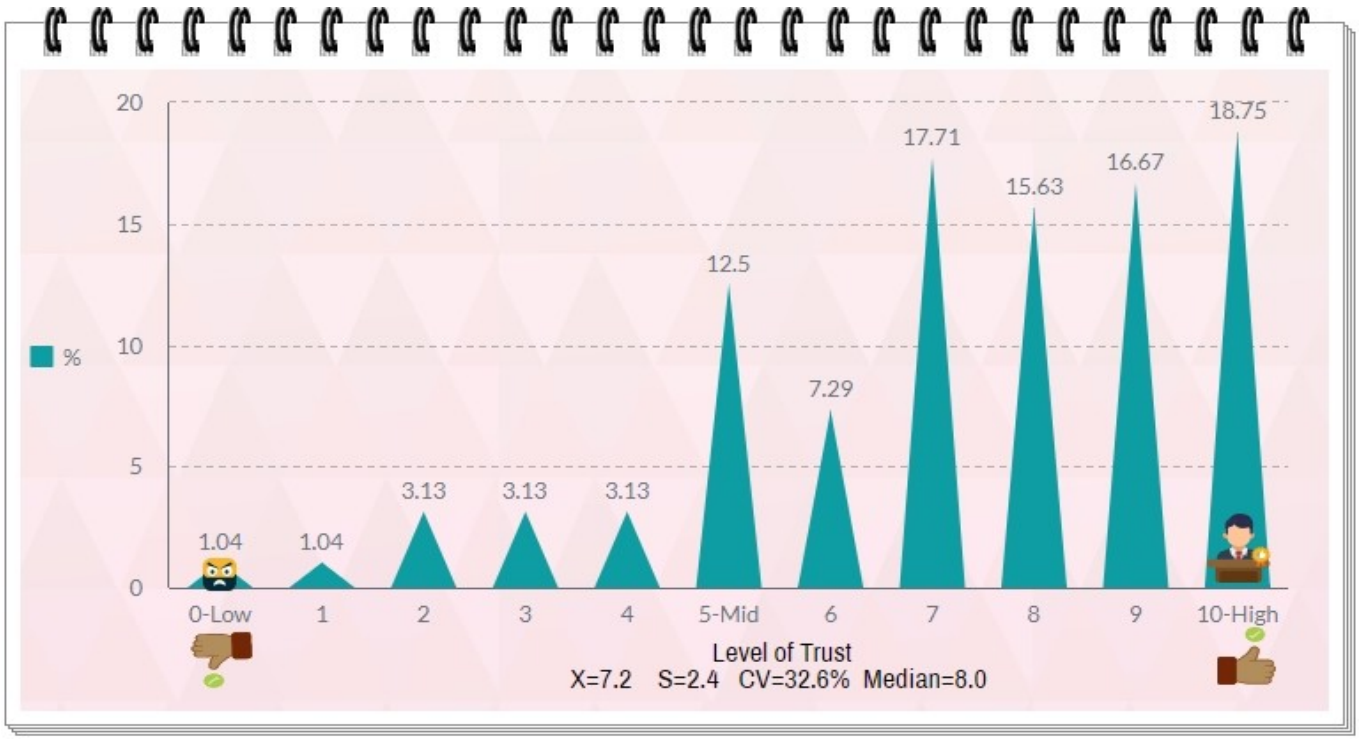


Figure 7: Level of trust in Thailand National Government about the number of deaths cases by Covid-19
Source: Author (2020)

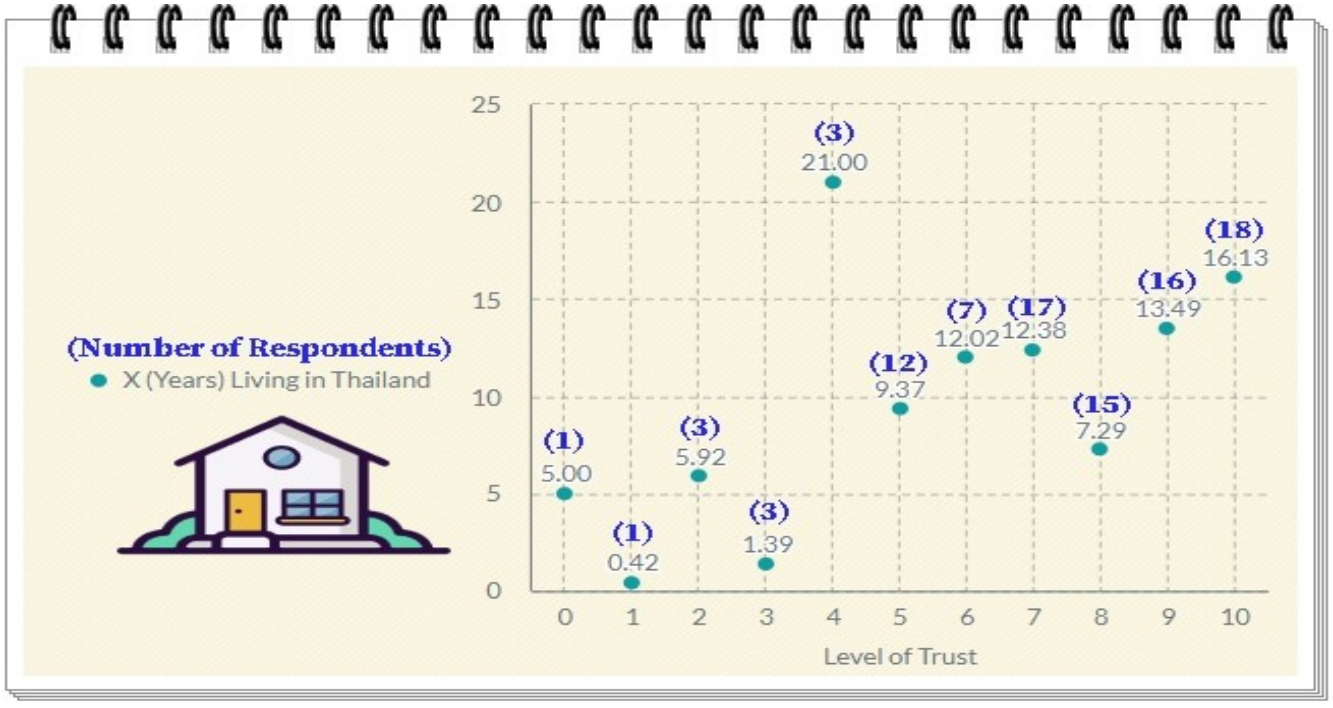


Figure 8: Correlation between the average (X in Year) of living in Thailand and level of trust
Source: Author (2020)

In short, most respondent trust in the official numbers (Figure 8) released by the Thailand National Government about the number of deaths cases, with most respondent living more than 7 years tending to consider the level of trust equal or higher than 5 points (except 3 respondent with the average of 21 years living in the country that rated 4).

This result is reasonable since the XMPSCRnd of Thailand (74.04%) is considered high (Tables 1), meaning that during the period analyzed, the official numbers released by this government represent on average 74.04% of total cases of real cases in the country.

6.3.5 The perception of the respondents on the main policies measures adopted that saved lives

Several authors and organizations focus on policies, responses, or measures against the Coronavirus (PANG, 2003; SVOBODA et al, 2004; BALAJEE et al, 2017; HA et al, 2020; IMF, 2020; JONES, 2020; ROSER et al, 2020; OCDE, 2020; OUR WORLD IN DATA, 2020a; WHO, 2020b).

However, in this research, it was aimed to identify the respondent perceptions about the subject, and all respondents selected at least one (multiple choice) of 18 measures provided.

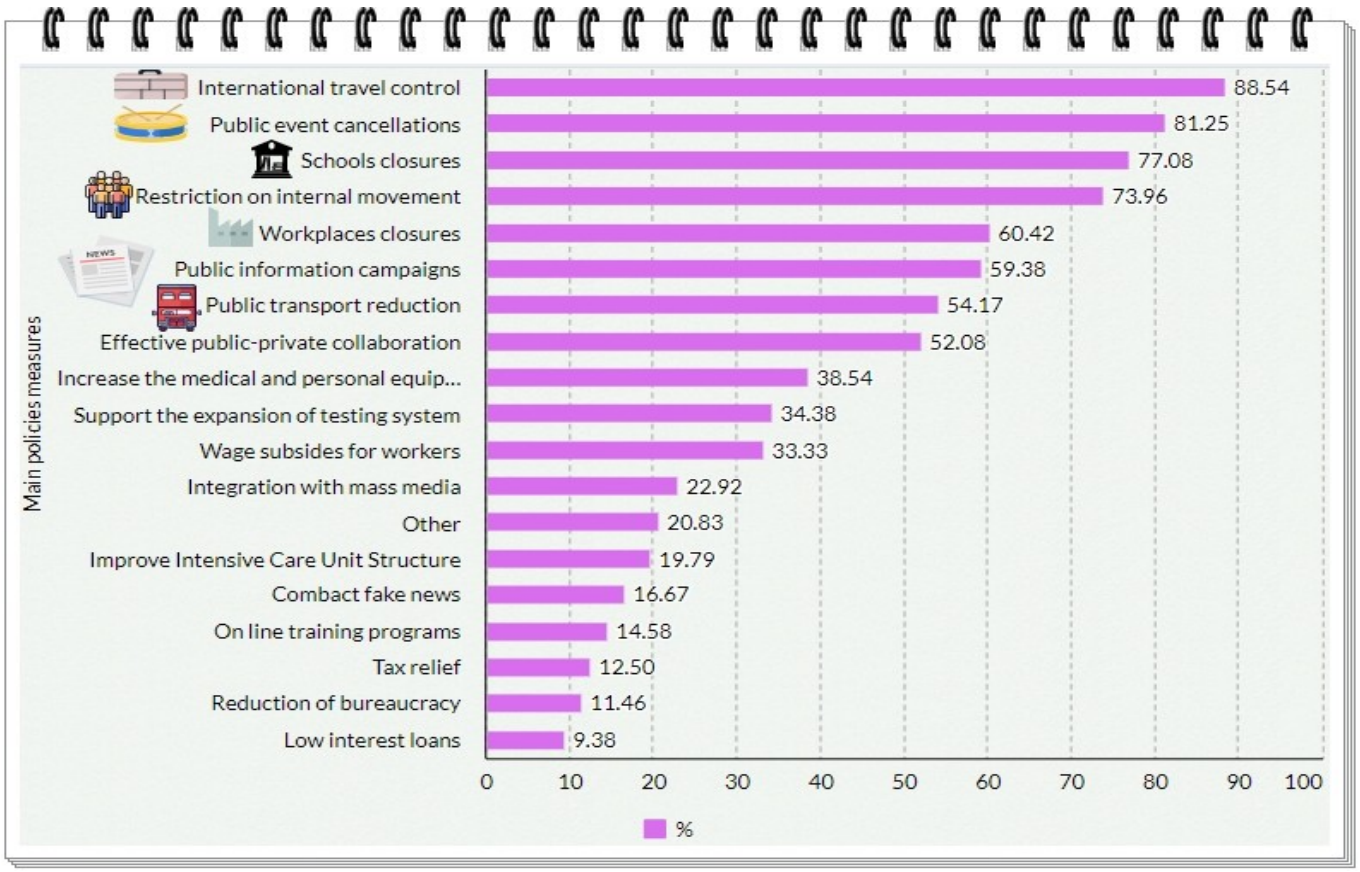


Figure 9: Perceptions of the 96 respondents on the main policies that saved lives in Thailand
Source: Author (2020)

Figure 9 shows that the ten main policy measures adopted by the Thailand Government that saved lives against the Covid-19 are: first) international travel control (88.54%); 2dn) public event cancellations (81.25%); 3rd) schools closures (77.08%); 4th) restriction on internal movement (73.96%); 5th) workplaces closures (60.42%); 6th) public information campaigns (59.38%); 7th) effective public-private

collaboration (52.08%); 8th) increase the medical and personal equipment capacity (38.54%); 9th) support the expansion of the testing system (34.38%), and 10th) wage subsidies for workers (33.33%).

Although they are considered important for the education and business activities, the five policies measures considered less powerful by the respondents to save lives are: 18th) low-interest loans (9.38%), 17th) reduction of bureaucracy (11.46%), 16th) tax relief (12.5%), 15th) online training programs (14.58%), and combat fake news (16.67%).

6.3.6 The most innovative products or services protecting people in Thailand against Covid-19

For question 5 of the questionnaire, it was asked to the respondent, if know, to write the name of the most innovative products or services that are protecting people in Thailand against the Covid-19.

Analyzing the answers, it was noted that: most (47=47%) respondent tried to inform what they believed as innovative products or services, while 31 (32%) respondents did not answer the question, ten (10%) informed that there was no innovative products or services, and 8 (8%) respondents informed that they did not know.

In technical terms, from the 47 respondents that tried to describe the innovative solutions, only ten (21%) informed the name of the products or services (Thai Channa app, and Village Health Volunteer System).

However, the main aim of this question was not to evaluate their ability in innovation issues, but to identify tips of products or services that respondents perceived as new during the pandemic, and from these tips, to search on the internet the organization, solution name, goal, technologies adopted, etc.

From the 47 respondents, the most innovative products and services are: Face Masks (8=17%), Apps (7=15%), Temperature (Thermometers) check at nearly all shop (7=15%), Hand sanitizer in all shops (6=13%), Public cooperation (6=13%), Thai Channa App (6=13%), Social distance (5=11%), Everybody wear mask (5=11%), Test Kit (4=9%), Village Health Volunteer System (4=9%), Early shutdown/lockdown (3=6%), Close borders (3=6%), General and strict control (2=4%), and Robots (2=4%), Citizen manufacturing masks (1), Clorox (1), Contactless transactions (1), Curfew masks (1), Fact-based communication (1), Food support (1), Mask distribution (1), Government measures to reopen (1), Personal protection equipment (1), Quarantine (1), Reduce seats on public transports (1), Check-in and Check-out (1), TV News (1), and Web News(1).

From the tips received, additional research was made to identify the innovative solutions, and a spreadsheet was developed with the following fields:

a) organization and solution, which describes the name of the organization and the solution developed; b) type, divided into Corporation (companies), Public Sector, Start-Up, University, and Other; c) contact, informing the e-mail or link for contact; d) site with the internet link; e) location, the name of the city where it was developed or applied; f) stage, divided into In Preparation, Pilot/Demo/Trial, or Ready; g) category, that classifies the solution as Prevention, Diagnostic, Treatment, Grants & Support Initiatives, Information, and Life & Business Application, by using the criteria of the Start-Up Blink (2020) that developed the Coronavirus Innovation Map; h) subcategory with subtopics for each category, by using the criteria of the Start-Up Blink (2020) that developed the Coronavirus Innovation Map; i) technology, which describes the main type of technology used; j) resume, which describes the main

information of the solution.

As a result, it was found 28 solutions in Thailand, with the majority led by Corporations (9=32.14%), Universities (8 from Chulalongkorn University =28.57%), followed by Public Sector (5=17.86%), Start-Ups (10.71%), and Others (10.71%).

Concerning the location, the most solution comes from the capital of Thailand, Bangkok (24=85.7%), followed by the other four cities. In terms of stage, most (26=92.86%) solution is Ready, and only two are in Pilot/Demo/Trial (Vaccines).

The main products, services, or technologies used by the solutions are Apps, Internet, QR Code, Websites, Chatbot, Face shields, Protecting Spray, Vaccine, Video Conference, UV Rays, Mobiles, Donations (Campaigns), 3D Printing, E-bike, Hepa Filter, Internet of Things (IoT), Nanotechnology, Online Map, Robot, Smart Indoor Air Quality, Social Channels, Stimulus Package Micro Loan, Test Kit, Call Center, Volunteers, Livestream Technology, E-commerce, E-Pharmacy, Data Storage, Masks, etc.

In terms of Category, most (12=42.85) is Prevention, while 7 (25%) for Diagnostic, 3 (10.71%) are Grants & Support Initiatives, 3 are for Information (10.71%), and 3 are for Life & Business Adaptation.

Chat 2 shows the organization name, the solution, the type organization, and the resume.

Organization → Solution	**Type**	**Resume and site**
1) Clicknic Co., Ltd. → CLICKNIC app	Corporation	An app that connects the patient to a doctor via video for a consultation. Site: https://www.clicknic.co/index.php/
2) BDMS → Samitivej Virtual Hospital	Corporation	It offers real-time consultations with doctors via video calling, available 24 hours a day, as well as home visits to take blood samples and deliver medication. Site: https://bit.ly/36c359V
3) Line Company Thailand → COVID-19 Info Hub	Corporation	A mini-app launched in Thailand that provides a daily health assessment. Sites: https://bit.ly/2Humit7; https://www.ryt9.com/en/prg/239007
4) Lazada Thailand → LazadaForGood	Corporation	To facilitate online donations to hospitals and medical foundations. Site: https://bit.ly/331ffjS
5) Lazada Thailand → A SME Stimulus Package	Corporation	To help more than 50,000 Thai SMEs with fast track access to microloan schemes with our bank partners and a 20% discount for Lazada's live-streaming channel. Site: https://bit.ly/331ffjS
6) Lazada Thailand → An O2O Promoter & Affiliate Programme	Corporation	To allow offline brand promoters or sales personnel to sell products through their social channels, and still earn commissions from brands and Lazada even though their offline livelihoods have been affected by the closure of shops in malls. Site: https://bit.ly/331ffjS

Continuation of Chart 2

Organization → Solution	Type	Resume and site
7) Line Company Thailand → "Work on LINE" promotion	Corporation	LINE tips and tricks for those working at home in Thailand, including on the use of LINE Call and LINE Video Call, which supports up to 200 people, and a live feature in LINE Group Chat, which supports up to 500. Site: https://bit.ly/2Humit7
8) Siam Cement Group → Modular Swab Unit	Corporation	Designed to separate patients in a pressurized room to prevent the virus from spreading while using concentrated UV radiation to kill the virus (UV Germicide) after each use. Site: https://bit.ly/3ilYNiG or https://bit.ly/2HJUdOK
9) BIOTEC & GPO → Inactivated Flu-based SARS-CoV2 vaccine + Adjuvant	Corporation	Non-replicating viral vector vaccine is in the Pre-clinical stage. Site: http://www.biotec.or.th/en/index.php
10) Cofact Thailand → Cofact Chatbot	Others	Users can verify the messages they receive via messaging services. They simply forward the message to the chatbot, which then accesses a database and tells users whether the message is correct or not. Site: https://cofact.org/
11) Maysa Talerd → Super Hero decorated face shields for children	Others	Face shields developed in Thailand with characters from cartoons, games, and sci-fi movies, hoping to cash in and promote safety for children. Site: https://reut.rs/3j525Ip
12) Chula VRC & GPO →Protein subunit vaccine	Others	RBD protein fused with Fc of IgG + Adjuvant vaccine in the Pre-clinical phase. Site: http://www.chulavrc.org/
13) NECTEC → µTherm FaceSense	Public Sector	A Smart Temperature Measurement System that identifies temperatures of up to 9 persons within only 0.1 seconds (within 1.5-meter range). Additionally, it supports IoT computing and data storage. Site: https://bit.ly/2S1H6tX
14) Thailand Government MoPH→ DoDC Covid-19	Public Sector	Thailand Government MoPH Department of Disease Control website to spread information (statistics, reports, articles, guidance, etc) about Covid-19. Site: https://bit.ly/33TbP1O
15) Thailand Government → Thaichana app	Public Sector	An app for use when people enter and leave stores and shopping centers in Thailand as some businesses were given the green light to reopen on May 17, 2002. Site: https://www.thaichana.com/

Continuation of Chart 2

Organization → Solution	Type	Resume and site
16) MoHESRI & Partners → WIN-Masks: Washable Innovative Nano-Masks	Public Sector	A mask with 3 layers. First, the water-resistant coated with nanotechnology and dust mite protection cloth, microfibre mixed with Zinc Oxide which can protect the user from bacteria and viruses. Third, the cotton cloth which can protect the user from the droplet from cough and sneezing. Site: https://bit.ly/33UEPq8
17) Government of Thailand MoPH→ Village Health Volunteer (VHV)	Public Sector	The VHVs scheme has been in place for over 43 years in Thailand. The Dep. of Health Service Support manages 1,040,000 VHVs across the country and an additional 15,000 public health volunteers in Bangkok. VHVs conduct home visits, provide health education, deliver medicines, and make reports to public health authorities. VHVs have been provided with surgical and cloth masks, face shields, biohazard bags, and alcohol gel. Between the 2nd and 26th March, VHVs visited 3.3 million households. Between 27th March and 11th April, VHVs visited 8 million additional households to support case (test and trace) efforts. Site: https://bit.ly/2S1OwgO
18) Doctor Raksa Co., Ltd → Raksa app	Start Up	App for online medical consultation and delivery of medicine. Site: https://www.doctorraksa.com/
19) 5LAB → CovidTracker	Start Up	An interactive map of Thailand that displays the location of the reported cases and a link to their sources to ensure that it is credible. It also lists the number of reported cases and shows any fake news that is being spread around. Site: https://covidtracker.5lab.co/en
20) CYFAI → E-bike Rental System	Start Up	An electric motorbike rental system in Bangkok that is reducing CO2 and protecting people from the crowded transport system. Also is donating part of the profit to BIG TREES PROJECT. Sites: https://m.socialgiver.com/shop/cyfai/ and www.cy-fai.com
21) Chulalongkorn University → Lung Care Application	University	The Lung Care application tests the lungs' performance. By blowing into the microphone of a smartphone, results will show how well the lungs are working. Site: https://www.chula.ac.th/news/29369/

Continuation of Chart 2

Organization → Solution	Type	Resume and site
22) Chulalongkorn University → Chula COVID-19 Strip Test Service	University	A quick screening test kit that provides results in 10 minutes. The 4.0 technology integration helps assess the risks and monitors the patient's symptoms to screen patients for risks before ordering for a CPR test. Site: https://www.chula.ac.th/news/28888/
23) Chulalongkorn Univ. → Willing Application	University	A platform that matches a donor to a recipient. Site: https://www.chula.ac.th/news/29521/
24) Chulalongkorn University → Face Shields	University	Face shields designed with 3D printing technology, made of lightweight PP+TPE material for ultra-comfort and can be cleaned with soapy water. The transparent sheet is made of anti-fog-coated PET sheets to reduce fogging during use. Site: https://www.chula.ac.th/news/29535/
25) Chulalongkorn University → Negative Pressure Cabinets for Specimen Collection	University	Made from transparent acrylic and designed to safely collect respiratory secretions from patients. The cabinet has an air cleaner installed with a HEPA filter, which can trap 99.96% of small particles. The UV-C light disinfection also hinders the virus from thriving. Site: https://www.chula.ac.th/news/29219/
26) Chulalongkorn University → Protecting Spray for Fabric Masks	University	The Covid-19 and PM 2.5 protecting spray from the Faculty of Pharmaceutical Sciences can be used on fabric masks to filter small particles of up to 0.3 microns, increasing the protection efficiency to 83%. Site: https://www.chula.ac.th/news/29506/
27) Chulalongkorn University → CU-RoboCOVID	University	A robot that provides medical support, decreases the workload of medical staff and replaces tasks prone to risks of exposure to infection. Site: https://www.chula.ac.th/en/news/30492/
28) Chulalongkorn University → VQ20 Spray Dispenser and VQ20+HP35 Device	University	The device makes sterilization of rooms and medical equipment more efficient. Site: https://www.chula.ac.th/en/news/30492/

Chat 2: List of 28 innovative products or services that are being implemented in Thailand to save lives against Covid-19.

Source: Author (2020)

7. Conclusions and recommendations

The main goal is to investigate the performance and the best management practices adopted in Thailand to save lives against Covid-19, during the first six months facing the pandemic. After the collection and analysis of data, it was possible to reach the ten conclusions and recommendations:

First) on 27th September 2020, without considering the unreported cases, population, and the same period of facing the pandemic, the 20 top countries leading the total number of fatal cases were: 1st) USA, 2nd) Brazil, 3rd) India, 4th) Mexico, 5th) UK, 6th) Italy, 7th) Peru, 8th) France, 9th) Spain, 10th) Iran, 11th) Colombia, 12th) Russia, 13th) South Africa, 14th) Argentina, 15th) Chile, 16th) Ecuador, 17th) Belgium, 18th) Indonesia, 19th) Germany, and 20th) Canada;

Second) when considering the indicator Fatality Total Index, which estimates the number of total real cases (including unreported), by one million (population) during the first 180 days facing the Covid-19, the ten most critical countries were: 1st) Mexico; 2nd) Peru; 3rd) Italy; 4th) Ecuador; 5th) Iran; 6th) Chile; 7th) the UK; 8th) Belgium; 9th) Colombia, and 10th) Brazil. Half of the ten critical countries comes from South America, followed by Europe (30%), North America (10%), and Asia (10%). No one of the ten top critical countries reported fatal cases of SARS2003, 60% of the nations without any case of that virus, which may indicate that since the first coronavirus in 2002/2003, these countries did not make enough investment and preparations for the future return of the virus;

Third) Thailand reported two fatal cases of SARS2003 and was the one first country to register new cases of Covid-19 after China. However, the value of Thailand's FTI180 is very low, indicating that this country has learned from the lessons of the past, reason by which is the best at saving lives against the Covid-19, when compared with all the 20 nations investigated. Further research could be done to investigate the main investments made over time. Also, a new study could compare the Thailand FTI180 performance with more countries, since this research was limited only to twenty nations with the highest number of total cases reported on 27th September 2020;

Fourth) in 2019, Thailand was globally recognized as strong in the following categories: Sufficient and Robust Health System to treat the sick and protect health workers; Prevention of the Emergence or release of pathogens; Rapid response to and mitigation of the spread of an epidemic; Commitments to improving national capacity, financing and adherence to norms; and Early detection and report for the epidemic of potential international concern (NTI, JHU, and EIU, 2019 p. 22 – 25). Besides, it has a strong field epidemiology training program and national laboratory system, demonstrating a robust electronic reporting surveillance system that functions at both national and sub national levels, rapidly collecting laboratory and epidemiological information. Thailand also demonstrates strength in prevention and response capability, conducting regular event-based surveillance through a dedicated Situation Awareness Team embedded in the Ministry of Public Health's Emergency Operations Center (NTI, JHU, and EIU, 2019 p. 55). However, this report also calls attention to the category that Thailand needs improvements: Overall risk environment and country vulnerability to biological threats;

Fifth) for the Deep Knowledge Group (2020), Thailand: 1) was the 47th best country among the 200 countries, and territories analyzed; 2) strongest category is Government Efficiency of Risk Management, Regional Resiliency, Monitoring and Detection, and Health Care Readiness. On the other hand,

Emergency Preparedness, and Quarantine Efficiency are the categories that need furthers improvements, reason by which new research could be done to identify solutions to improve the indicators of these categories;

Sixth) for 86 respondents living in Thailand, wear a mask, not shake hands, not hug in public, wash hands, and not wearing shoes in the house, were the five most decisive cultural practices that saved lives. On the other hand, the less decisive were: avoiding speak during public transport, few foods eaten with bare hands, and cleanliness of restaurants. As a result, for effective national and regional efforts against any pandemic, cultural practices play an important role to get public cooperation or support, reason by which government leaders and managers should adopt the leadership by example, with intensive public information campaigns, especially in countries where wear masks, not shake hands, not hug in public, wash hands, not wearing shoes in the house are not cultural practices among most people;

Seventh) for leaders of a nation, the situation is much complex and demand leadership by example with the following behaviors to help people change and support government policies measures, programs, projects and actions: 1) hear carefully the scientists, WHO and intelligent services; 2) act fast for the national unity by integrating all ministries, media, companies, universities, army forces and main actors to fight the pandemic; 3) support the scientists and WHO; 4) follow the Covid-19 Safety Protocols; 5) encourage correct measures; 6) adopt clear communication and combat fake news; 7) avoid to spread medicines, drugs or treatments that are not proven effective against the virus; 8) praise and develop measures to protect the health workers, researchers and other professionals that are facing the Covid-19; 9) show empathy for sick people and for the families that lost parents over the time; 10) use diplomacy to create global cooperation against the virus. Further research concerning behavior field should be done to advance the understanding of how leadership by example are playing crucial role in successful countries during the pandemic;

Eighth) for 96 respondents living in Thailand, the ten main policy measures adopted by the Thailand Government that saved lives against the Covid-19 are: first) international travel control; 2dn) public event cancellations; 3rd) schools closures; 4th) restriction on internal movement; 5th) workplaces closures; 6th) public information campaigns; 7th) effective public-private collaboration; 8th) increase the medical and personal equipment capacity; 9th) support the expansion of the testing system, and 10th) wage subsidies for workers. The result show the importance of such measures for policymakers and public managers, and further research could be done to: 1) identify how those practices were implemented; 2) identify and disseminate the successful programs, methodologies, methods, techniques, plans, partnerships, and projects developed;

Ninth) to save lives against Covid-19, twenty-eight products and services are being implemented in Thailand, with the majority led by Corporations, Universities, followed by Public Sector, Start-Ups, and Others. In terms of stage, most (93%) solution is Ready, and only two are in Pilot/Demo/Trial (Vaccines). The main products, services, or technologies used by the solutions are Apps, Internet, QR Code, Websites, Chatbot, Face shields, Protecting Spray, Vaccine, Video Conference, UV Rays, Mobiles, Donations (Campaigns), 3D Printing, E-bike, Hepa Filter, Internet of Things (IoT), Nanotechnology, Online Map, Robot, Smart Indoor Air Quality, Social Channels, Stimulus Package Micro Loan, Test Kit,

Call Center, Volunteers, Live stream Technology, E-commerce, E-Pharmacy, Data Storage, Masks, etc. Further research should be done to investigate the efficacy level of each solution.

Tenth) probably due political instability in Thailand and the use of English in the questionnaire, part of research result came from a small sample of 96 respondents, most foreigners living in Thailand that volunteering answered the survey, reason by which, is strongly recommended to translate the questionnaire into the official Thai language, to realize new research with a better representative size.

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Oversharenting and family life: likes on *Instagram*

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Abstract

This article invites us to reflect on oversharenting and family life that, owing to the proliferation of communications technology and the internet, is intersected by digital cyberculture. The research was carried out on the social network, using the method of searching by hashtag. The results showed that during 2018 in two weeks, 20,781 posts were made using the hashtag "minidiva" and 1,679 with the hashtag "miniblogger", from which three posts were collected each day. Netnography was used to analyze the images and categorize them: (1) oversharenting and family life, (2) social media and child consumption, (3) child adultization. It was concluded that online social networks (Instagram) are spaces where interpersonal relationships; it was seen that the act of consuming gained relevance in the family and that the child's exposure occurs without awareness, which can cause a high degree of exposure and consequently have adverse effects for everyone.

Keywords: Oversharenting; children; families; *Instagram*.

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Introduction

Technological development and the advent of the internet are important influencers on human relations today. The use of social media and networks, for example, is a common practice for a large part of the world's population and influences the way of living and existing in the world. For Bolesina and Gervason,

(2015, p.2), "the intimate link between internet, cyberculture and postmodernity gives rise to a kind of network that involves, without breaches, all contemporary social life." For these authors, postmodernity is the context of cyberculture and the internet, cyberculture being one of the cultures of postmodernity, and the internet, as cyberspace, one of the spaces of postmodernity.

As such, the way technology has invaded the daily lives of societies has changed the way of understanding the world and, in addition, it has changed the way culture is understood today. Technology has become not just a resource, but a way of life in cyberspace. In this context, we highlight social networks as one of the most expanding and important forms of virtual communication and construction of cyberculture. After all, "these networks are undoubtedly elements not only of social contacts, but, above all, they constitute efficient instruments for the propagation of ideologies, cultures and identities" (Castro & Spinola, 2015, p.171).

When we consider that social, economic, cultural and political transformations have had a profound impact on family life, we emphasize the importance of understanding the family from a comprehensive concept, based on the affectivity and proximity between members and the understanding of the current variety of family constitutions, including single-parent, multigenerational or homo-affective families, among others (Dessen & Braz, 2005). Aspects such as parental hierarchy, forms of communication, dependency relations and the participation of each member in family life are constantly changing; there is increasing participation of women in the labor market and the older age at which they have children, in addition to new lifestyles and consumption patterns that are marked by quick access to information and technologies. Thus, modern family relationships are strongly influenced by media and technologies (Andrade, 2017).

As we address the increasingly marked presence of families and, consequently, their children on virtual social networks, we are struck by the large number of child profiles managed by the children's families, especially by the mother, with the aim of sharing the family routine. This is in spite of the ban on the participation of minors on most social networking sites and applications, such as *Instagram* and *Facebook*. In this context of greater child participation in social networks, we can cite information provided by the Guide to Virtual On-line Security by AVG 3 (Sanches, Cardelino & Ramos, 2014), which shows that 81% of children under two years of age already have some kind of profile on the internet and about 23% start their digital lives before they are even born, when parents post prenatal exams on the net. In addition, the average age for children to acquire an online presence, through their parents, is 6 months and more than 70% of mothers say that they post, or have posted, images of their child to share with their friends and family. The cited data were obtained in a survey carried out in seven European countries and America, with 2,200 mothers, in 2010, by the virtual security company AVG.

Generally designated as profiles for disseminating the child's daily life and exchanging information about the roles of motherhood / fatherhood, children's profiles include images of the child's routine that are published and shared. The images include their simplest activities, such as going to school and playing, or even more intimate information, such as the objects that they own, the clothes worn, the places frequented, food eaten and things done. Social networks enable thousands of people to access this information simply and rapidly. Another point that deserves attention is the security of the information conveyed. Many families that manage pages with content about their children do not use the privacy resources available on social networks.

Steinberg (2017) discusses the conflict between the parents' right to freedom of expression and the children's right to privacy, pointing out that parents build a digital identity for the child, being narrators of their lives without their consent. This can cause discomfort, either in the present or in the future. Steinberg also points out the need to consider the potential for harm, from the action of dangerous strangers, or the mis-use of a child's data for other purposes, such as advertising or even disclosure of embarrassing information.

According to Borda (2015), in the context of social networks, the category of "mommy blogs" is evident, that is, blogs and pages that focus on the experience of motherhood. We know that there has always been curiosity about the lives of celebrities, after all, famous people are fascinating because of the status achieved through their visibility, as well as by their social and economic position.

However, we emphasize that, with the advent of the internet and the popularization of online social networks, we see more and more famous anonymous people appearing. That is, ordinary people who, initially unknown, become popular on social networks through videos and posts that have an immediacy and authenticity, gaining thousands of followers without requiring the intermediation of other media, such as television, for example (Jerslev, 2016). They are the so-called "do-it-yourself microcelebrities or celebrities" (Evans & Hesmondhalgh, 2005 cited by Jorge, Andrade & Marapô, 2017, p. 144) anonymous people who, through different means, are able to interact with a large public, collecting "likes", comments, shares and thousands of followers willing to frequently follow their private lives and those of their children on social networks.

For Jorge, Andrade and Marapô (2017) this great growth of pages dedicated to the themes of motherhood and parenting, in recent years, needs to be investigated. These authors researched maternity blogs authored by celebrities and mothers who achieved public visibility thanks to the blogosphere, in order to understand the cultural impact of this phenomenon, pointing out that the maternity blogs sector has become an influential public sphere not only for the exchange of experiences between parents, but also as a reference for lifestyles and consumption. Hence, the intimate connection between the internet, social networks, consumption and adultization can be perceived.

Weber and Franciso-Maffezzolli (2016) corroborate this idea by pointing out that the phenomenon of adultization is closely related to media and consumption, as well as to new family organizations. This requires investigation because it involves social and economic issues, in addition to impacting on society as a whole. Silva and Guimarães (2014) also establish this relationship by emphasizing that understanding the adultization of childhood involves understanding how advertising works, both in the minds of children and in the lives of their parents. By making the children behave like adults more and more willing consumers are developed earlier and are more likely to compulsively acquire goods, since they are not mature enough to discern consumption.

In addition to consumption, Postman (2012) comments on the issue of early eroticization of children as one of the alarming aspects that highlight the disappearance of childhood and that the concept is in decline today. It is observed, therefore, that characteristics of childhood no longer resemble those of previous centuries and this can be seen in clothes, eating habits, language, play, emotional behavior, in the field of sexuality and even in the physical appearance of children, which are becoming increasingly like those of adults.

However, due to age, the child is unable to express an opinion on the use of their image and body. Silva and Guimarães (2014, p.10) point out that when we do not yet have a well-formed cognitive structure, it is a complex activity that requires a lot to maintain an image as such. These children do not have full control of what is happening and nor are they able to relate it to other things, or to link what they use with the message being conveyed.

It is possible to perceive that in the sharing of high-visibility parenting, the image of the child is extremely valued in its media function, including to the detriment of their opinions and preferences. We are, after all, inserted in a "consumer society", where people are encouraged to promote an attractive and desirable commodity, using resources to increase the value of the product they sell or advertise on the market: and that product is themselves. In this consumer society, no person becomes a subject without first being a commodity. One dreams of fame and recognition because no one wants to be forgotten or devalued, but desired, coveted and noticed, as a highly regarded commodity standing out from the others (Bauman, 2008, Caniato & Nascimento, 2010).

All of these publications demonstrate that subjectivities and identities can be built on the relationships established in social networks that favor the gathering of people and communities that have common characteristics and interests, with the aim of exchanging ideas and experiences. This occurs in child and motherhood profiles, where this practice of sharing parental life has become known, in English, as "sharenting". This is a term derived from the combination of "sharing" and "parenting".

The practice of "sharenting" happens as parents reveal their life experiences on social networks and disseminate personal information about their children, such as photos, location, place of study, friendship group or health and education issues, among other things. This practice builds a digital footprint that will accompany the child throughout their life (Eberlin, 2017). In addition, the term "Oversharing" is used to designate the excessive sharing of personal and intimate data on a daily basis on social networks. It is from these two concepts that the phenomenon we intend to investigate is termed. Oversharenting is characterized by the incessant and exaggerated publication of children's intimate information, by parents, through photos, texts and videos, which in addition to damaging the privacy of children, can jeopardize the safety of the whole family (Turra, 2016, Machado & Bettencourt, 2018).

Therefore, the aim of this article is to provide critical reflections on oversharenting, based on hashtags on *Instagram*. It aims to contribute to the acquisition of knowledge about the practice, as well as providing support to psychologists and other professionals, especially those working with families and children, to offer guidance and information about this very current and under-researched issue.

Methodology

We conducted qualitative research of the descriptive type, based on Virtual Ethnography, that is, Netnography. Netnography is an important research method in the human and social sciences and has the premise of being on the spot to listen and be together with those we intend to study and understand, without the researcher controlling the behaviors being observed (Zanini, 2016). Netnography uses ethnography for online research, it is a specialized form and has computer-mediated communications as its data source, aiming at the understanding and ethnographic representation of a cultural phenomenon on the internet. Its

approach is adapted to study, among other things, forums, newsgroups, blogs, social networks, which constitute examples from the vastness of cyberspace (Kozinets, 2014).

Research environment

The present study considered cyberspace as its research environment, more specifically the application *Instagram*, as a place for data collection. The choice of the *Instagram* social network for this research was also due to its massive popularity among Brazilians, with Brazil having the third largest *Instagram* user base, with 64 million monthly active users, according to information released by the network in October 2019.

When addressing what he calls the "*Instagram* phenomenon", Piza (2012) points out that this is the result of a dynamic process that originates from the favorable conditions of the information technology era, which offers the possibility of popularizing individuals within the network: the greater the number of followers one has, the more prestige and recognition the user will have within the community.

As a platform that enables the use of multimedia content, *Instagram* allows the sharing of personal narratives, in real-time, with resources for introspection and reflexivity (Jerslev, 2016).

Procedure for data collection

The data collection started with the overview of the social network *Instagram*, where the annotation and archiving of posts, comments and observations of this virtual field were made, observing which hashtags were most used in the posts with the images of children in different situations. The information resulting from the hashtag search was recorded in a field diary for two weeks (from October 16 to November 6, 2018, always between 3pm and 5pm, because this is a peak time for people to access *Instagram*, generating a lot of views).

According to Moura and Mandaji (2014) hashtags are words, phrases or expressions preceded by the symbol #, which make it possible to group posts by topics, that is, groups that express ideas, feelings, preferences and the locations of individuals who operate in cyberspace.

From their recurrence, we selected six hashtags with terms and words related to our research object, which were: #miniblogger; #minidiva; #mummyblogger; #minidigitalinfluencer and #realmotherhood.

It was possible to see that the number of results for the search for hashtags increased considerably over the two week interval. The hastags used the most were "minidiva" (in 20,781 posts) and "miniblogger" (in 1,679 posts). We recorded and collected at least three results per search day, depending on the relevance of the posts found, which were saved in a Word document. We used the Print Screen function to save the images in a computer folder to facilitate the analysis. Subjects' names, parts of images and other personal information was hidden to protect privacy and identity, and fictitious names were used.

Procedure for data analysis

For the data analysis procedure, the ethnographic method called ethnonursing was used. The ethnonursing research method was developed by Leininger in 1985 and is organized in phases:

First phase - data collection and documentation, making records according to the research objectives.

Second phase - the identification of the descriptors, when the data are organized based on similarities and differences of statements and behaviors, they are classified to facilitate the understanding of certain issues and situations being studied.
Third phase - analysis of contexts, meanings and recurring patterns of behavior and statements, examining categories of data and interpretations in search of recurrences.
Fourth phase - analysis and synthesis of information. This phase requires reflection and creativity to analyze the data, elaborate formulations, theoretical inferences and provide recommendations.
At the end of these phases, in the present study, categories of analysis were elaborated for the discussion of the data, namely: oversharenting and family life, social media and child consumption, and child adultization.

Ethical Care
The project was submitted to the Research Ethics Committee of the Federal University of Amazonas on July 30, 2018 and approved on August 23, 2018, under CAEE number 96190818.2.0000.5020.

Results and discussion

In the search for the term "Miniblogger", we found images of girls and boys in different everyday situations: daily routine, education, health, and consumer lifestyle. The hashtags “realmotherhood” and “mommyblogger” returned the posts from mothers whose content related to motherhood, the childcare routine, domestic life, the responsibilities of the mother, experiences about raising children, among other subjects. The hashtag "Minidiva", in turn, brings more specific images of girls super-produced, dressed-up, made-up, participating in events or fashion shows. Finally, the hashtag “Minidigitalinfluencer” includes posts with images of boys and girls in situations created for publication purposes, with the intention of influencing followers in certain behaviors and styles.
To explain the results found, the findings were organized into categories, namely: (1) oversharenting and family life, (2) media and child consumption, (3) child adultization.

Category 1: oversharenting and family life
The family is the first social system to which the child belongs, having an important influence on his cognitive and affective formation. It is in the family that the child first experiences affectivity and social bonding. As an essential source for the development of the subject and their personality, the family undergoes, throughout its history, countless transformations because it is inserted in a dynamic society, with constant changes that systematically influence its social practice (Khöler & Amaral, 2011).
Regarding the influence of new technologies on the functioning of the family, Tapscott (1999), cited by Leão (2014), shows that contemporary children are already in contact with technologies from an early age, understanding them as part of their environment. The child today is born and grows up with technological innovations. Technology is, therefore, something as natural as breathing itself. Weber and Franciso-Maffezzolli (2016) also elaborated a conceptual scheme based on Postman (2012), and also on the assumptions of Buckingham (2006), where they point out that there is a triad that shapes childhood and is

responsible for the child's socialization: (1) the family, (2) the school and supervised activities, (3) social media and consumption. In the case of children's pages on social networks, we highlight the active role of the family and social media as potentially influencing the development of children's social life.

For now, we can approach the practice of oversharenting here as one of the ways for the family to insert the child in the world of the internet and thereby determine their first virtual experiences. For many, the sharing of family life begins well before birth. Many parents share positive pregnancy tests, making the results public to their followers on social networks, as we can exemplify in Figure 1.

Figure 1 –*hashtag* "maternidadereal"

Fonte: *Instagram*

Images and texts about the entire gestation period, finding out the child's sex, preparation for childbirth, choosing and buying baby clothes, the baby's birth and details about childbirth are also quite frequent and common, as well as dissemination of the child's image in the first hours of life, as shown in the post in Figure 2.

Figure 2 –*hashtag* "maeblogueira"

Fonte: *Instagram*

Parental life is also shared through the experiences, anxieties, joys and difficulties of the mother or father. Therefore, children's and parent's profiles demonstrate the online presence of mothers and fathers in the task of sharing parenting and family life, with a strong influence on the exchange of experiences with other mothers and fathers, in addition to being a lifestyle reference. As an example of this, in Figure 3, the mother shares her difficulties related to tiredness and adapting to the child's routine.

Figure 3 – *hashtag* "maternidadereal"

Fonte: *Instagram*

In looking for insight into oversharenting we refer to Poletto and Koller (2008), who approach the family as the social group whose function and structure have a determining role in the development of the individual, highlighting especially the relationships between parents and children. These are considered complex relationships and indispensable to the promotion of an encouraging, protective and safe environment, providing the right conditions for a person's learning and development.

Correlating to the possible consequences of a child's excessive exposure on social networks practiced by parents, Meirelles (2006) addresses the issue of parenting, pointing out that when it is pathogenic, it ends up potentiating anxious, insecure, overdependent and immature behavior, which can lead an individual to develop neurotic symptoms, depression or phobia, in stressful conditions.

Turra (2016) corroborates this idea by stating that there is a real danger for the child whose parents practice oversharenting. This might include the misuse of images, paedophiles accessing the child's data and the action of people with criminal intentions, in addition to harming the child's development, in view of the prematurity of the construction of their social/digital image by the parents.

Finally, we highlight that Alcântara and Osório (2014), when talking about the place in childhood of the digital world, emphasize that the internet can be used as a space for play, social coexistence and content production, but stress the importance of security and understanding that children need support, affection and guidance from adults, in view of the challenges imposed in such diverse and demanding environments.

Category 2: Social media and child consumption

Contemporary society is characterized by an excess of images, information, objects and the globalization of ways of life and customs. In this context, consumption is a way of sharing codes and symbols, regardless of ethnicity, social class, economic condition or nationality (Alcântara & Osório, 2014). According to Coria (2006 cited by Laurindo & Bruck, 2014) consumption behavior, economic conduct and symbolic exchange values in children's material goods are elaborated through information and influences received from adults and the media. Thus, we are witnessing an intense identification of children and adolescents with the materiality necessary for their role as consumers.

In this context, the child audience acquires a prominent social position, having visibility and becoming the target specific products and services. Buckingham (2007) details his concern about the lack of understanding about the involvement of children and adolescents in commercial and advertising issues. However, he points out that this group no longer play a passive role as recipients or submit to the market, as they are active social actors in the process of building meanings.

We see then that childhood is permeated by several discourses related to consumption. On the one hand, we have a childhood seen as a period of care and protection, deserving of affection and respect in its specificities. And on the other, we have an independent childhood, with children being citizens with consumption and choice rights. In addition, we still have the child as a commodity, an actor in consumer society (Alcântara & Osório, 2014).

In the context of our research of children's or parental profiles on *Instagram*, we can conceptualize and discuss these different roles of children in consumption practices, under the strong influence of adults, especially the family. All of this dynamic refers to the culture, social class and subculture of the developing

person, influencing their consumption patterns and lifestyle, as well as the relationships that they establish in the most immediate environments in which they interact, such as family and school.

Consequently, minibloggers participate in events such as store sales and fashion shows, actively or passively promoting products and clothing brands, shoes, accessories, toys, food and many other products. These are called "partnerships" where in exchange for promotion, bloggers receive payments, exchanges, gratuities and/or products and services.

Such practice has achieved visibility and in most cases it generates financial return for the blogger parent, considering that many posts are paid for, either with money or with products and services. The same goes for brands of baby diapers, shoes, party services, food, hygiene products, etc. According to Salazar (2014) the current order of action is: consume, register and share. This whole discussion can be demonstrated by the post shown in figure 4.

Figure 4 – *hashtag* "miniblogueira"

Fonte: *Instagram*

This post was one of the results found under the hashtag "miniblogger". The child was only two years old and had 158,000 followers on *Instagram*. The post had more than 6,000 likes in one day. In the caption, the person who manages the page (the mother of the child) describes each item of the girl's clothing as a pattern of the child's consumption: "*introducing my new Gucci belt* (...) *my great new bow is from Louis Vuitton*." Also described are the stores that sell or distribute the products, in what is probably a lucrative partnership.

We see that for brands, either big or small, being advertised by a blogging mum who has a considerable amount of followers can be a very profitable business. The level of public awareness that can be generated is unprecedented. In addition, there is the discourse of a person who, at least in public, is using the product on their child and reporting their positive personal experience, stimulating curiosity and arousing interest.

According to Ishida (2016), the popularization of social media brought new types of public figures to the fore: youtubers, bloggers, Instagrammers, snappers, etc. A strategy increasingly adopted by organizations is to sponsor or hire popular profiles to reinforce campaigns, seeking to appropriate the profile's popularity. Resuming the discussion about the presence of children's images in the promotion of products on their *Instagram* profiles, Bauman (2008), and Caniato and Nascimento (2010) point out that we are inserted in a "consumer society", which promises a happy and successful life, by promoting consumption as a lifestyle and as a way of existing. Silva and Guimarães (2014) state that, since the child does not yet have a well-formed cognitive structure, he is not able to relate what he uses with a message to be transmitted.

In relation to the universe of media artifacts produced for girls, Petersen and Schmidt (2014) say that to show that they belong to this voracious consumer society, children themselves become consumer goods, that is, they advertise not only their own media character, but also their bodies, their sexuality, their ways of being, behaving and dressing (p.45).

It is due to the important role in mediating reality and social relations that social media and the consumption patterns it instills in society, strongly affect children and adolescents. The valorization of physical beauty, abilities, social and financial conditions, in addition to consumption power are issues that become part of the child's daily life in their search for personal satisfaction, resulting in a process intrinsically linked to consumption which we will discuss next: child adultization.

Category 3: Child adultization

The process of child adultization is strongly marked by social media and by its consumption to the extent that the child becomes part of the consumer society, with more and more products and services aimed exclusively at them, allowing active participation in the economy. In addition to their remarkable condition as a commodity, we have the child as both a celebrity and a consumer (Alcântara & Osório, 2014).

For Pires (2013) based on the assumption that to achieve appreciation and visibility the child needs to be publicized, social media exploits the image of the child by promoting and encouraging early erotization and sexuality by transforming children into miniature adults, frequently using elements of children's imagination to persuade consumers.

When we searched for the *hashtag* "miniblogger", the image in Figure 5 caught our attention, as one of the most relevant posts. The image is of a young child, the description above the image states that the girl was elected Miss Baby 2018 from a certain city when only three years old. Her task is to be a digital influencer. Thus, we see a small child, hair styled, made up and dressed for a beauty contest. When we visited her profile on *Instagram*, we found that the beauty queen has 11,000 followers and is a "Mini Fashion Blogger, Model and Mini Miss". In other words, at the age of three, she performs numerous activities that are not (or until recently, they were not) characteristics of this age group, being tasks that demand care of the body and appearance, as well as time, discipline and disposition.

According to Pires (2013), the importance of following fashion, from which children's beauty contests emerge, stems from the market need to encourage children to behave like adults and, consequently, to consume products originally intended for adult audiences. The majority of advertisements aimed at children exalt and overvalue adult attributes, especially women, in the case of advertisements aimed at girls, in addition to highlighting the modeling profession.

According to Menezes (2013) children also seek to characterize their bodies within accepted social and cultural precepts in this body cult society. In an attempt to insert themselves into a pattern of beauty that appears to be about well-being and happiness, children invest in their bodies the standards imposed by websites, celebrities, magazines and television in order to obtain recognition and acceptance.

The description in the child's profile also provides information that the profile is managed by "mom" and that partnerships (with stores, brands and companies) can be handled direct (via private messages through the app itself). In the comments of the followers, we can also see messages of praise and admiration and encouragement for the Mini Miss's activities.

Searching under the hashtag "minidiva" we highlight the post in Figure 6. This is a seven-year-old girl. The caption in the photo says: "*Beautiful and wonderful fashion show with the producer ...*" What really caught our attention was the child's serious countenance, as well as the clothes and makeup. Visiting her profile, we found that this pattern of seriousness is repeated in most of her photos.

In her profile the information given is: model at Agência Estrelas, singer, actress, ballerina. It also contains a contact phone number and the information that partnerships can be dealt with 'direct' and that the page is "100% monitored by mom". The profile has 12,600 followers. A relevant observation is that the photo had 521 likes in just five hours.

As we can see in the online profiles, the child's body undergoes several interventions, through makeup, accessories, clothes and behavior, which are influenced by the discourses of beauty and practices around the production of an idealized body. We understand that the child has no control over what is happening, nor over the message transmitted through their clothes (Silva & Guimarães, 2014, p.10).

When researching adults' perceptions about the influence of children's clothing companies' marketing communication on the adultization process, Barros, Barros and Gouveia (2013) pointed out that this influence is encouraged by the use of adult garments that reproduce the patterns and styles of adult clothing in children's clothing. In other words it is the adultization of the child's body.

Final considerations

The search for chosen hashtags allowed us to have access to posts relevant to the study, making it possible to investigate the relationships established between children, their families and cyberspace. It is in this digital context that we are faced with a contemporary contradiction: on the one hand, the greater proximity between people through the use of technologies and means of communication and, on the other, bonds and relationships that are increasingly superficial and transitory. It is what Bauman (2008) calls "liquid modernity", referring to the present time, globalization and ephemerality in the affective relationships that are established.

We believe that, in most cases, online social networks exemplify this space where relationships between people are established more easily and quickly, but with less stability and emotional depth. Although the virtual environment is rich in facilities, in the possibility of sharing, interacting, mobilizing and generating connection, we also find that there are aspects that characterize the impoverishment of this environment: the vulnerability of information, the volatility of relationships, the compromised privacy and security problems.

This is the concern that hangs over our discussion of the insertion of children, their families and their daily lives in the space of social networks. In the bioecological paradigm of Bronfenbrenner, poor environments, ones where relations are superficial and not very affective, impact on proximal processes, and can cause dysfunctions, especially in childhood. We know that the family is the microsystem in which the child will develop and relate initially, through reciprocal and bidirectional relationships, later expanding their involvement in other systems, such as school, and finally to the social macrosystem, with its culture, politics and historical moment.

It is by taking the role of the family as a provider of healthy conditions for the development of children and adolescents and also being responsible for understanding the world and the meaning of situations, that we highlight our concern with the issue of child exposure on social networks. That is, we question the influence of this practice on the relationships and affective bonds between parents and children. It is certain that there is a harm done to face to face interactions, and what we have seen many times, are relationships mediated in constructed realities and almost always forged for publication purposes.

The child, in most cases, has no understanding of how their image and personal information are conveyed, being unable to express an opinion and make decisions about themselves. This raises numerous other issues, highlighted in our study, including security and privacy problems, greater vulnerability to violence, bullying and cyberbullying.

In addition, we also cite posts for marketing purposes using the image of children to make subversive appeals to consumption. Here we refer again to what Bauman postulates (2008), about the consumer society that we have become. The act and the sense of consuming have gained a new level of relevance, making consumption a central element in the formation of people's identity, and it is not only simply a matter of necessity. These are the relationships that we highlight: we consume to identify ourselves with a certain pattern of life and behavior, we consume to be noticed. Ultimately, having becomes more important than being.

We also emphasize the need to deepen the theme of this paper, allowing for diverse intersecting themes, and also the importance of the development of longitudinal studies for example. These can follow the children for a sufficient period of time to enable the development of inferences and even more in-depth and grounded knowledge.

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Observations on Cross-Cultural Discussion Dynamics – Case study: American-Moroccan Students

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Abstract

The article at hand seeks to unveil the different patterns of communication between Moroccan and American students. The article is based on a conducted experiment in which a group of American students were put together to converse freely under the topic of social media. The same experiment was replicated with a group of Moroccan students. Each group used their native language (Moroccan Arabic for Moroccans and American English for Americans). The results are drawn from the observations made by the researcher during the experiment for each group discussion. The experiment was audio taped which allowed the researcher to make observations after the experiment.

Keywords: Cross-cultural Communication, Inter-cultural Communication, Speech Pattern, American English, Moroccan Arabic, Comparative Study, Observational Study

I. Introduction

This article is the result of an experiment that seeks to highlight the pattern differences in communication between Moroccan and American participants. The article mainly focuses on observations made during the experiment that highlight apparent communication dynamics between the two groups. The experiment is in the form of two group discussions. Each group discussion had participants of the same culture: Moroccan participants convers among themselves and same goes for American participants. The discussion duration is 60min. Those group discussions were recorded for a duration of 60 minutes each.

The two experiments conducted in two different settings. One group discussion took place at a local café in Rabat (Morocco) while the other one took place at a language institution in the city of Kenitra (Morocco). Participants in every group discussion are complete strangers to one another. This is a crucial aspect that helps in determining the conversation dynamics in initial conversation that is unaffected by personal relationships.

Both group discussions had social media as a topic of conversation. This topic has the potential of being neutral in the sense that it is a topic of controversy to both cultures and will engage both groups equally. This is because social media is a new social phenomenon that is penetrating every culture. Every culture has its own experience with this new technological landscape. It is also a hot topic that every culture handles it in its own way. That is why we saw that the topic is objective and does not necessarily appeal more to

one cultural than the other. Furthermore, participants were encouraged to leave the main topic of social media if needed in order to ensure a natural flow of conversation and so that they do not feel constrained. This would make the experiment more like day-to-day conversation.

2. Participants

Participants in this experiment were randomly selected. Every group encompassed 6 participants. Most of these participants are students from various levels and majors. The Moroccan group discussion has students from Ibn Tofail University (Kenitra, Morocco). The American group discussion has students from various universities in the United States. These American students are in a short visit to Morocco, mostly in the city of Rabat where study abroad programs take place. In regards to gender, the Moroccan group discussion has 2 female participants to 4 male participants. The American group discussion consists of 2 male participants and 4 female participants.

3. Asymmetry of Turn-taking

It has been observed in both group discussions that participants that spoke the most (duration wise) tend to maintain their speaking turn for the longest time despite interruptions. In reverse, the participants that spoke less did not face any resistance or interruption when they spoke. In regards to differences, American participants experienced a natural progression of conversation in a manner that one idea led to another. Moroccan participants on the other hand seem to struggle in staying in one topic. Many unrelated topics were touched on. The future of the discussion seemed unclear. Another observation in regards to turn taking is that a leader of the discussion arose within the Moroccan participants. No such leader appeared in the American participants. Instances of struggle in maintaining the floor were observed but the latter was not as salient as among the Moroccan participants.

The struggle in maintaining speaking turns within Moroccan group discussion resulted in less silence pauses in the group discussion. This observable fact could also be due to the dominant participant who spoke the most. The social structure in Morocco also calls for a dominant figure like the king or religious leader like the Imam. This aspect of the wider context of the Moroccan social fabric could have had an influence on the context of the Moroccan group discussion. Although this may be true, American participants seem to have no emigrant leader of the discussion. This, too, could be due to the social and political structure of the United States (the United States is a republic where a leader is assigned by the majority, but does not naturally arise.)

Maintaining speaking turns is done in different ways when contrasting the two group of participants. Moroccan participants use high voice amplitude to obscure anybody else's voice. This forces other participants to become silent and listen to the one asserting their speaking turn. Conversely, American participants simply go on speaking at the same voice pitch despite interruptions. This brings about a prolonged speech overlap among participants. Eventually, participants abandon their speaking turn in favor of one speaker.

In addition to the above are two modes of speaking turn insistence, Moroccans seem to jump in the conversation once they hear something that interests them. The urge to share their take on the idea being

discussed is strong. American participants wait for a crack in the conversation before they insert themselves into the discussion. These cracks could be syntactic boundaries, a prolonged in-turn lapse, or hints that a speaking turn is about to end. Further, turn projection are also used to predict an opening for a new speaker to initiate a speaking turn. Finally, it seems that turn taking exchanges are different from one group discussion to the other. Moroccan participants rely on topic relevance to one's self to initiate a turn taking, whereas American participants rely on physical boundaries like silence to engage. Temporal structure is respected among American participants. This could be due to the subtle cultural differences such as those between industrial cultures and nonindustrial ones, more specifically monochronic and polychronic societies (Hall, 1959). Our observations also include that Moroccans speak about more than just one topic at the same time. They engage in a circular discussion whereas American participants use a block structure in discussion. That is to say, Moroccan participants hover from one topic to another while maintaining all these diverse topics in the back of their mind since they always comeback to previously mentioned topics. In a sense, they are managing multiple topics simultaneously. American participants tackle one topic at a time. When topic A is finished, the discussion then can proceed to topic B. These differences seem to manifest themselves in turn-taking mechanisms mentioned earlier for each group discussion.

4. The Implementation of Silence as a Linguistic Device and a Structural Boundary

The use of silence differs from one group discussion to the other. For example, Moroccan participants use silence to make a point or stress an idea. This aspect was absent in the American group discussion. American participants mainly used silence pauses to indicate that a speaking turn has ended. Further, interruption of speaking turns seems to be frequent among Moroccan participants which resulted in less silence pauses. The latter was not observed among American participants. American participants seem to have an even distribution of speaking turns with the exception of a couple outliers that spoke the least. Moroccan participants had one main speaker that dominated the discussion, thus resulting in lengthy speaking turns. Lengthy speaking turns result in less and less silence pauses. Moreover, in the Moroccan group discussion, participants engaged in individual dialogues while the rest of participants ceased from being engaged in the main discussion and become attentive to the two participants, especially towards the last quarter of the discussion.

The group discussion shows that Moroccan participants were less silent when compared to the American participants. Also, the use of silence in the Moroccan group discussion is linguistic and when it is used in that sense it can become an extended pause of silence that American participants may not be comfortable experiencing. As for American participants, the use of silence is structural. It is heavily used to structure the discussion as a form of boundaries between speakers' turns. Therefore, we observe that the American group discussion has more gaps of silence and less communicative silence. However, American do still use silence for communicative proposes, and Moroccan participant do structure their discussion by means of silence. These two basic functions are universals and found in all languages. However, it is worth noting here that the extent of use differs from one culture to another, and Moroccan and American cultures might differ in this regards according to our experiment.

The difference in silence use among the two cultures can be attributed to historical factors such as the

historical perspective of oral and written cultures (Ong, 1982). Contrasting north African cultures to European and North American cultures we notice that the latter rely on documenting events and the former rely on oral accounts and collective memory. For example, the prehistoric history of North Africa is very little due to lack of documentation. The little that survived to today is mainly Roman written accounts during the period when the Romans had settlements in North Africa. This cultural difference might explain the reason why Moroccan participants use silence for communication and Americans use it for structure. Writing has visible entities we call 'space'. Space in writing has structural function of separating words and defining borders. Space is the equivalent of speech silence in writing. A written culture might actually carry that element of space over to speech and realize it in the form of silence. Thus, silence would have a structural function in speech as the main structure. That could be the reason why American participants used silence for structuring their discussion. Oral culture does not necessarily see silence as a mainly structural device. Silence for them is part of communication. For example, silence almost has no existence in the Arabic written language. Written Arabic has words meshed together erasing borders between words. That could be an influence coming from the oral language that does not necessarily see silence as borders between words, but more a linguistic device.

The struggle that arose between some Moroccan participants which resulted in an extended individual dialogue could signify the unwillingness to accept opposing views. To resolve this impasse, the participants who are engaged in individual dialogue keep trying to convert the other one into accepting their views. This is also noticed among American participants, but it was faint and indirect. This can be due to the cultural diversity existing in the United States that encourages accepting other people from other backgrounds. Morocco on the other hand seems to be a more homogeneous culture compared to the United States given the factor of a unified religion and the monarchy.

5. The Influence of the Researcher and the Recording Device

One interesting observation is that one of the American participants that was silent throughout the groups discussion, he started talking more and more right after the 60 minutes discussion ended. That is to say, once the microphone was shut, he started talking casually with the other participants. This is an indication that the microphone was a clear factor that prevented him from speaking. No such thing was observed among the Moroccan participants. In addition to that, the tone of talk changed among Americans when the recorded discussion ended. It is as if the microphone was imposing a certain atmosphere in the group as a whole. This could be due to privacy factors. Moroccan participants seem to have forgot that there was a microphone recording and engaged fully into the discussion.

Privacy is an on-going publicly debated issue in the United States, especially with the growth of social network services and the ongoing data privacy regulations. This means that privacy is an important right to Americans. This might be the reason why we observed that Americans were aware of the presence of the microphone. For Moroccans, privacy is not a heated topic in the public sphere. Moroccans seem to care less about their personal information that is harvested by phone applications and other internet services such as social media and on-line retailers.

6. Modes of Expression

Modes of communicating ideas seems to differ from one group discussion to another. Moroccan participants for example, in expressing ideas and opinion, they tend to present them as being facts. They also seem to talk on behalf of the rest of participants without being tentative with their claims. In contrast, American participants make sure to mention that what they are stating is their own opinion and they use lot of expressions such as: "I think...", "In my opinion…", "To me…". It is worth noting that Moroccan participants are not challenged by other participants as they speak as though they agree with the speaker. However, American show resistance to ideas that they may not agree and provide alternative thoughts. These differences could be due to the different natures of both cultures, especially the degree of openness towards different thoughts and the extent to which a culture is heterogeneous or homogeneous.

Moroccan participants seem to use rhetorical questions that are followed with extended silence to press an idea. American participants on the other hand ask lot of question as a way of seeking information. Moroccan participants do not seem to use question for stimulating new information. It seems that Moroccan participants have an assumption that the other person does not differ much from themselves and thus the need to ask information seeking questions is minimal. American participants question asking might be motivated by the assumption that there are differences.

In regards to paraphrasing and rephrasing the previous speaker thoughts, Moroccans seem to rely on this aspect at the initiation of a speaking turn. This process might take a couple minutes before venturing into what one thinks about the matter. It is a period or a phase in which the speaker is dancing with the previous speaker's idea and assimilating it in order to fully process it. This characteristic was not observed among American participants.

The use of paraphrasing among Moroccan participants seems to be a process by which participants get acquainted with other people's contribution to the discussion. It is a way for Moroccan participants to agree with what had previously been stated and then integrating that idea or set of ideas into one's own thought scheme. In addition to that, Moroccan participants use very little expression of agreement. Therefore, we conclude that paraphrasing is a way for Moroccan participants to validate the other speaker stand. As for American participants, we notice the use of ample expressions of agreeing such as:

- I so agree
- That's so right…
- Yeah…
- I know!!
- Right?!
- That's true
- Exactly!

In our observation we noticed that Moroccan participants have the tendency of finishing another speaker's phrase. In addition to that, they tend to make use of incomplete phrases that may not stand alone in normal speech and which is placed at the end of a speaker's turn. This phenomenon seems to be highly motivated by in-turn pauses. Especially the kind that is used to earn more cognitive processing time in order to come up with the appropriate lexical word. An exception that we noticed during the group discussion is that one

Moroccan participant contribution to the group discussion consisted entirely of sentence or phrase completion for other participants. This phenomenon was not observed during the American group discussion. They seem to allow time for the speaker to finish their phrase.

This observed phenomenon seems to contribute to the silence volume imbalance between participants. The amount of potential silence pauses that were filled with phrase-completion utterances among Moroccan participants is abundant throughout the group discussion. As for American participants, phrase completion was not observed which resulted in more silence occurrences. Therefore, recorded silence pauses among Moroccan participants had less volume and frequency than American participants and this could be partially due to the phrase-completion phenomenon. This phenomenon might be due to the culture. Maybe shared cultural background might align people to think alike and finish each other's sentences without feeling bothered. It is a way of anticipating an idea that the speaker is formulating and making their task easier. For American participants, this phenomenon might be perceived as being disrespectful and impatient, especially that American participants seem to respect each speaker's turn territory. So, any attempt to complete a speaker turn may be appreciated.

7. Derogatory Language

In this experiment, the use of derogatory words is unobserved among Moroccan participants. Moroccan group discussion seems to be reserved and that could be due to cross-gender communication context. On the other hand, the American group discussion is plain-spoken. American participants had no problem using swear words every now and then. In addition to that, derogatory language was not heavily used amongst American participants, but it was permitted.

The cultural reason why derogatory language was not used in the Moroccan group discussion is that the boundaries between the two genders in the Moroccan culture are defined and stressed. This cultural aspect is beginning to fade away in urban and dense areas but still observed in the rural areas and amongst old generations. These results might be due to two differing modes of communication between the two opposing sexes since cross-gender communication mainly takes place with members of the immediate family such as husband and wife, sister and brother, father and daughter, and uncle and niece. However, the circle of cross-gender communication is beginning to expand in Morocco, especially among the youth. In denss cities like Casablanca, the use of derogatory language in cross-gender communication can be observed. All in all, the remains of the Moroccan conservative cultural legacy could explain the absence of derogatory language that was respected in this experiment.

8. Ways of Handling the Topic of Discussion

The topic of discussion is tackled in different ways by each group discussion. For example, the Moroccan group discussion mainly explored the social medial misuse and disadvantages whereas the American participants explored the impact of social media on society as well as exploring the function of different types of social network platforms. Moroccan participants also compared the use of social media in Morocco with other cultures, especially western cultures. This comparison consisted of frequent use of *us* versus *them*. In this regard, Moroccan participants showed an awareness of being guests to social media

technology whereas the western culture is native to the technology since this tool was invented by the west. During the group discussions, we also observed that Moroccan participants talked about social media in a philosophical manner. They questioned social media raison d'être and if we need it at all. They seem critical in discussing topics and they try to get to the fundamentals of things and paint a larger picture in order to make sense of the idea at hand. This was not observed among American participants. For example, Moroccan participants, in discussing social media, they talk about it as a global phenomenon and that Morocco is only a small part in a larger context. American participants on the other hand talk about it only within the context of U.S. politics or in relation to celebrities.

9. Conclusion

In general, the two group discussions did not only exhibit differing aspect between the two groups but also some similarities. For example, both groups recounted personal experiences in order to elaborate on an idea or a thought. Conflict was less frequent in both discussions. The presence of a recording device might have played a role in that. In addition to that, both group discussions had one participant that spoke the most, and one participant that spoke the least. There are other similarities that are universal, such as repairing a sentence or an utterance, hesitation, and general patterns of turn taking. There are definitely more differences in communication patterns between the two groups than what we stated in this article. The patterns we managed to capture in this article consist only a small portion. The discussions have a wealth of data and pattern that could be extracted. The audio recordings attached in the appendix are presented as a modest contribution to the field of research and curious mind in order to be investigate further.

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Appendix

Recorded audio files of the two experiments

Private Link:
https://drive.google.com/drive/folders/1da-T0YMVYmpL6Hq7wO8MKrMF13cjVx6Q?usp=sharing

Desinent Socio-Environmental Conflict of Mineral Coal Extraction Liabilities in the Southern Carbonifera Region of Santa Catarina State

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Abstract

The objective of this work was to analyze the socio-environmental conflict that develops in the community of Rio Carvão, in the municipality of Urussanga, in the south of the State of Santa Catarina. The conflict

involves residents of the community and the company UM Urussanga Minérios Ltda. In the locality there are environmental liabilities arising from the activity of mining coal carried out in the past, currently the atmospheric pollution caused by the emission of gases from the processing of coal is directly impacting the lives of residents. The methodology used was based on historicity, temporality, characterization and context, seeking to establish a dialogue with the environmental and social sciences. It was identified that the social actors of the conflict are the Rio Carvão Community Association versus the UM company, with the involvement of the Public Ministry and the municipal government, represented by the city council of Urussanga. The conflict has historical origins in the use and appropriation of natural resources, enhanced by the increase in the emission of gases by the company that found itself in the community due to the harmful way it has been developing its activities

Keywords: Historicity; Temporality; Socio-environmental context; Community.

1. Introduction

The use and appropriation of the resources offered by nature is a condition for the development of humanity. At the same time, such actions impact the environment, causing degradation and affecting all natural elements.

From this perspective, one of the activities that most benefited the human being was the exploration of mineral resources, mainly after the Industrial Revolution in the 18th century, with a mode of production based on productivity, resulting in a more aggressive model for the environment. For HobsBawm (2001) the period of 1789-1848, called the great revolution, was the triumph of the capitalist industry model, a change that had its genesis in Great Britain and France spreading to other countries in the world.

Among the resources that transformed the aforementioned paradigm was mineral coal, which in the southern region of the state of Santa Catarina, throughout the 20th century, played an important role in the history of municipalities throughout its production chain, serving as a fundamental pillar of economic and social development. Social.

However, this activity left marks on landscapes easily perceived through environmental degradation, compromising the quality of air, soil and water in the territories of the Araranguá, Tubarão and Urussanga river basins. These environmental liabilities led the entire region to be considered the 14th National Critical Area for the purpose of Pollution Control and Environmental Quality, according to a Federal Decree 85,206 / 1980 (BRASIL, 1980).

Among the municipalities that make up the Santa Catarina Carboniferous Basin, Urussanga stood out at the beginning of the industrial exploration of coal, in which the Companhia Carbonífera de Urussanga (CCU) was one of the first companies to carry out the activity on an industrial scale (ESCARAVACO, 1984).

In the interim of the use of mineral resources that generated economic benefits to society, referring to the historical importance versus the degradation of the natural resources and environmental liabilities present here, especially in the municipalities that had directly the activities of coal extraction, a series of conflicts between the community unfolded and mining companies.

The conflict highlighted is ongoing in the community of Rio Carvão, in the municipality of Urussanga. In recent years, a collection has been taking place to recover environmental liabilities arising from coal mining. For some time, in addition to living with the legacy of the degradation of the river, soil and air, another impact is generating direct disturbances to the community. Residents are affected, and are denouncing a coke company, for the increased emission of gases into the atmosphere from coal processing. The emitted gases reach the houses, the plantations and damage the lives of the residents of this community. This panorama has been provoking a strong mobilization against this activity and the company.

In view of this scenario that differs from other socio-environmental conflicts in the region as it has air pollution as a central element, the work seeks to carry out an analysis of the conflict that occurs between residents of Rio Carvão, represented by the Rio Carvão Community Association (ACRIC) before the company UM Urussanga Minérios Ltda., Which is headquartered in the same location and is responsible for the activity that generates the mentioned impact.

2. Methodology

For the analysis of the problem, the understanding of socio-environmental conflict found in Little (2001, p. 57) was considered, which asserts "socio-environmental conflict as disputes between social groups derived from the different types of relationship they maintain with their natural environment". Methodological support was sought in Little (2001 and 2004) and Gonçalves, Aliste and Follmann (2019), the latter based on the analysis technique that contemplates the dimensions of historicity, temporality and context. In order to think about conflict management, we tried to consider the notes made based on the aforementioned authors, seeking to establish a dialogue with the environmental and social sciences. Figure 1 is a summary of the path followed.

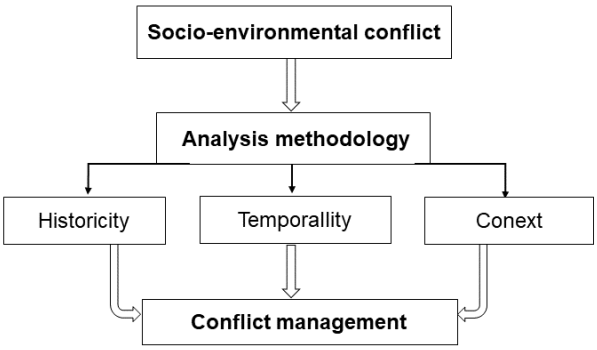

Figure 1. Synthesis of the methodological path
Source: Authors

The sources of consultation for the construction of the article started with the bibliography that addresses the topic of socio-environmental conflict. In order to get information about the conflict specifically in question, database searches were carried out, however, apart from the mention of Virtuoso's work (2019), no academic papers were found. The information was collected and investigated mainly in the media in the form of reports, interviews, on the website and in the profile of the social network of the company UM Urussanga Minérios, in sentences or manifestations of the Federal Public Ministry (MPF), minutes of the city council of Urussanga available on its homepage in profile of ACRIC's social network.

Regarding location, the study area is in the community of Rio Carvão, in the municipality of Urussanga, south of Santa Catarina (figure 2). According to an estimate by the Brazilian Institute of Geography and Statistics, in 2020 the population of the municipality is 21,344 inhabitants, with an urban population of 56.40% and a rural population of 43.60%, its demographic density is 79.35 inhabitants / km² and territorial area of 254,954 km² (IBGE, 2010).

Rio Carvão is located in the rural area of the municipality, the community is divided into Rio Carvão, Rio Carvão Baixo and Rio Carvão Alto (SORATO, 2019). According to data from the Municipal Health Department of Urussanga, the number of inhabitants in these 3 communities is 498 people (URUSSANGA, 2020).

All communities are located in the Carvão river basin, which has an area of 30.07 km² (BACK et al., 2015). From the meeting of the Carvão river with the Maior river, the Urussanga river is formed, which will also compose the hydrographic basin of the same name (ADAMI; CUNHA, 2014). According to the authors, the Carvão river basin is located in the high valley of the Urussanga river basin. As far as vegetation is inserted in the Atlantic Forest biome classified as Dense Ombrophylous Forest with predominance of the Submontane Forest (IBGE, 2012).

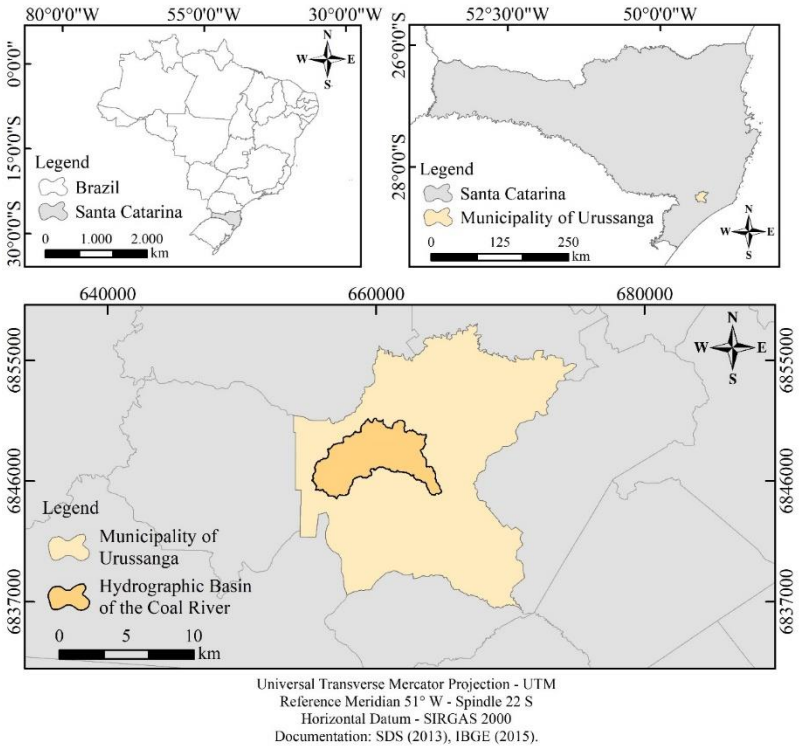

Figure 2. Location map of the Carvão river basin

Source: Authors

3. Historicity

Gonçalves, Aliste and Follmann (2019) state that historicity is of fundamental importance for bringing landmark information on conflicts and the development process, based on the capitalist production method in force since the Industrial Revolution.

Next, we will raise a brief contextualization of some points in the history of coal mining in the Santa

Catarina Carboniferous Basin. However, we sought to emphasize the records that corroborate with information about the area and object of study.

Despite the knowledge of the existence of coal before the World War I period, it is from that moment that the product comes to be exploited industrially, beginning to have significant economic and social importance for the entire south of Santa Catarina (GOULARTI FILHO, 2001; BELOLLI; QUADROS; GUIDI, 2002).

In the municipalities of Criciúma and Urussanga, from 1917 to 1922, some coal companies were founded, among which was Indústria Carbonífera Rio Deserto Ltda. (GOULARTI FILHO, 2001). Years later with a business redistribution, one of the partners retired and founded in 2013, the company UM Urussanga Minérios Ltda., Despite receiving this name, from the records found, the enterprise has been operating in the same place since 1947 (URUSSANGA MINÉRIOS, 2019) . We will see later that this company is one of the social actors in the socio-environmental conflict studied in this article.

The municipality of Urussanga appears prominently in the historical development of the coal activity. Escaravaco (1984) mentions that Companhia Carbonífera de Urussanga S.A was one of the first to operate on an industrial scale in Santa Catarina. In 1917, the company acquired lots and applied for the concession to explore the subsoil of several rural areas, among them were areas in the Rio Carvão community (ESCARAVACO, 1984).

It is essential to mention that in relation to human activities, throughout the region over time, the uses of natural resources have changed, also changing landscapes following the transformations of the economy. First, activities linked to land lose importance and give way to commercial activities, then coal exploration spreads, making the activity the main product of the regional economy (ADAMI; CUNHA, 2014). For Carola (2004), the colonial nuclei were found on one side, with agricultural activities and the traditional rural landscape, on the other side in the same physical space, the coal economy developed. Gradually, the coal industry expanded and occupied new areas in the territory, causing, above all, small rural owners to sell their land (CAROLA, 2004).

In the 1940s, with the advent of the Second World War, the ban on coal imports, a series of government incentives and the creation of the Companhia Siderúrgica Nacional (CSN), in 1942, in the State of Rio de Janeiro, were decisive for the increase the number of coal companies in Santa Catarina (BELOLLI; QUADROS; GUIDI, 2002). According to the authors, the implementation of CSN resulted in the installation of the coal processing plant in Capivari de Baixo, then in the municipality of Tubarão, in the southern region of Santa Catarina. The processing was done to obtain steel and energy coal, later turned into a thermoelectric plant, which still works. These factors have a direct impact on the region's coal economy and will also reach the Rio Carvão community. In mid 1940 the company Mineração Geral do Brasil (MINERASIL) installed its first coke industry in this community, with six ovens, and doubling that number at the end of that decade (BELOLLI; QUADROS; GUIDI, 2002).

Still in the study area, Costa (2012) explains that between the years 1952-1954, the company acquires equipment to transport coal. The cableway was used to transport the Santana - Rio Carvão - Estação community. Deactivated in 1977, the aerial cable became one of the symbols of the municipality, but almost nothing remained of this historical landmark (COSTA, 2012).

Since the beginning, coal activity has gone through some economic phases, according to Goularti Filho

(2001, p.171) “until 1973, the sector followed a path of slow and continuous growth. With the oil crisis, the last, and biggest coal boom in Santa Catarina came on the scene ”. According to Goularti Filho (2001), Ladwig and Dagostim (2017) the peak of production and economy came in the mid-1980s, but it was also in this period when environmental degradation was reaching its limit, so much so that the Federal Decree is issued No. 85,206 of 1980, considering the Carboniferous Region as the 14th most critical national area, for the purpose of pollution control and conservation of environmental quality. (BRASIL, 1980).

A phase of decay then begins, while environmental awareness and the organization of environmental movements grew (LADWIG; DAGOSTIM, 2017). The authors reported that coal was mined in underground mines or in open skies, affecting the soil, air and water in the Araranguá, Urussanga and Tubarão basins, compromising natural resources. The exploration resulted in large areas covered by deposits of coal tailings that radically altered the landscapes, leaving marks still visible in many locations in the region, as well as in areas in the Rio Carvão community (figure 3).

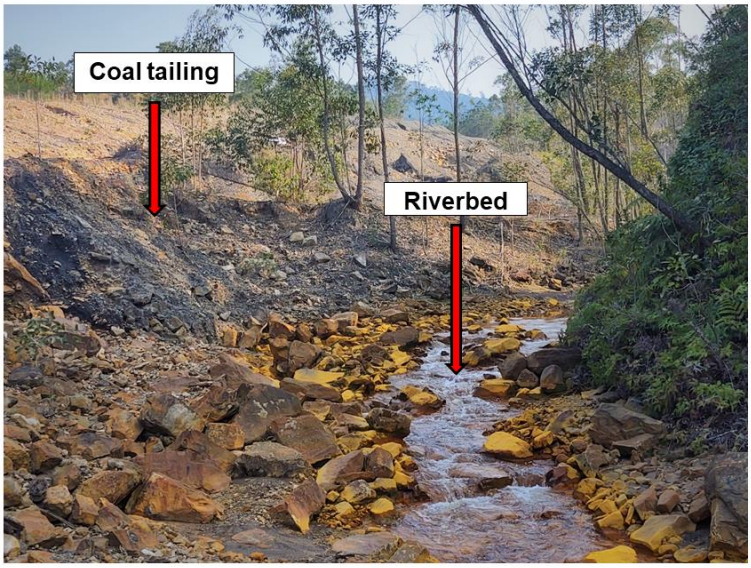

Figure 3. Area impacted by coal mining, Rio Carvão community, Urussanga
Source: Authors

The coal exploration activity continues to be developed in the region, although with less economic emphasis. The concern of society with public health and the attention given to the environment, practically nonexistent in past times, are now on the agenda in the various spheres of society.

With regard to environmental liabilities, coal companies (many declared bankrupt), the State of Santa Catarina and the Federal Union, were ordered, in 1993, in a public civil action by the Federal Public Ministry, to present environmental recovery projects that have been developed since 2000 (LADWIG; DAGOSTIM, 2017).

In this way, the coal mining activity characterized and marked several municipalities and communities, among them is Urussanga and the community that has coal in its name. This community is called Rio Carvão, where a socio-environmental conflict based on the economic exploitation of this product is currently unfolding.

4. Mining conflicts in the Santa Catarina Carboniferous Basin

The records of conflicts that occurred in the region between communities and mining companies seem recent, if we establish that activities began on an industrial scale more than a century ago. Scotto (2011) states that in recent years we are witnessing an increase in the number of social conflicts involving mining, mainly in Latin America, with the participation of several organized collective actors. This collective force of civil society, in Brazil, gained a lot of impetus and representativeness as we see explicit in our Citizen Constitution of 1988, in its article 225 that deals with the Environment: Everyone has the right to an ecologically balanced environment, a common use of the people it is essential to a healthy quality of life, imposing on the Public Power and the community the duty to defend and preserve it for present and future generations (BRASIL, 1988, Art. 225).

However, in the case of conflicts in the coal region, more broadly, there were not many works related to quantity, and which socio-environmental conflicts occurred involving companies and communities. However, Nascimento (2010) cites studies, locations, involved and the date of socio-environmental conflicts until 2010.

In order to compose table 1, in addition to the work cited, a bibliographic search was performed on digital platforms, in order to search for other records. It should be noted that other socio-environmental conflicts involving companies and communities may have occurred, but these were not found registered by the media, state agencies or were not researched.

Table 1. Synthesis of records of socio-environmental conflicts in the Santa Catarina Carboniferous Basin.

County	Involved	Causes / Impacts / Results	Year
Siderópolis	Companhia Siderúrgica Nacional (CSN) and residents of the Monthões community.	Coal exploration.	1988
Siderópolis	Companhia Carbonífera Belluno and about 200 farmers.	Opening of a mine in an agricultural area. Transformation of the area into APA.	1994
Urussanga	Mining Company Treviso and Community Association of Alto Rio Molha (ACARIMO).	Against the silting up of rivers and areas degraded by coal mining.	1995
Criciúma	Installation of mining companies and residents of the Morro Albino and Morro communities Stephen.	Articulation for the creation of an APA and creation of the APA.	1996
Siderópolis	Carbonífera Rio Deserto and community in the vicinity of Mina Trevo.	Lowering of the water table, with a decrease in the water level in some streams and wells in the rural area. Vibrations felt with the detonations.	1999
Urussanga	SETEP Company and Rio Maior Community Association.	Impacts on water resources, people's health and constructions, mainly in centenary houses (historical heritage).	2002

Içara	Carbonífera Rio Deserto and the agricultural communities of Santa Cruz and Esperança.	Against the installation of exploiting coal underground in the agricultural area. Residents fear environmental, economic, social and public health impacts.	2004
Orleans	Union of the Industry of Coal Extraction of the State of Santa Catarina (SIECESC) and Popular movement in defense of natural goods and against the exploitation of coal in Orleans (MOV).	No opening of mines in the municipality of Orleans.	2018
Urussanga	UM Urussanga Minérios Ltda and Rio Carvão Community Association (ACRIC).	Emission of gases causing atmospheric pollution. Community mobilization	2019

Source: Authors

Regarding table 1, it is worth noting that perhaps the dates are not exact, but they were the ones that were arrived at after conducting the research. It is likely that many started before the year registered, as will be the case in this work, because to mine any area, it takes time and a process with several stages. To corroborate, Little (2004) observes that, over time, a conflict can last for years and between that period there are different moments, some more intense with greater prominence, and others, with less visibility.

In the case of the conflict studied, it appears that despite the complaints and manifestations already indicating occurrences for some time, the tie has a more direct record as of July 2010 with two reports giving voice to the complaints of residents and 2011 with the participation and speech of the president of ACRIC in the Ordinary Session of the City Council of Urussanga. In 2019, the conflict is showing signs of intensification with greater denunciations and demands by the residents, providing greater visibility to the case. However, attention is drawn to the heart of the matter in this item, which is to demonstrate that there were, and still are, conflicts involving mining communities and companies in the Santa Catarina Carboniferous Basin.

In view of the analysis in Table 1, it is concluded that the conflict in Urussanga, in the Rio Carvão community, is not something new in the region or in the municipality. What is new, compared to the other conflicts, is that it is characterized as the only one that has as its main problem the inconvenience of the generation of gases that cause air pollution, directly impacting the lives of residents.

5. Temporality

For Milton Santos (1987) the temporalities vary in relation to the different social agents and any other phenomena that occur in the same space, however it is important to emphasize that they occur in a successive and simultaneous manner. In this sense for Saquet (2011, p.79) “the temporalities also mean historical proceduralities that are found in the present. We live past, present / coexisting and future temporalities ”.

Moving towards the analysis of socio-environmental conflicts, it is understood that it is essential to observe the temporal aspects. From this perspective Gonçalves, Aliste and Follmann (2019) reinforce that temporality is linked to the context and the moment in which the conflict emerges. It is best able to determine who are the actors most directly involved, their values and their interests (GONÇALVES; ALISTE; FOLLMANN, 2019, p. 158).

In the 21st century, socioenvironmental conflicts become fundamental for bringing in their analyzes the discussion of the conditions of sustainability of humanity on Earth (BRITO et al, 2011). For the authors, it is essential to create an economic matrix that would enable environmental, economic and social sustainability. In Brazilian history, mining has great relevance, but it also brought many environmental impacts and several socio-environmental conflicts that have been established throughout the country's historical process (ARAÚJO; FERNANDES, 2016).

Environmental conflicts and injustices in Brazil are mainly related to the path adopted by environmental policies in recent years, which reflect the situation of the Brazilian economy. According to Zhouri et al. (2018), this dynamic has a global impact and demonstrates legislative limits and jurisprudence decisions that reflect practices, which are not democratic.

Passing through the world and national historicity of the economy of the exploitation of natural resources activities until reaching the current paradigms, one can situate the temporality of the socio-environmental conflict underway in the Rio Carvão community. That said, we understand that, on the one hand, the trajectory of using mineral resources that generated economic benefits and characterized society, reminding us of historical importance, on the other, is the degradation of natural resources with environmental liabilities that impact people's lives and your way of living.

In this context, the case of the Rio Carvão reflects the history that occurred throughout the region of the Catarinense Carbon Basin. For Carola (2010), the exploitation of coal changed the economic base from agriculture and guaranteed industrial progress, but did not account for the socio-environmental impacts at first. This issue only began to receive more attention from the 1980s, when the spread of greater environmental sensitivity in the region began (CAROLA, 2010). As already shown in Table 1, this is the period when socio-environmental conflicts involving mining companies and communities begin.

Virtuoso (2019), when researching the appropriation of common resources with a focus on water use in the Urussanga River basin, cites some socio-environmental conflicts, among them the case of the Rio Carvão. He verified in his thesis that when impacts advance on nature and involve communities that mobilize in defense of common interests, a socio-environmental conflict ends up. This is what has happened in the Rio Carvão community in recent years. Its residents live the drama of environmental imbalance, caused by the exploitation of coal from the beginning of their activities on an industrial scale and are now mobilizing to defend a better quality of life.

It is in view of this situation that the challenge of the conflict that comes into focus arises, since socioenvironmental conflicts are present in various ways today. For Acselrad (2004), these conflicts are more evident in the world, while the process of economic and social transformation of the territories deepens, showing the different conceptions about the forms of appropriation and use of natural resources.

6. Context

In order to understand the context of the researched conflict, it is essential to follow what we have outlined so far, historicity and temporality. To complete the triggering of exposed ideas, it is now based on Little's methodology (2001; 2004).

In this regard, through the analysis of socio-environmental conflicts, the aim is to expose the conflict with records of the manifestations, the identification of the type of conflict, an identification of the main actors and their positions throughout the process.

Currently, the community, through its ACRIC association, is claiming from the competent bodies the recovery of areas degraded by coal exploitation in the community (figure 4). In addition to being fighting harder to solve the problem, a recurrent emission of gases by burning coal carried out by the UM Urussanga Minérios Ltda.

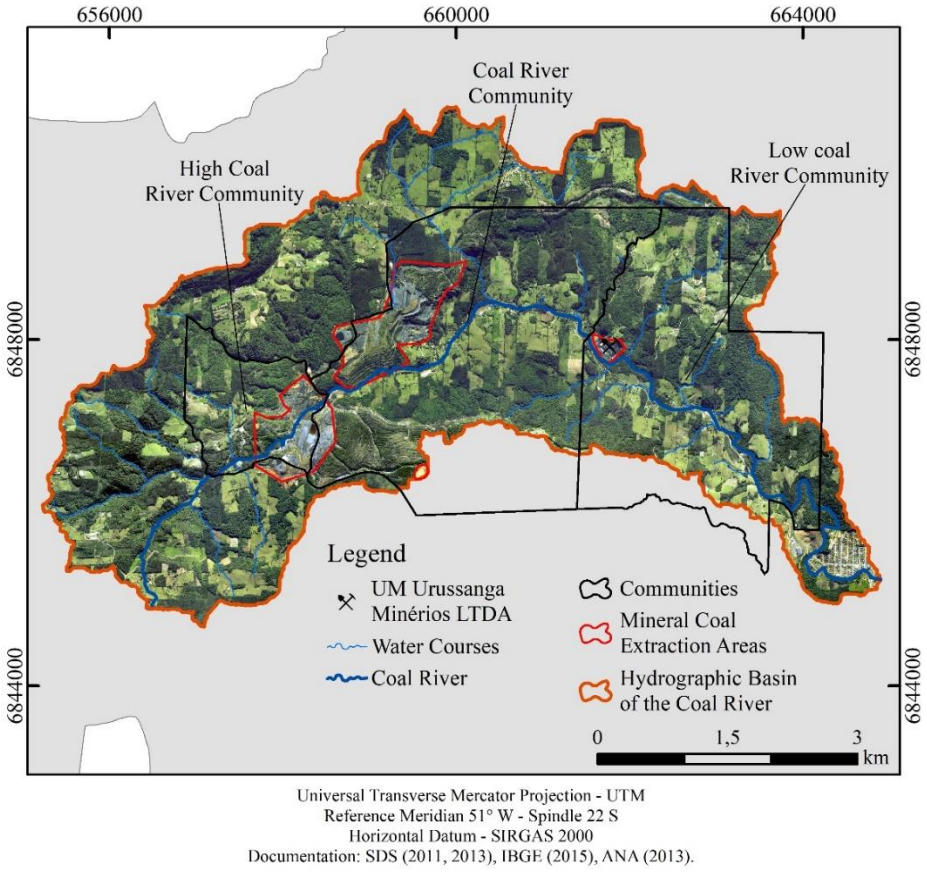

Figure 4. River basin and Rio Carvão communities

Source: Authors

It is imperative to stress that the entire Catarinense Carbon Basin, since 1980, is considered one of the most critical in the country regarding environmental degradation. The history refers to the year 1993, in Public Civil Action n. 93.8000533-4, when via MPF those responsible were sentenced to submit environmental recovery projects (LADWIG; DAGOSTIM, 2017). Among the degraded areas that must be recovered are areas in the municipality of Urussanga, one of which is in the community of Rio Carvão.

As of the sentence (n. 2000.72.04.002543-9), a series of environmental recovery projects should have been carried out, but many have not been and the outcome of what will happen in the future is still uncertain.

Several areas, such as the Rio Carvão community, continue to be destroyed by the degradation caused by coal mining, hoping that damage to the environment, and to the community, will be at least minimized.

Among the various actions that ACRIC seeks to promote in order to raise awareness and demand from the authorities the recovery of environmental liabilities and for the current problem of gas emissions, are the dissemination on its social network of videos and images, the participation in meetings in the Chamber of Councilors of the municipality of Urussanga, public hearings, reports linked in the local and even national media. When researching the history, it was found that since 2010 there are records in the press (ECHEVENGUÁ, 2010; MORETTI, 2010) and it is from that date that the community exposes with greater emphasis the problem of the emission of gases that cause atmospheric pollution, this being the issue that most directly bothers residents at present.

In the minutes of the session of the City Council of August 2, 2011, the president of ACRIC Cleyton José Pereira, registers the problem of atmospheric pollution, faced by the residents. Pereira reports that even in 1970, “Mrs. Irene Ceron Gastaldon, tired of the black dust around the house, on the clothes and faces of her grandchildren, took the attitude of being the first resident of Rio Carvão to go to the Public Prosecutor's Office to complain about air pollution ”(CITY HALL OF URUSSANGA, 2011). That, due to problems with these problems, in 1986, it was forced to withdraw from its origins. During this period, the community had 476 inhabitants, in relation to the direct mining activities there were 2 coke companies and 2 coal companies (CÂMARA MUNICIPAL DE URUSSANGA, 2011).

A 2011 survey surveyed hospital admissions for respiratory and cardiovascular problems. If compared to other communities in the municipality of Urussanga, the largest number comes from the Rio Carvão community (MONDO, 2011). This research also demonstrated that the emission of polluting gases into the atmosphere can be a problem that affects the lives of many residents.

Returning to the minutes of the session on August 2, 2011, another statement by the president of ACRIC is recorded.

From the year 2012 to 2018 few records were found, this does not mean that the community was stopped or satisfied with the situation and / or the company's activities were being less impactful. According to the records, the indicative is that the community was hoping that after the denunciations and manifestations measures would be taken.

In 2019, on July 16, in another session of the city council with the participation of the president of ACRIC, Sidinei Casagrande and chemical engineer Jorge Luís dos Santos Amaral, information about the emissions of gases into the atmosphere by the company was presented . The minutes show the report of a study based on data from the last 6 years, prior to 2019, from the expertise and audits carried out by the MPF.

On the occasion, the then president of ACRIC, stressed that it is not the objective of the community that the company closes, but that it works in accordance with the legislation and the community, providing quality of life to its residents.

Considering the minutes of the aforementioned meeting and others surveyed since the year 2000, no statement by the company was found in the city council of Urussanga. What we found were some notes in the media based on compliance with legislation based on expert sides and a photo of the MPF's letter of June 4, 2019 on the company's social network demonstrating that it is not emitting gases in violation of the

legislation (URUSSANGA MINÉRIOS, 2019).

A more extensive note was linked in the press on June 22, 2019. In this note, the company UM Urussanga Minérios Ltda., Among other issues, claims to comply with CONAMA Resolution 436, which deals with the emission of gases by burning coal for the coke. He mentions that the points collected for air quality analysis were determined by the community itself, together with the Environment Institute (IMA), without interference from the company. Finally, the company says it is open to criticism and requests, and mentions that the Public Ministry itself recognizes this conciliatory stance of the company (LUCIANO, 2019; TRIBUNA DE NOTÍCIAS, 2019).

"The request for help is stamped on the shirts of those who live here" (MORADORES ..., 2019, p. Https://recordtv.r7.com). Thus, the reporter's speech in the linked article begins in July 2019, with more than 7 minutes of duration, shown on the program Domingo Espetacular of Rede Record de Televisão. The report presented several landscapes degraded by the exploitation of coal, recalled a serious accident that occurred in 1984 with the death of 31 workers, and highlighted, in general, the community's concern about environmental liabilities and the future of the area and people. However, the main focus of the report was to highlight the problem currently faced by residents: the emission of polluting gases into the atmosphere that has caused the deposition of soot on houses, gardens, etc. In figure 5, posted on the profile of ACRIC's social network on September 25, 2019, it is possible to view this statement. The report also shows that the residents appeared together, wearing black T-shirts with the words “S.O.S Rio Carvão, no more pollution. A neglect ”.

The MPF manifested itself in the matter, through the public prosecutor Demerval Ribeiro Vianna Filho, stating that due to the agency's interference, there was an improvement in the environmental conditions for the community, but recognizes that it is far from reaching the ideal.

The report also heard the company UM Urussanga Minérios Ltda., Which through the environmental manager, denied the irregularities, alleging that it monitors air quality and that all partial measurements indicate that the gas emissions are in accordance with the legislation. The manager also reported that some specific issues raised by the community were all answered.

Figure 5. Soot deposition images
Source: ACRIC, 2019

On the other hand, ACRIC disputes, saying that it does not have the counterproof if these

measurements are within the technical and scientific criteria. It is worth mentioning the speech of one of the residents interviewed, stressing that the community does not want to close the company. In their words, they claim that "we also want to breathe better things". Such demand is guaranteed, as already mentioned in the Federal Constitution of Brazil in 1988 in its article 225.

The Brazilian Magna Law guarantees the preservation of natural resources, even emphasizing that when a certain exploration activity causes considerable degradation, studies of environmental impacts are carried out, and that such studies are published. In the case of the Rio Carvão, the degradation of the area is notorious, and the environmental impact caused by the burning of coal has been affecting the quality of life of its residents.

Another way that ACRIC found to give voice to its desires was to use its page on a social network, where there are awareness campaigns, complaints with photos, videos and complaints from residents, participation in meetings and related press reports. In 2019, one of his cover images (figure 6) indicates the struggle that this community is waging to improve the quality of life of its residents, combating the problem of pollution and charging the authorities.

There are many other records on the social network page, in the press and in the minutes of the session of the city council of the claims of the Rio Carvão community. When ACRIC is challenged that the company's activity does not affect residents as much, including people who do not complain, the community justifies that the company has specific times when it intensifies its activities, that the emission of gases harms residents more than live close to the company and that climatic factors also influence the dispersion of gases. Despite having many complaints on the social network page, the city council and the press seem to be the place where ACRIC found the most space to emphasize and claim their wishes with the public authorities and society in general.

Figure 6. 2019 ACRIC social network cover image (Image translation: Coal river; no more pollution; It's a neglect; How will our future look? Gentlemen!!!)
Source: ACRIC, 2019

Another relevant point to be observed is that when the community expresses itself, it aims to establish dialogue and to seek solutions, whether for the problems left by the exploitation of coal in the past, either with the representatives of the State or with the company UM Urussanga Minérios Ltda. which burns the coal, emitting the gases that most directly affect residents.

Until the beginning of the year 2020, the impasse still persisted and it seems that it was taking shape for a dispute that will drag on for a certain period with the same notes and elements evidenced here.

For Little (2001), the classification of socio-environmental conflicts is a way of aiming to understand him better, with the aim of a possible resolution. Little (2001, p. 57) listed in: "1) conflicts over control over natural resources; 2) conflicts over the environmental and social impacts generated by human and natural action; and 3) conflicts over the use of environmental knowledge ". However, the author warns that this typology cannot be understood in an uncompromising way, but as a heuristic tool and with flexibility in the analysis of socio-environmental conflicts.

In this interpretation, the conflict analyzed here in relation to its typology, we fit in a "conflict around the environmental and social impacts generated by human and natural action". What is identified in the present case is that the environmental and social impacts generated are only due to human action.

Little (2001) assesses that in this type of intervention, the impacts are sustained in economic development, affecting both nature and humans. While one group benefits directly, others suffer only negative impacts. From this perspective, the situation, in addition to impacting the health of residents, represents a social and environmental injustice. In this process Little (2001) classifies it into three subtypes of negative impacts (table 2), when trying to transpose these negative impacts to the conflict analyzed here, it is possible to state that these occur as follows.

Table 2. Analysis of negative impacts

Little's classification (2001)	**Conflict analysis**
a) The cases of contamination of the environment are many and generate differentiated negative impacts on the populations of the environment where it occurs;	The impacts are diverse. However, not the entire community area is being impacted in the same way. Residents and areas closest to the industry are most affected.
b) Depletion of natural resources also generates different impacts on social groups, which are not easy to quantify because the depth of the impact will only become evident in the future;	The depletion of natural resources directly impacts many residents of the community, but other groups will suffer in the future due to the abusive use and pollution of water, soil and air.
c) The degradation of ecosystems is linked to the processes of contamination and depletion, but it has some peculiarities.	The degradation of ecosystems linked to contamination and depletion processes, when prolonged, has the potential to reach entire ecosystems in such a way that natural cycles will break.

Source: Adapted from Little (2001).

Little's definition of socio-environmental conflict (2004, p.1) is about "clashes between social groups due to their different modes of ecological interrelationship, that is, with their respective social and natural means". He emphasizes the importance of identifying and analyzing the main social actors involved when studying socio-environmental conflicts, since: Since it tries to explain the specific interests at stake in the conflict, followed by a survey of the interactions between each of these social actors. To understand a conflict in its entirety, the researcher has an obligation to understand the intentions and positions of all the

social actors involved, even if he has a preference for one of the groups involved (LITTLE, 2004, p.4).

Little (2004) also warns that in a socio-environmental conflict, each social actor involved has his own way of adapting. Thus, in view of this reasoning and based on the research, we sought to identify and indicate the performance of each social actor involved in Table 3.

Table 3. Identified actors and their performance

Social Actors	Performance
ACRIC	- Represents the residents of the Rio Carvão community; - Claims through manifestations on its social network, in the press, with the legislative, executive and judicial powers, answers to the problem of air pollution.
EMPRESA UM (Urussanga Minérios Ltda)	- Responsible for the emission of gases and dust that affects the residents of the community of Rio Carvão; - It claims to comply with current legislation and measure gas emissions according to the required protocols; - It is said to be open to negotiations with the community.
Federal Public Ministry	- Receive complaints from the community; - Promotes public hearings; - Acts in the inspection of compliance with the monitoring of gas emissions by the company; - Seeks to establish dialogue and conciliation between the parties.
City council of Urussanga	- Opens space for complaints; - Forward requests from the community; - Expresses support for the community. - Request clarification from the company.

Source: Authors

Although it does not fit as an actor acting in direct participation, we put the press as a fundamental instrument of research source and tool that the community found to highlight and draw attention to their problems, trying to pressure the authorities and the company to speak up. Another contribution fostered with the dissemination process, was regarding the expansion of the debate with local, regional and even national public opinion. In this sense, Little (2001) warns that, in order to understand the conjuncture in which conflicts develop, it is necessary to observe the political, social and cultural changes suffered over time and also the role played by the media in this context.

7. Conflict Management

Officially Brazilian historiography teaches in its narrative that the formation process of the Brazilian people was colonized, that it lived and still lives resilient, through the nation's socio-political trajectory. However, the factors that determine the need for changes in this neutrality in relation to the tensions of private companies towards the progress of the region, are in the question of the unsustainability of natural resources, as well as economic credit for the community. It is necessary to understand the extent to which progress towards development can be considered, when natural resources are being altered / contaminated by human actions. These issues are understood by the residents of the Rio Carvão community, but which seek from the State representatives a rigid stance in relation to compliance with environmental laws and without burden to any party involved.

Knowledge of the functioning of community resources, linked to researchers of environmental policies, can contribute positively to overcome this ethics of the modern world, of crime without punishment. For the mining company, it is an act that converges to benefit the economic progress of the community and the municipality, as it contributes to the goals of the private company. According to Almeida, Nothing guarantees that a good intention does not degenerate into future atrocities. Good deeds can generate bad results and the other way around. Like complex thinking, complex ethics does not escape the problem of contradiction. There is always uncertainty hidden under the unambiguous appearance of good and evil (ALMEIDA, 2005, p. 141).

Through an ecological ethical perspective, one can think about how to balance the conflicts and contradictions constituted by the difference over what is relevant for the survival of individuals or not. The concept of development itself, in an etymological analysis of the word, suggests its opposite: des (without) + involvement. However, in an ethical perspective of diversity (D'Ambrósio, 1999), it is possible to think of an activity that today already supplies the community's need for a new posture, in the following points: Respect for the other with all its differences; solidarity with the other in meeting survival needs and transcendence and cooperation with the other in the preservation of the common natural and cultural heritage (D'AMBRÓSIO, 1999, p. 642).

In the search to manage and find resolutions for socio-environmental conflicts, it is essential to have a base to guide the analysis and the paths to be followed. For Nascimento (2010, p. 34) "conflict analysis presents analytical schemes that help in understanding the actions of the actors, their positions, the dynamics and the crucial relationships inherent in the dispute process". The author emphasizes that with this perspective the problems will not be solved, since there are other variables involved, however it is essential to look for the fundamental elements of the dispute in order to arrive at a more balanced resolution.

The fundamental elements here are based mainly on what Gonçalves, Aliste and Follmann (2019, p. 158) suggest, "taking into account the aspects of historicity, temporality and context and the identification of the social actors involved as well as their interests". In addition to Little's view (2001, p.61) "the treatment, and possible resolution, of conflicts needs to be preceded by a stage of research and analysis of the roots and causes of the same". Thus, for the author: To resolve a conflict permanently, the multiple causes that gave rise to it would have to be eliminated and the existing differences between the parties resolved peacefully, voluntarily and by consensus. Furthermore, the degradation processes of the natural

world would need to be stopped for the solution to be social and environmental. These requirements, while achievable, rarely occur in practice. Therefore, it is more realistic to talk about treating socio-environmental conflicts instead of resolving them (LITTLE, 2001, p. 63)

In this sense, Leff (2006, p. 217) corroborates "the environmental issue emerges from an economic, social, political, ecological issue, as a new worldview that transforms the paradigms of theoretical knowledge and practical knowledge". For the author, a methodology is necessary to build an environmental rationality based on the dialogue of knowledge in a transdisciplinary practice, "epistemological conditions are necessary to articulate social, ecological and technological development processes" (LEFF, 2004, p. 21).

And even considering these conditions, harmonic management will not be guaranteed. Well, it is known that people in the locality need means to survive, however, limiting the possibility of survival and development to just one activity, which due to its characteristics of extraction and processing of coal, affect and unbalance the environment, is at least unwise and foolish. Continue with activities related to coal so that the community / region can develop without the perception that even with the supposed development, everyone will lose irrecoverable natural resources, characterizing a crime against the environment and against humanity.

Due to the situation analyzed, this situation will be defined and will take place directly in the State's legal bodies, through the MPF, as verified in the fine imposed on the company in September 2019. Regarding environmental liabilities, the entire community expects the legal processes have an effect, and that the recovery of the environmental liabilities left by inheritance by coal mining begins as soon as possible.

Anyway, the actions related to the conflicts listed in this article are not watertight, and need to be monitored and discussed, aiming at better procedures in search of the balance between quality of life and the maintenance of economic activities can contribute to the well-being of those involved.

8. Conclusion

The human awareness that natural resources, nature itself, deserves to be where it is, and to remain alive, has been part of the anguish of men and women since ancient times. However, it can be said that this awareness continues, as knowledge and social politicization advance, springing up in regional and local society, as it happens in Rio Carvão. In the southern region of the state of Santa Catarina, in the municipality of Urussanga, more precisely in the locality of Rio Carvão, this ethical stance generated in the face of environmental conflicts has expanded in the awareness of the preservation of natural resources.

The environmental conflicts debated in the locality of Rio Carvão are noteworthy, since it generated a cohesive organization of the community's residents through ACRIC, also a social commotion of non-governmental and governmental organizations in support of the local public power, mainly in the City Council , Public Ministry and the local media in favor of the community and environmental preservation

The induced or instigated awareness that nature deserves to remain alive, also understands the need for the production of means of survival, and comes up with projects, such as rural tourism and exploration of activities that do not affect local integrity through the cultivation of fruits, colonial products and other items

that, receiving encouragement from public agencies, will also bring income streams to the community, thus deconstructing the need to submit to risky private interests.

Therefore, it seems that the order established in the Rio Carvão community and in the rest of the planet, remains the depletion of natural resources and impacts on local populations. As of the end of this article, there have been no significant changes in relation to the conflict in the Rio Carvão community..

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Comparative Analysis Of Compact Fluorescent Lamps Versus Led Lamps: An Economy Factor

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ABSTRACT

The general objective of this article was to promote through bibliographic studies the two types of lamps, in addition to the comparative analysis of compact fluorescent lamps versus LED lamps: an economy factor. The specific objectives were: - to explain the conceptual precepts on: lighting engineering, definitions, characteristics, invention, operation, defect, quality and the environments used and the NBRs regulations; - address the economic impact generated by the choice of LED lamps and compact fluorescent lamps; - emphasize on an economic feasibility study on the use of LED lamps and compact fluorescent lamps. The justification of the study is related, in the promotion regarding the use of LED lamps and compact fluorescents, in the factor that generates savings. Since the areas related to artificial lighting are responsible for a significant portion of energy demand, both on a large scale - such as lighting for public roads or industrial buildings - and on smaller scales - in commercial and residential buildings. Therefore, its promotion is crucial in the context of economic viability. The lamps provide the luminous energy, through which a better luminous efficiency is obtained. Currently, there are several types of lamps available, different in several aspects: luminous intensity, reproduction colors, energy efficiency, physical composition, method for emitting light, specific purposes, prices, among others. It is worth mentioning that the lamps differ from each other not only by the different luminous fluxes that they radiate, but also by the different powers they consume. In order to compare them, it is necessary to know how many lumens are generated per absorbed watt. This greatness is called energy efficiency. Thus, the proposal of a study was evidenced, in order to promote these luminous resources, in addition to emphasizing their economic viability.

Keywords: Lamps of LED; Compact Fluorescent; Economic Viability**.**

1. INTRODUCTION

A society's energy consumption is directly proportional to its economic and social development. In this way, when a society has a gain in the quality of life, in logic they have bigger houses, more electronic and home appliance there is a greater demand for energy and electricity.

According to Ferreira (2015), one of the sectors with the greatest impact on the global energy balance is that of urban centers, since the process of concentration of cities and the increase in energy consumption make them responsible for 70% of total energy consumption.

Therefore, it becomes interesting to seek solutions so that the units that consume energy produce their own demand more efficiently and with less losses. Therefore, the techniques that enable improvements in the use and also in the efficiency of electric energy must be analyzed and implemented according to their feasibility.

The photometric theory, formulated by Pierre Bouguer (1698-1758) and elaborated mathematically by JH Lambert (1728-1777), was completely forgotten until the mid-1900s, when, with the appearance of the electric lamp, humanity can aspire to better artificial lighting .

LEDs are the English initials for Light Emitting Diode. It is a semiconductor device that emits light with a certain wavelength when polarized in the direct position. This means, in other words, that the LED works with polarity, produces light by photoluminescence.

When lighting a fluorescent lamp, the filaments heat up and emit electrons. This process promotes the start of gas ionization, with the formation of ions. In these conditions, the mixture inside the tube, formed by free ions and electrons, is called “plasma”. A "starter" then automatically interrupts the circuit and turns off the heating of the filaments. The reactor, connected to the lamp, immediately produces a high voltage pulse, which initiates the discharge in argon. This discharge heats and vaporizes the mercury, the largest amount of which is initially in the liquid state. There is then the possibility of cargo movement and the gas, inside the tube, becomes conductive. The electrons are directed towards the positive electrode (anode), while ions with positive charges are directed towards the negative electrode (cathode).

Compact fluorescent lamps have a high efficiency compared to incandescent lamps, that is, their power consumption is lower and their production of luminous flux is higher. Revolution in energy saving, they came to synthesize the concept of miniaturization of the light source in fluorescents. LEDs have advanced incredibly and are now used in all areas of lighting. These are the highlights of the new lighting projects. However, comparative studies are lacking that prove the economic viability of LED and compact fluorescent lamps.

1.1 GENERAL OBJECTIVE

This work aimed to promote, through bibliographic studies, the comparative analysis of compact fluorescent lamps versus LED lamps: a saving factor.

1.2 SPECIFIC OBJECTIVES

The specific objectives were: to explain the conceptual precepts on: definitions, characteristics, operation, defect, quality and the environments used and the NBRs regulation; address the economic impact generated

by the choice of LED lamps and compact fluorescent lamps; evidence the comparative analysis of compact fluorescent lamps versus LED lamps; emphasize on an economic feasibility study on the use of LED lamps and compact fluorescent lamps.

1.3 JUSTIFICATION

The justification of the study is related, in the promotion regarding the use of LED lamps and compact fluorescent lamps, in addition to the comparative analysis of compact fluorescent lamps versus LED lamps in the generating factor of savings. Since the areas related to artificial lighting are responsible for a significant portion of energy demand, both on a large scale and in the lighting of public roads or industrial buildings, as well as in smaller scales in commercial and residential buildings. Therefore, its promotion is crucial in the context of economic viability.

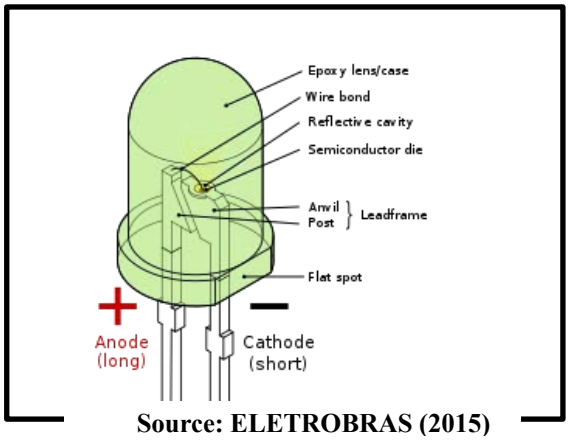
However, LED lamps in artificial lighting projects have been increasing in recent years and in many cases, their durability, energy and luminous efficiency have been proven in comparison with conventional lamps. On the other hand, compact fluorescent lamps have a high efficiency compared to incandescent lamps, that is, their power consumption is lower and their production of luminous flux greater.

2 THEORETICAL FRAMEWORK

2.1 APPLICATION OF LED LAMPS

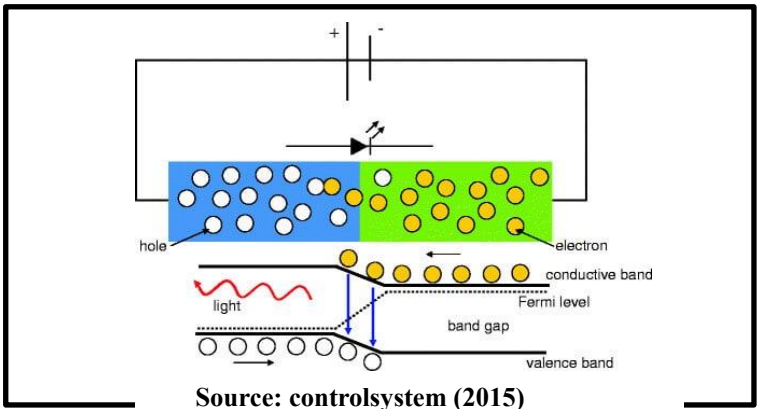
LED is the acronym in English for Light Emitting Diode, or Light Emitting Diode. It is a semiconductor diode (PN junction) that, when energized, emits visible light, that's why LED (Light Emitting Diode) figure 1. The process of emitting light by applying an electrical energy source is called figure 2 electroluminescence.

Figure1: Light Emitting Diode



Source: ELETROBRAS (2015)

Figure 2: Principle of operation of the LEDs and diode symbol.



Source: controlsystem (2015)

At any directly polarized P-N junction, within the structure, close to the junction, recombination of gaps and electrons occurs. This recombination requires that the energy possessed by this electron, which until then was free, be released, which occurs in the form of heat or photons of light. As recombination occurs more easily at the energy level closest to the conduction band, the impurities for making the LEDs can be properly chosen, in order to display bands suitable for the emission of the desired light color (specific light length).

2.2 CHARACTERISTICS OF THE LED LAMP

According to Kalache et al (2017), the LED is the combination of different semiconductor materials used in the construction of the LED influencing the production of different colors (wavelength) and the efficiency of the device. The main combinations can be mentioned: AlInGaP (aluminum-indium-gallium phosphide) which produces the colors red and amber, and InGaN (indium-gallium nitride) which emits the colors blue, green and cyan.

The white light produced by current LEDs made it possible to obtain wavelengths closer to the limit of human vision. There are basically three ways to produce white light on LEDs.

However, to be used as a light source in general, white light is necessary, which can be obtained in three ways according to Santos (2015) cites the three ways:

- The first technique mixes the lights from three monochrome sources, the red, green and blue, a process known as RGB, in English red, green and blue. The combination of these colors produces a source of white light sensitive to the human eye;

The second uses an ultraviolet (UV) LED that excites the phosphor, which is deposited in the semiconductor material of the ultraviolet LED. This converts UV light to white light, similar to a regular fluorescent lamp;

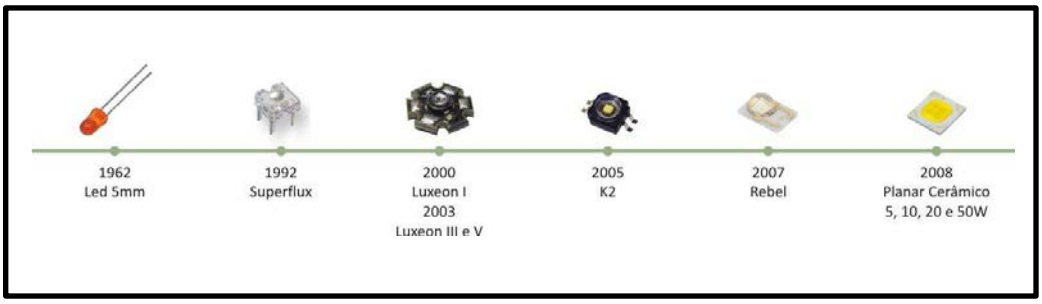
The third form uses a blue LED to excite the phosphor. Part of the emitted blue light turns yellow due to the presence of phosphorus, so the combination of the blue and yellow color produces white light. (SANTOS, 2015).

2.3 INVENTION OF THE LED LAMP

According to reports, the LED was present in everyday life, prevailing its red colors, in the 50s, and green, which appeared in the 70s. However, in order to have white LED light, it was necessary to discover the blue component.

Bakman (2018) describes that, for almost 30 years timeline as shown in figure 3, three scientists Akasaki, 85 years old, Amano, 54 years old, and Nakamura, 60 years old, sought to develop blue light, until in the 90s managed to achieve their goals, enabling their use for lighting.

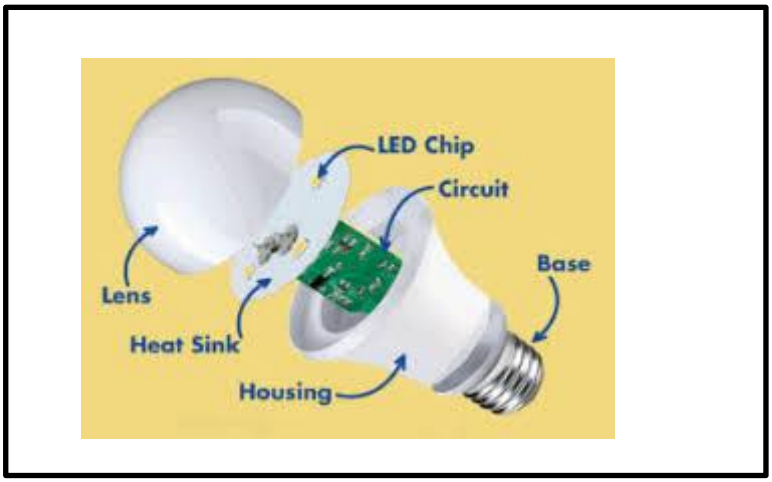
Figure 3: LED and its evolution over the years.



Source: Torres (2015)

Santos (2015) mentions that, the great discovery of the Japanese Akasaki and Amano and the American Nakamura made them in 2017 to be awarded the Nobel Prize in Physics, breaking the logic of past awards, much for having created a revolution in the sector as shown 4.

Figure 4: LED lamps and their components internally.



Source: Total energy (2017)

The creation of a blue light diode allowed a much more economical source of white light to be achieved. This invention was so important that it made scientists Isamu Akasaki, Hiroshi Amano and Shuji Nakamura win the 2018 Nobel Prize in Physics. In addition to the wide recognition of their work, they will receive 8 million Swedish kronor (US $ 1.1 million) to share. (LUIZ; SILVA, 2017).

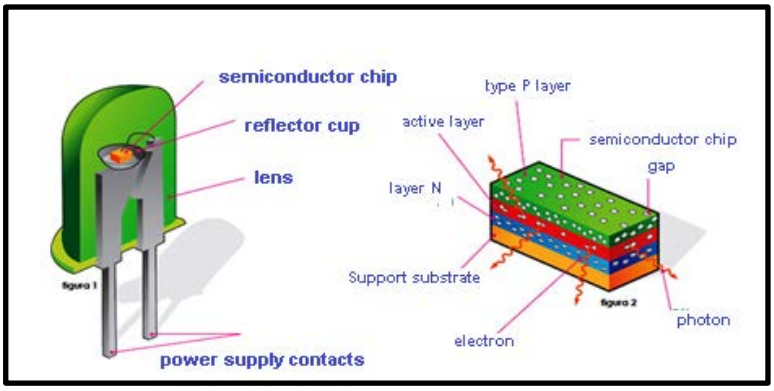
2.4 OPERATION OF THE LED LAMP

Cree (2018) mentions that the LED is a component of the bipolar type, that is, it has a terminal called anode and another, called cathode. Depending on how it is polarized, it allows the passage of electric current and, consequently, the generation or not of light.

The most important component of an LED is the semiconductor chip responsible for generating light. This chip has very small dimensions, as can be seen in figures 5 and 6, a conventional LED and its components.

Figures 5 and 6: LED components

.



Source: CREE (2018)

2.5 LED LAMP DEFECT

Fields; Santos; Roberto, (2015), mention that in the defect item there are some observations, there are issues that must be observed: the lack of manufacturing standards and standardization makes it difficult to control the quality of lamps found on the market due to the lack of a tax standard for LED products it generates discrepant differences in price and confuses the end consumer.

2.6 QUALITY OF THE LED LAMP

According to Santos et al (2015), LED lamps today are a real alternative to conventional lamps. They have several qualities such as:

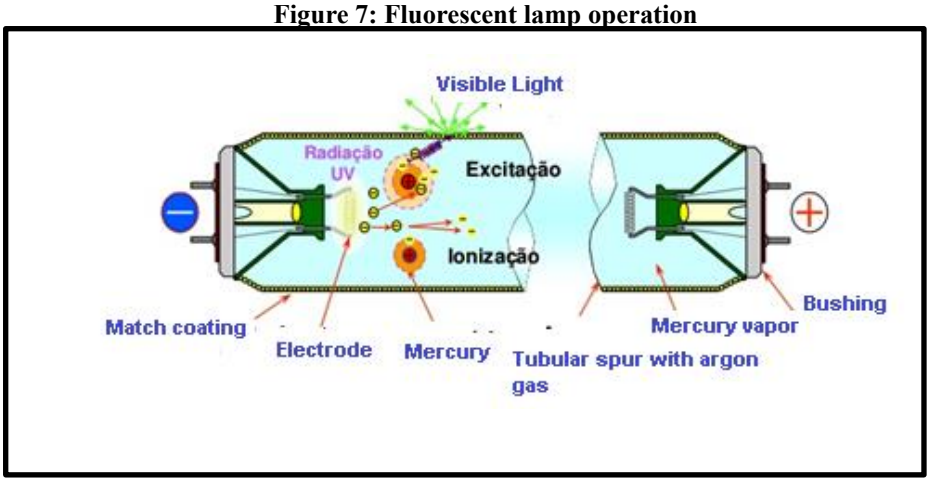
- ✓ Long durability, more than 100,000 operating hours;
- ✓ High luminous efficiency;
- ✓ Low energy consumption and little heat dissipation;
- ✓ Variety of colors;
- ✓ Great resistance to shocks and vibrations;
- ✓ Does not generate ultraviolet radiation and little heat dissipation;
- ✓ Little need for maintenance;
- ✓ Variable intensity control: varies according to the current flow;
- ✓ Bright, saturated colors without a filter: it occurs due to the monochromatic wavelength;
- ✓ Ecologically correct: does not use mercury or any other element that causes damage to nature;
- ✓ Absence of ultraviolet: Does not emit ultraviolet radiation and is ideal for applications where this type of radiation is undesirable. Ex .: Pictures - works of art;
- ✓ Absence of infrared: It also does not emit infrared radiation, causing the light beam to be cold;

- ✓ Reduction of electricity consumption, as they work with low power and great luminous efficiency;
- ✓ Absence of heavy metals, which makes it more advantageous for not having elements toxic to the environment and human health;
- ✓ Greater durability than that of all lamps used so far, estimated at up to 100,000 hours (if switched on for 12 hours / day, they last for about 22 years);
- ✓ Environmentally correct because its life cycle requires less energy and less raw material at all stages, from manufacture, use and disposal;
- ✓ Does not emit heat, which reduces the use of air conditioning and provides greater efficiency (converts more than 80% of energy into light);
- ✓ Does not emit IR and UV rays, which makes them suitable for lighting works of art and does not harm the skin;
- ✓ Does not attract insects;
- ✓ There are already marketable LEDs with high IRC, up to 90, which further increases the variety of applications for this type of lamp;
- ✓ With the use of lenses your beam can be directed;
- ✓ Possibility of dimming;
- ✓ Dynamic color control;
- ✓ Resistant to vibrations and impacts;
- ✓ The number of times and the fluency in which it is turned on and off do not change its useful life;
- ✓ Immediate ignition; Flexibility of use, shape, size and design.

2.7 COMPACT FLUORESCENT LAMP

Silva (2017) highlights, the following concepts about fluorescent lamps figure 7: they are lamps that use electrical discharge through a gas to produce light energy. Its efficiency is high and the service life is between 7000 and 10000 hours.

Figure 7: Fluorescent lamp operation



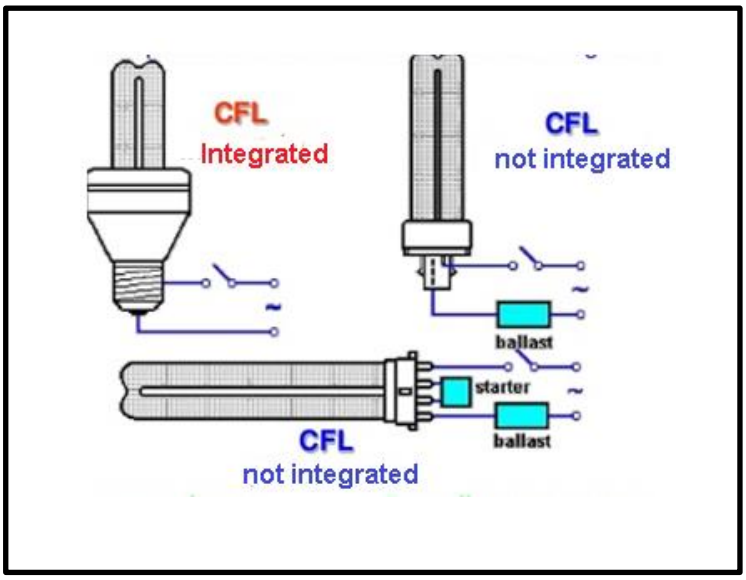
According to Miyashiro (2016) when an old fluorescent lighting is exchanged for modern fluorescents with an IRC of 85, there is a tendency to become entrenched. Some even say that the lamp is bad for your health,

as people get red. In fact, what happens is that we get used to seeing people in a light that reproduces colors poorly, making them pale and when we start to see them with their natural colors, we are strange.

2.7.1 CHARACTERISTICS OF THE COMPACT FLUORESCENT LAMP

Sousa; Ferrari (2015) cite that compact fluorescents D / E and T / E: they are similar in shape in relation to the two previous lamps, however, they have at their base four pins for fixing to the socket, thus indicating the use of specific electronic ballasts for its functioning. Unlike the two-pin ones that cannot use electronic ballasts for their operation, these four-pin D / E and T / E only work with electronic ballasts shown in figure 8.

Figure 8: Fluorescent lamps and their ballasts



Source: GIMI (2016)

2.7.2 INVENTION OF THE COMPACT FLUORESCENT LAMP

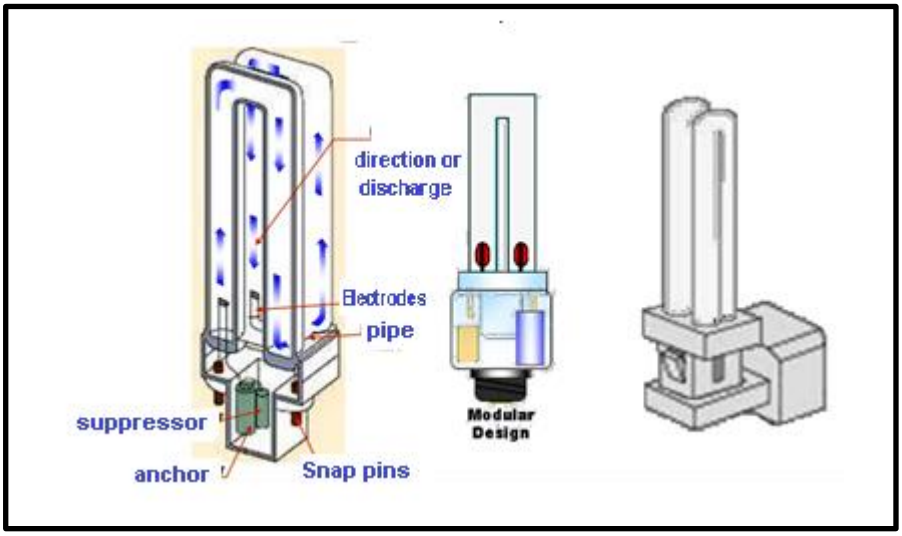
Fluorescent lamps have four basic components: a transparent glass tube, two electrodes, one at each end, a mixture of gases and a material that lines the tube internally. (VILUX, 2018, p.1).

2.7.3 OPERATION OF THE COMPACT FLUORESCENT LAMP

Godinho et al (2017) claim that the operation of compact fluorescent lamps consists of the electrical stimulation of special gases. They transform the ultraviolet rays into white light, as shown in Figure 09. This stimulation also follows steps such as:

- ✓ The electrodes generate an electric current that agitates the molecules of argon and mercury vapor, stimulating the emission of ultraviolet rays;
- ✓ UV radiation is absorbed by the inner lining of the tube, with a special chemical composition that transforms it into white light;
- ✓ The lamp circuits are composed of a wave rectifier, D1 to D4, the oscillators TR1 and TR2 13003 and the transformer L1, L2 and L3.

Figure 09: Fluorescent lamp operation



Fonte: GIMI (2016)

2.7.4 DEFECT OF THE COMPACT FLUORESCENT LAMP

According to Sousa; Ferrari (2015) defects of the compact fluorescent lamp include:

- ✓ Constantly switching on and off: Compact fluorescent lamps should not be used in environments, or in a way that they are switched off and on repeatedly or repeatedly, as in corridors and presence sensors, as this causes great wear on the internal electrodes that make up the starting the lamp, and this means that the service life is greatly reduced.
- ✓ Vibration: It should not be installed in equipment prone to vibrations or mechanical shocks, as they will have a significant reduction in life.
- ✓ Moisture: Fluorescent lamps must be installed in locations that can provide protection from humidity, as their internal reactor can be damaged by containing electronic components.

2.7.5 QUALITY OF THE COMPACT FLUORESCENT LAMP

Moraes Junior et al (2015) approach that, the quality of the compact fluorescent lamp is similar to the other conventional lamps, however with reduced size. They are available in various shapes and sizes and their base is threaded. They are of excellent quality of light, with high energy efficiency, in addition, they have a useful life of approximately 15,000 hours. Its electricity consumption is up to 80% lower compared to ordinary incandescent. Your IRC is approximately 85%.

2.8 NBRS OF COMPACT LED AND FLUORESCENT LAMPS

Regarding ABNT NBR 14,538 (2000) - Compact Fluorescent Lamps with integrated ballast for general lighting:

The lamps with integrated ballast are units sealed at the factory and are not subject to repair. However, to simulate abnormal or fault conditions (as per sections 12 and 13), they can be opened.

2.9 ECONOMIC IMPACT GENERATED BY THE LED LAMP AND COMPACT FLUORESCENT

As for compact fluorescent lamps of 15 or 18W replace a 60W incandescent lamp, however with consumption around 1,900 kWh, considering the same standards, quite economical when compared to incandescent. LED lamps equivalent to 60W of incandescent and 15W of fluorescent need only 8 Watts to emit light, reflecting a much lower expense than the others, about 1,000 kWh (KALACHE et al, 2017).

2.10 NATIONAL ELECTRICITY CONSERVATION PROGRAM (PROCEL)

According to Bakman (2018) over these program years, more than R $ 2.5 billion has already been invested by Eletrobrás, saving 92 billion kWh. In 2016, 11.7 billion kWh were saved, which is equivalent to the annual consumption of 6.02 million homes. The avoided CO^2 emission corresponds to 499 thousand vehicles in one year. In addition, more than 44 million pieces of equipment were sold under the PROCEL seal.

2.11 ACCEPTANCE ON THE BRAZILIAN MARKET

Bakman (2018) claims that companies existing in the Brazilian market today can be classified as:

a) Interference of inadequate illuminance levels and flicker in productivity levels;

b) User satisfaction regarding the luminous flux of LED lamps in the work environment;

c) Comparisons of the luminous flux of LED tubular and fluorescent tubes using Ulbricht integrating sphere, existing brands in the DIALux software and luminaire without reflector;

d) Study of the Color Reproduction Indexes of LED lamps;

e) Disposal of LED lamps; f) Reassess the calculation of the payback including the readjustments in the electric energy rate and the projected fall in LED prices.

3. MATERIAL AND METHOD

3.1 COMPARATIVE ANALYSIS OF THE USE OF THE LED AND COMPACT FLUORESCENT LAMP

Energy savings per year, including lamps, auxiliary equipment and air conditioning; - Savings in exchange for light bulbs, including equipment and labor; - Return on investment period; - Return on investment (RSI), defined as the relationship between money earned or lost through an investment, and the amount of money invested.

3.2 LIGHTING PROJECTS

A quality lighting project must be given, by the relationships between: the distribution of light with visibility, integration with natural light and visual pollution; the relationship between the environment and the task location, considering light fixtures, color, glare, flicker and luminance: and the relationship between lighting and people or objects through modeling, points of emphasis, distributed within three aspects: architecture, economic and environmental aspects and human needs. (SOUZA, ET AL, 2017).

4 RESULTS AND DISCURSIONS

4.1. DISCURSIVE ANALYSIS

In the analysis, the prevalence of economy and quality of fluorescent lamps and LEDs was identified (62% quality LEDs and 38% fluorescent). In all discursive analysis, the importance to carry out the study was observed. By the calculation below:

$$\Phi = (E * S) / (Fu * Fd)$$

Subtitle:

Φ = Luminous flux in lumens (lm); E = Illuminance admitted to the environment; S = Area to be illuminated

Fu = Lamp usage factor

Fd = Depreciation factor of the same (luminaire or lamp);

To obtain the value of Fu, it is necessary to find the value of K, which is the reflectance index, in possession of the value of K. (BONA, 2010).

$$k = (l * c) / h * (l + c)$$

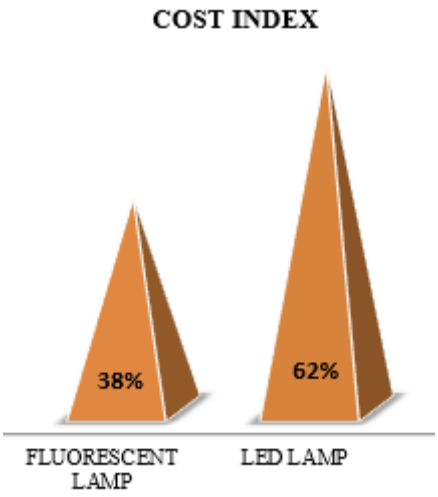
Subtitle:

K - Reflectance Index;

c - longitudinal length in meters; l - width in meters;

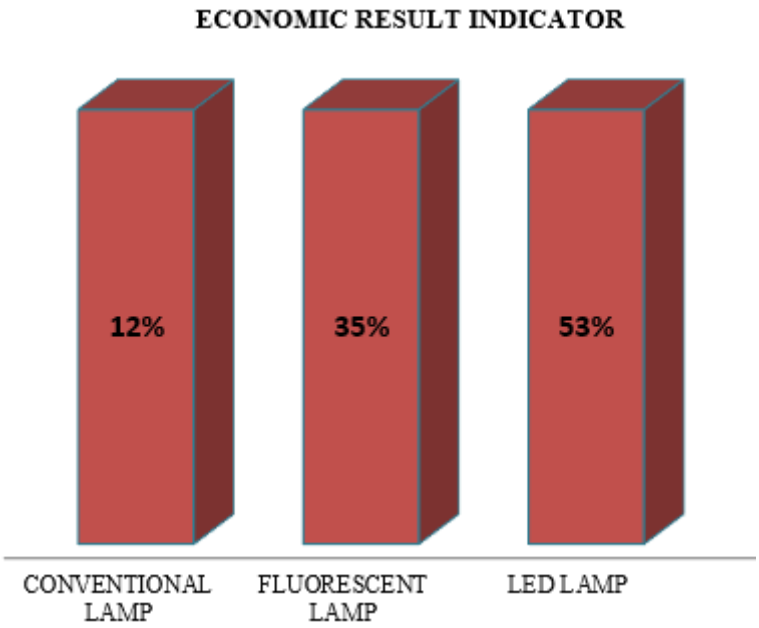
h - height of the installation floor in meters.

Graph 1: Cost Index between LED and Fluorescent Lamps



Source: Authors, 2020.

Graph 2: Economy Result Indicator for Conventional, Fluorescent and LED Lamps



Source: Authors, 2020.

The economic result indicators were calculated using the formulas of net present value (NPV) and internal rate of return (IRR), demonstrated at the beginning of the project, in the discursive analysis.

The result of the study addresses several benefits associated with the application of fluorescent lamps and LEDs. The advantage of using the compact fluorescent lamp system is 35%. As for LED it is 53%, and the conventional lamp is 12%.

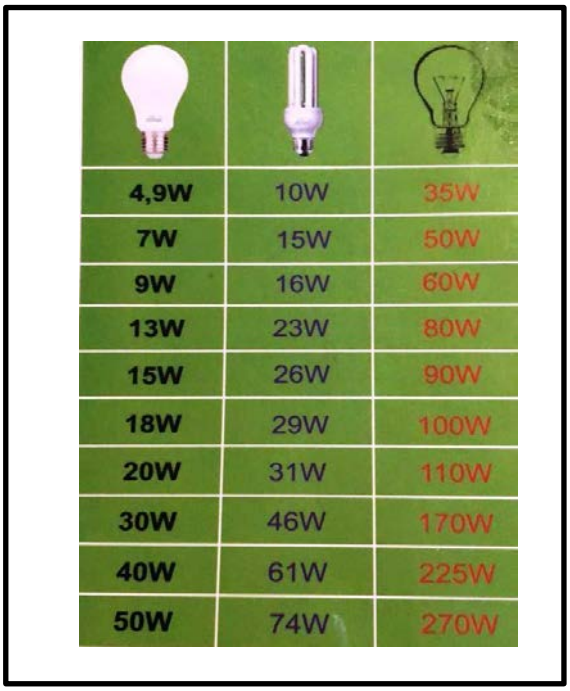
While 26W compact fluorescent lamps have a median life of 10,000 hours (Reference: Osram Dulux® Superstar Micro Twist) 12W LED lamps have a life of 30,000 hours, that is, three times the first (KALACHE et al, 2013).

Considering the aforementioned useful lives and the scenario of use of the lighting system described above, replacement and replacement.

Kalache et al, (2013) cite some tips for recycling or repairing compact fluorescent lamps such as:

- ✓ Check if there is a fuse and if they are open;
- ✓ Perform visual inspection to detect cold welds, if in doubt re-weld;
- ✓ Measure the tube filament, the two filaments must be intact;
- ✓ Measure the semiconductors as transistors and diodes, making sure that none of the above items is damaged, one of these will be open.

Table 1: Equivalence (W) of LED bulb



4,9W	10W	35W
7W	15W	50W
9W	16W	60W
13W	23W	80W
15W	26W	90W
18W	29W	100W
20W	31W	110W
30W	46W	170W
40W	61W	225W
50W	74W	270W

Source: ELETROLUX (2020).

5. CONCLUSION

In this work, we approached compact fluorescent lamps and LEDs explaining an economic feasibility study. Describing information obtained from reference sources for compiling the study. It was found that Compact Fluorescent and LEDs are essential for the execution of a lighting project, where both represent an economically viable value for the professional and his client.

However, based on the analysis carried out, it is concluded that the use of LED technology for lighting entire environments is not yet economically attractive. This statement is justified due to the high costs of LED lamps on the market in relation to more traditional lamps such as compact fluorescent.

It should also be noted that the luminous efficiency of the LED lamp, in many cases, is superior to the luminous efficiency of compact fluorescent lamps, in some environments, depending on its purpose, this contributes to increase its attractiveness.

It should be noted, however, that due to the useful life of LED lamps, it is considerably longer than compact fluorescent lamps, being three times longer in the case analyzed.

As a suggestion for future work, a possible implementation of a lighting control of these luminous resources is left. The constant demand and improvements and technological improvement over time should decrease the price and access making future application feasible for the purely economic aspect. In the other contexts covered, we can highlight the quality of the LED and the main one the durability.

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Regional Management Information System and Training for Regional Financial Accountability

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Abstract

Financial accountability is the responsibility for financial management in the form of financial reports through the use of information technology, which is expected to be able to support regional governments in carrying out better regional financial management as well as having competent human resources in their management. This study aims to provide information about the usefulness of information technology and human resource competence in the accountability region financial report. This research was conducted in three regional expansion in Lampung Province with a descriptive qualitative method with the help of NVivo software for data analysts. The result showed that to achieve regional financial accountability is supported by utilizing information technology in the form of a regional management information system, while to be able to operate the SIMDA application program require adequate human resource and training is given to increase competence.

Keywords: Management Information System; Competence; Training; Accountability; NVivo.

1. Introduction

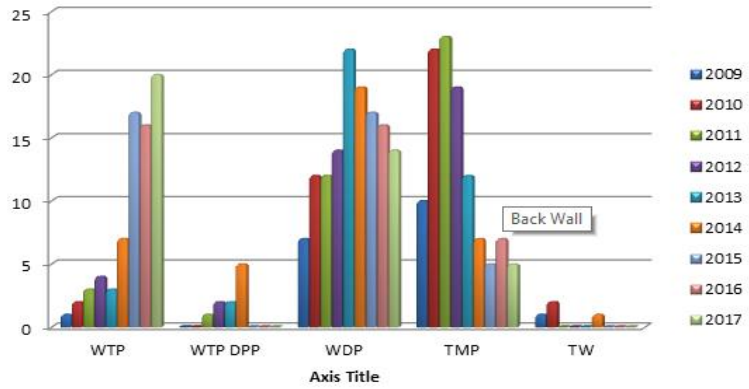
Good government governance related to government accountability to society has encouraged the government to be able to implement public accountability. In the financial context, accountability is the responsibility regarding financial integrity, disclosure, and compliance with financial management, the goal of accountability is financial reports (BPKP 2000). Making financial reports is a need for transparency, which is a supporting requirement for accountability in the form of openness of the government to public resource management activities (Andriani 2010). The application of the Regional Financial Accounting System (SAKD) to realize transparency and accountability of regional financial reports is supported by an accounting system, information system and is managed by resources who have appropriate backgrounds and are responsible for financial reporting (Firdaus 2017). Accountability of Regional Financial

Management, as an implementation of public policy in practice, requires adequate human resource capacity in terms of numbers and expertise (competence, experience, and adequate information) (Insani 2009). In achieving the effectiveness of financial management, the government must have competent human resources (Kalumata et al. 2016). To support the achievement of a good accounting system, human resources with the capacity to produce quality financial reports are needed (Hanafi 2013).

Utilization of information technology which is considered to be able to support in producing accountable financial reports. The existence of a government website is an effort to increase government accountability which makes it easier for stakeholders to access information (Nurrizkiana et al. 2017). Financial reports are a source of information for stakeholders so that the accuracy and ability of human resources in the administration of local governments must be able to produce financial reports that are by existing regulations (Fontanella, 2010). In achieving the effectiveness of financial management, the government must have competent human resources (Kalumata et al. 2016). To support the achievement of a good accounting system, human resources with the capacity to produce quality financial reports are needed (Hanafi, 2013).

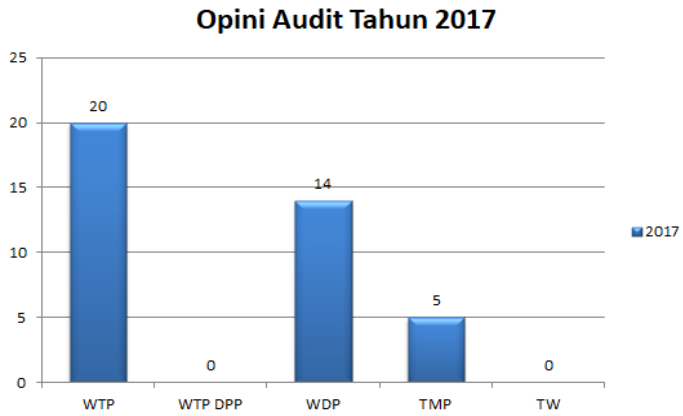
Specifically, seen from the financial aspect, the Indonesian government through Law Number 15 of 2004 defines accountability as the government's obligation to carry out the management of State finances in an orderly manner, obeying statutory regulations, efficiently, effectively, and transparently, by taking into account the sense of justice and compliance (RI, 2017). The Constitution of the Republic of Indonesia clearly states that the BPK has to examine the management and accountability of State finances (Afriyanti et al. 2015). In assessing the accountability by the BPK, it is through giving opinions on the financial statements. For local government institutions, regional financial accountability is reflected in the quality of opinion expressed by BPK RI from the results of audits of government financial reports (RI, 2017). Specifically for the Unqualified Opinion which contains a statement that the financial statements have been presented fairly in all material respects according to SAP, giving rise to expectations that the entity has met the elements of transparency and accountability in its financial management (RI, 2017).

Over the past 10 years (2009-2017 reports) there were 39 district governments of the newly created districts that experienced an increase in opinions ranging from Unreasonable opinions to Unqualified Opinions. It can be seen in the following graph:



Graph 1. Development of Opinion LKPD for the expansion regions in 2009-2017
Source: data processed from IHPS BPK RI 2013 & 2018

However, only 20 (51%) district governments received Unqualified opinion (WTP), 14 (36%) district governments received Unqualified opinion (WDP), and the remaining 5 (13%) district governments obtain an opinion that does not give an opinion (TMP). It can be seen from the following graph.



Graph 2. The opinion of the LKPD of the expansion areas in 2017

2. Theoretical Framework

2.1. Financial Accountability

Each reporting entity should report the efforts that have been made and the results achieved in implementing activities in a systematic and structured manner during a reporting period for accountability, management, transparency, intergenerational balance, and performance evaluation (PSAP KK 2010). Accountability is one of the main elements of the embodiment of good governance which is currently being pursued in Indonesia. The government is asked to report the results of the programs that have been implemented so that the public can judge whether the government has been working economically, efficiently, and effectively.

Financial accountability is the obligation of every person or institution to account for and report on the use of public resources in the exercise of the public authority they hold (Afriyanti et al. 2015). Financial

accountability is the responsibility of public institutions to use public funds (public money) economically, efficiently, and effectively, there is no waste and leakage of funds, and corruption (Zeyn 2011). Financial accountability is related to avoiding the misuse of public funds (Mardiasmo 2002). The stages in financial accountability start from financial planning (budgeting), implementing and financing activities, to implementing reporting (Zeyn 2011). In other words, accountability is the entity's obligation to report on regional financial management in the form of financial reports.

The Indonesian government, through Law Number 15 of 2004, defines accountability as the government's obligation to be able to carry out financial management in an orderly manner and comply with laws and regulations as well as to be carried out efficiently, economically, effectively, and transparently by taking into account the sense of justice and compliance. Regional financial accountability is reflected in the quality of opinion expressed by BPK RI from the results of audits of government financial reports as mandated by Law Number 17 of 2003 concerning State Finance and Law Number 15 of 2004 concerning Audit of the Management and Accountability of State Finances (RI 2017).

The Supreme Audit Agency, through opinion on financial statements by conducting financial audits, is carried out to assess the accountability of government financial reports (Afriyanti et al. 2015). The financial audit aims to provide adequate assurance on the fairness of the presentation of financial statements in all material respects by generally accepted accounting principles in Indonesia. An opinion is a professional statement as the examiner's conclusion regarding the fairness of the information presented in the financial statements. Based on the decision of BPK RI number 4 / K / I-XIII.2 / 9/2012 paragraph 13 regarding types of opinion, there are four types of opinions that can be given by the examiner, namely Fair without Exception, Fair with Exceptions, Unfair, and Not Providing Opinions.

Utilization of Information Technology

Government Regulation No. 56 of 2005 concerning regional financial information systems describes the obligations of local governments in utilizing information technology. Public demand for the formation of a government system that is clean, transparent, and accountable has created two main things in the definition of e-government, namely the use of information technology and the purpose of its use (Nurhakim 2014). Utilization of information technology is the optimal use of computers (mainframe, mini, micro), software, databases, networks (internet, intranet), electronic commerce, and other types related to technology Wilkinson et al. (2000) in Hanafi (2013).

Martin et al. (2005) in Hanafi (2013) information technology is a combination of hardware and software in computer technology to process and store information and transmit information. Information technology apart from being computer technology (hardware and software) for processing and storing information also functions as a communication technology for information dissemination (Kalumata et al. 2016). Information system technology (hardware and software) is needed to facilitate information processing so that the required information is available on time (Andriani 2010). The use of appropriate information technology and supported by the expertise of the personnel who operate it can improve the performance of

government agencies (Chintya 2015). The government needs to conduct training related to information technology to improve the capacity of its staff.

2.2. Human Resources Competence

Human resources are one of the important elements in an organization, besides that human resources must also have adequate competence to support the implementation of organizational duties and functions. Organizations need competent human resources to be able to achieve the vision and mission and goals of the organization. Competence is a skill that a person possesses through education and training to achieve high performance in completing his duties (Susanto 2018). Competence is a sufficient skill to perform a task or as a necessary skill and skill according to Herlambang (2014) in Sagara (2015). Competency components include knowledge, experimental, ethics, and subjective and objective skills according to Nur Afiah (2004) in Indriasih & Koeswayo (2014).

Widodo (2001) in Sukmaningrum (2012) explains that human resource competence is the ability of human resources to carry out the tasks and responsibilities given to them with adequate education, training, and experience. Competence is the ability and characteristics possessed by a civil servant in the form of knowledge, skills, and behavioral attitudes required in carrying out their duties as described in Government Regulation No. 101 of 2000 concerning Education and Training for Civil Service Positions.

In regional financial management, SKPD must have quality human resources, with a background in accounting education, attend training and education, and have experience in finance. Qualified human resources will be able to understand accounting logic well. The failure that occurs in the preparation of financial statements that are not by Government Accounting Standards is an impact that results from the selection of human resources that are not qualified.

In previous research conducted by Firdaus (2017) concluded that the information system is divided into three, namely software, hardware, and Brainware, where the use of SIMDA software is quite helpful in completing tasks, the availability of hardware must be by the needs, and Brainware, namely the operator who is responsible for reporting. finance must have the suitable background knowledge and take accounting and finance training. In line with research conducted by Indriasih & Koeswayo (2014), it is revealed that the competence of government officials will improve the quality of financial reports and have an impact on accountability. Oktari's (2013) research concluded that the use of information technology does not support the performance of government agencies. Kalumata et al. (2016) explained that the competence of human resources was not by the needs in financial management, whereas in the process of preparing financial reports it was supported by the use of information technology so that in preparing financial reports, adequate knowledge of the accounting cycle was not required. Hanafi (2013), the capacity of human resources with an inappropriate level of education and a lack of understanding in financial management will hinder the timeliness and reliability of financial reporting, while the use of information technology can help in the timeliness and reliability of financial reporting because it has advantages in terms of speed.

This study aims to examine whether to achieve accountability in local government financial management the use of information technology is carried out and how the competence of human resources in local government financial management. The object of research in the expansion area in Lampung Province which in its financial management is considered to be accountable is seen from the unqualified opinion. This opinion was provided by the Supreme Audit Agency of the Republic of Indonesia for the 2017 financial statements. This research was conducted in areas that experienced an increase in the provision of opinions on financial reports by the Indonesian Audit Board.

3. Research Methods

This research is a descriptive study with a qualitative approach. The results of this study only describe or reconstruct interviews with research subjects so that they can provide a clear picture of the understanding of the use of information technology and human resource competence in the accountability of regional financial reports. Samples in qualitative research are further referred to as participants or informants (Sugiyono, 2017).

The selection of informants in this study used a purposive sampling technique with considerations that are directly related to financial management in the Budget Planning Section (BPA), the Treasury Section (BPB), and the Accounting Section (BAK). The data was collected by conducting interviews with the head of the field, the head of the sub-sector, and the staff/operators as executors in operating the accounting information system. This research was conducted in the expansion area in Lampung province, namely Pringsewu Regency, Pesawaran Regency, and West Onion Regency. Interviews were conducted with 3 informants in each region.

Data were analyzed using text coding from documents (Yuliansyah 2015). The results of the interview will be analyzed through a coding process using data processing and management software, namely the NVivo application. The output data coding from NVivo is the word frequency query result and explore diagram codes as the basis for data processing. The use of computers in the process of qualitative research analysis can increase accuracy to produce a reliable analysis (Yuliansyah et al. 2012). The use of NVivo aims to find the keyword for each research variable from the many sentences delivered from the interview results.

4. Research Results and Discussion

The results of this study are in the form of statements regarding the use of information technology and human resource competencies with the accountability of regional financial reports. The results of the interview showed that the use of information technology was in the form of the use of the regional management information system (SIMDA), the use of the internet network, computers, and updating of central government information through the website. As for the competence of human resources in the newly created areas, they do not fully have a background in accounting education, but most of the human resources are drawn from educational backgrounds who understand financial management such as financial management and to be able to adjust to regional financial management and use of the SIMDA application program. then the local government will conduct special training or technical guidance in the area of

regional financial management to increase the competence of human resources in managing regional finances and create accountability or accountability in the financial reports of local governments.

4.1. Discussion

4.1.1. Utilization of Information Technology

In the Lampung province, especially for the expansion area, namely Pringsewu district, Pesawaran district, and West Tulang Bawang district, financial management is carried out by utilizing the system/application. The financial management system used is the Regional Management Information System (SIMDA) which is an application program belonging to the Development and Finance Supervisory Agency (BPKP). As stated by the following informants:

"…… For financial management to compiling financial reports, yes we use or utilize information technology in the form of an application called SIMDA… .."

"... ..in preparing the financial statements using the system, we have a financial reporting system, the name of the system is SIMDA which is a product of BPKP for each local government using the system ..."

"… .. The use of technology in government finance is called SIMDA, it is an application to manage government finances made by BPKP to improve the quality of local government financial reports… .."

The SIMDA application can be implemented for regional financial management through the use of the internet network because this application uses multi-user technology, it requires the use of a stable internet network to be able to connect between clients and servers. However, one of the problems that are often faced is the internet connection which is often disconnected so that you cannot use the SIMDA application. As the following interview results:

"... because the name is an application, let alone connected to many computers, of course, it is assisted by an internet connection ..."

"… ..Yes using the internet network, using the application because it uses the internet network. If there is a disturbance there it is clear that we cannot use the application… .."

"…… Yes, using the internet because you are using an application, if the connection is lost you cannot use the application earlier… .."

The financial reports generated from the SIMDA application program are developed by the BPKP by statutory regulations that serve as guidelines for regional financial management. The financial reports of the expansion areas in Lampung province are considered to have met the accountable element by the Republic of Indonesia's BPK because they are by statutory regulations and Government Accounting Standards. The development of a stable internet network is expected to make it easier for financial managers to be able to use the SIMDA application to achieve financial report accountability.

4.1.2. Human Resources Competence

4.1.2.1. Education

Government accounting education is not the main basis in local government, because in regional financial management there is still a lack of human resources who have a background in accounting education for government, but local governments choose to give authority in regional financial management to human

resources who understand financial management such as background behind his education in financial management. As an excerpt from the following interview:

"…… This is indeed still standing here. Human resources cannot immediately become an absolute requirement, yes, we have to make adjustments, if the basic school doesn't go there but with the assignments, it adjusts… .."

"…… For that competency, we still cannot find the appropriate one, such as the graduates must be from accounting, we are not new, so that means we can only adjust the graduates of each HR with the required part. For those who graduated from accounting here, there are only 2 people….. "

"…… For education, I don't think it's all from accounting, but for those who do financial management they have to understand how the cycle is even though they are not purely accounting graduates from financial management… .."

In regional financial management to create accountability for regional financial reports, its management must be carried out by human resources who know the field of accounting so that they can understand the existing rules. In the expansion area of Lampung province, it was found that there was still a lack of human resources who knew the field of accounting, but most of the human resources had knowledge in financial management which is a branch of science in accounting education. The lack of human resources who know the field of accounting is because it is difficult to find human resources who are graduates of accounting.

4.1.2.2. Training

Training is a means that must be carried out by local governments so that their human resources can carry out regional financial management by-laws and regulations by government accounting standards so that they can create accountable financial reports.

"… ..We have human resource development, which means we always guide, if there are new regulations about new rules or updates on the system, we all follow it… .."

"... so even though we are not graduate from accounting, we do training to increase the capacity of our human resources to be able to manage and prepare financial reports ..."

"… .. There is training because of that because not all of them have a background in accounting education and if there are new regulations from the center that we have to adjust, then technical guidance will be carried out with related parties, depending on what we need… .."

The training provided is also to prepare human resources in the local government so that they can achieve a better level of mastery of information technology to strengthen the government base in implementing regional autonomy better. The training provided for the mastery of information technology through the use of the SIMDA application program is expected that local government officials have the knowledge and practical experience in regional financial management.

In addition to the mastery of information technology, the training aims to increase knowledge, expertise, skills, and attitudes to be able to carry out tasks in a professional manner based on employee personality and ethics. Creating an apparatus capable of acting as reformers and the glue of national unity and integrity. Strengthen the attitude and spirit of service that is oriented towards service, protection, and community empowerment. As well as creating a common vision and dynamic mindset in carrying out general

government and development tasks for the realization of good governance by Government Regulation No. 101 of 2000 concerning education and training for civil servant positions.

5. Conclusion

Based on the results of the study, it can be concluded that to achieve regional financial accountability in financial management, it can be done by utilizing information technology in the form of a regional management information system (SIMDA) because the development of the SIMDA application program has been adjusted to the law used as a guide in the implementation of regional financial management. While the competence of human resources does not always have to have a background in accounting education, financial management education can also carry out local government financial management and to be able to increase human resource competence, it can be done by providing adequate training in carrying out tasks to support the realization of regional financial accountability.

5.1. Research Limits

This research was only conducted in the expansion area in Lampung Province. This research was only conducted on OPDs whose financial reports were audited by the Indonesian Audit Board as well as the Regional General Treasurer, namely the Regional Financial and Asset Management Agency (BPKAD) in 3 (three) expansion areas in Lampung Province, without involving other Regional Government Organizations.

5.2. Suggestion

For further research, it is necessary to research with a wider coverage covering the expansion areas in other provinces. Conduct research in each area of the division, not only in areas that have experienced an increase in an opinion by the Supreme Audit Agency so that the results can be compared.

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Influence of Changing Family Transition on Gender Roles Among Chuka Community in Meru South District, Tharaka Nithi County

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Abstract

The instability of family structure has become an increasingly salient part of people's lives in Kenya. Lack of stable parenting coupled with strained relationships between parents and other family members as a result changing gender role have impacted negatively on family cohesion. This study investigated to investigate effects of family transitions on gender roles among the Chuka community. The objectives of the study was to determine the influence of changing family transition on gender roles among Chuka community in Meru south district, Tharaka Nithi county. The study was guided by social structural theory. This study utilized the descriptive survey research design and the target population was 140 subjects comprising of 98 household heads in Magumoni division, 30 Church leaders, 6 women group leaders and 6 Chiefs. A total of 5 church leaders, 6 location chiefs, 6 women leaders and 98 households participated in this study. Questionnaires were used as the instruments of collecting data from all the respondents. A pilot study revealed a reliability coefficient of 0.7047 with the house hold head questionnaire, 0.7014 with chief's questionnaire, 0.7020 for both church leaders and women leader's questionnaire. The study concluded that the change in traditional family gender roles heavily impacts on gender household responsibilities and ultimately the cohesiveness of the family household. The study recommends counseling and other intervention programmes such as to mitigate the negative outcomes arising from the changes in the traditional family gender roles.

Introduction

The family is a basic unit of social structure, the exact definition of which can vary greatly from time to time and from culture to culture. How a society defines family as a primary group, and the functions it asks families to perform, are by no means constant. The LO diverse data coming from ethnography, history, law and social statistics, establish that the human family as an institution and not a biological fact founded on the natural relationship of consanguinity (Forbes, 2005). Chick and Meleis (1986) define family transition as passage from one life phase, condition, or status to another. Further, Chick et al. argue that transition refers to both the process and the outcome of complex person-environment interactions. This may involve more than one person and is embedded in the context and the situation. Family transitions represent connections between people and their changing environment.

Gender roles in Western societies have been changing rapidly in recent years, with the changes created both by evolutionary changes in society, including economic shifts which have altered the way people work and indeed which people work as more and more women enter the workforce, and by perhaps pressure brought to make changes because of the perception that the traditional social structure was inequitable (Cohany & Sok, 2007). In Africa, the traditional gender roles vary from culture to another and might vary in the same culture as time goes by. There are expectations and roles, which are expected to be met by the proper gender in certain cultures; for example, men in a traditional culture are expected to be able to find work and be the main source of income for the household. Women on other hand are expected to know about the housework. In Meru South District in Kenya, traditional gender roles to still exists to some extent, but some of them have changed over time; for example, women can help men in providing some of the households as well as men can help women in the housework and looking after children to some extent as well. The negative effect is when men think that they should do only what men had done in the past and nothing else; in addition, women have no place in men's work and that the women's place is inside the house. Women on the other hand think that men should help women in the housework; in addition, women should be able to work outside of the house on equal footing with men. The roles on gender household responsibilities determine the cohesiveness of the family. Those who believe that particular behaviors and attitudes are innate to each gender are more likely to subscribe to traditional concepts. The attitudes that men and women hold towards appropriate gender roles have a significant influence on many aspects of marital and family dynamics. The attitude helps to perpetuate gender household differentiated opportunities in education, politics, religion, employment and other areas.

Statement of the Problem

Family transitions represent connections between people and their changing environment. Little is known at present about how family transitions are influenced by social trends and historical forces and how these changes are influencing changes in perceived gender roles within the institution of the family in Kenya. When a family is in transition, interactions among family members and subsystems within the family facilitate or impede the process of family cohesion. Family transitions are accompanied by a wide range of changes in family gender roles with women bearing the greatest blunt. Women in Meru South District typically spend much more time in the house than men as they perform their reproductive and household roles. This imbalance has implications on poor rural women, especially as the structure of the family unit is changing and female-headed households are on the increase in this area. The effect of such structural changes has on family have received little attention in research. It is against this background that this study was conducted to investigate the influence of changing family transition on gender roles among Chuka community in Meru south district, Tharaka Nithi county.

Theoretical Framework

This study draws on social structural theory by Eagly and Wood (1999), which expands role theory to address the differentiation of power between men and women. Eagly and Wood (1999) developed social structural theory to challenge evolutionary theories of gender differences. The theory posits that the roles

people occupy whether due to individual choice, sociocultural pressures, or biological potentials lead them to develop psychological qualities and, in turn, behaviors to fit those roles. Parenthood is more salient for women's self-conceptions than for men's and men tend to perceive fathering as something they "do," whereas women generally experience mothering as something they "are". Parenthood is also salient for men, although not as salient as the worker role. The role of economic provider for men is supported by society through opportunities for work and higher pay, thus leading men to be more committed to the provider role than to the parental role. The degree of developmental change taking place following the birth of a child depends on how much the individual invests in the parental role. For individuals for whom the parental role is more salient than other roles, developmental change is expected to be more dramatic than for individuals for whom the parental role is less salient. As noted above, parenthood is more central for a woman's self-concept than for a man's self-concept and women perceive more change than men following the first-time transition to parenthood. The salience tenets of this theory make it useful in guiding this study. It is conceptualized that family transitions are responsible for changes in perceived gender roles as men and women adopt new roles as a result of modern changes in lifestyles.

Conceptual Framework

The conceptual framework of the study is shown in Figure 1.

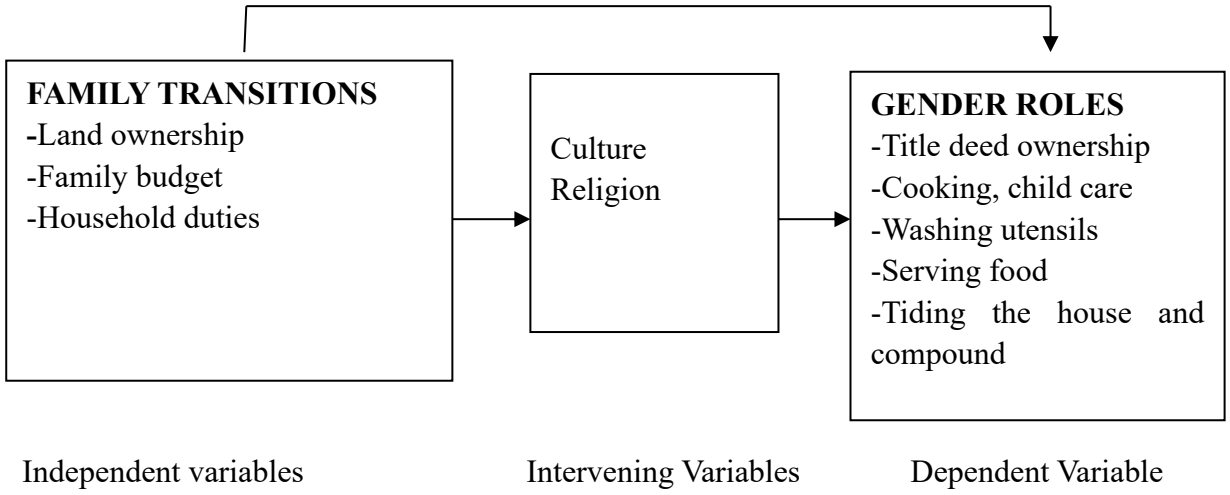

Fig 1. Effect of family transition on gender roles

The independent variable is family transitions, which is indicated by household duties, headship of the family, land ownership and family budget. Gender is the dependent variable and is denoted by cooking, child-care roles, washing of utensils, serving of food and tiding of the house and compound. This study sought to determine the effects of family transition on gender roles in modern society.

METHODOLOGY

In this study, descriptive survey design was adopted. The study was carried out in Magumoni Division in Meru South District. Magumoni Division was selected out of three divisions that make up Meru South

district because it has more indigenous population than the other two. The target population for this study was 140 comprising of 98 household heads in Magumoni division, 30 Church leaders, 6 women group leaders and 6 Chiefs. Thus 10 mainline church leaders, 6 location chiefs, 6 women group leaders and 98 households heads were purposively selected for the study making a sample size of 120. The study employed two types of data collection instruments: a questionnaire and an interview schedule. The questionnaire was used to collect data from the church leaders, location chiefs and women leaders. The interview schedule was used to conduct interviews for 98 households. The data was collected by administering questionnaires to the mainline church leaders, locational chiefs, and women leaders and to the households. The researcher introduced himself to the respondents and gave the questionnaires in person. He gave the guidelines on how to respond to the questionnaires and gave assurance of confidentiality. The researcher collected the filled questionnaires as soon as they were complete. The data were coded and analyzed using the Statistical Package for Social Sciences (SPSS 11.5) which yielded descriptive statistics such as frequency tables, pie charts and bar graphs.

FINDINGS

Demographic Data of the Participants

This study benefitted from information provided by a total of one hundred and fifteen (115) respondents categorized into households, chiefs and women leaders. More than fifty percent of the household respondents 57 (58.2%) were female while 41 (41.85%) were male. Majority of the chiefs 4 (66.75) were male while 2 (33.3%) were female. All the women leaders 6 (100%) were female while most of the church leaders 5 (83.3%) were male and 1 (16.7%) was female as indicated in Table 1.

Table 1: Gender of respondents

Gender	Households		Chiefs		Women leaders		Church leaders	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Male	41	41.8	4	66.7	0	6	5	83.3
Female	57	58.2	2	33.3	6	100	1	16.7
Total	**98**	**100**	**6**	**100**	**6**	**100**	**6**	**100**

Information shown on Table 1 indicates that 13 (13.3%) of the households' respondents were of the ages between 20-29 years, 26 (26.5%) were aged between 30-39 years, 34 (34.7%) were aged between 40-49 years, 16 (16.3%) were aged between 50-59 years and 9 (9.2%) were aged 60 years and above. Most of the chiefs 4 (66.7%) were aged between 40-49 years and the rest were aged between 30-39 years. Also, most of the women leaders were of the ages between 40-49 and 2 (33.3%) were of the ages between 30-39 years. Most of the church leaders 4 (66.7%) were of the ages between 40-49 years and the rest 2 (33.3%) were aged between 30-39 years. Gender disparities are evident in the study population. The study further sought to establish age of the respondents and the data shown on Table 2

Table 2: Age of respondents

Age	Households		Chiefs		Women leaders		Church leaders	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Between 20-29	13	13.3	0	0	0	0	0	0
Between 30-39	26	26.5	2	33.3	2	33.3	2	33.3
Between 40-49	34	34.7	4	66.7	4	66.7	4	66.7
Between 50-59	16	16.3	0	0	0	0	0	0
60 and above	9	9.2	0	0	0	0	0	0
Total	**98**	**100**	**6**	**100**	**6**	**100**	**6**	**100**

The study's findings on Table 2 indicates that most of the respondents 70 (71.4%) of the households, 6 (100%) chiefs, 6 (100%) women leaders and 6 (100%) church leaders had 'O' level education and above while the rest 26 (26.5%) households had primary level qualifications and 2 (2%) households said they never went to school.

Table 3: Education level of respondents

Education level	Households		Chiefs		Women leaders		Church leaders	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Bachelor's degree	6	6.1	0	0	1	16.7	3	50
Diploma	33	33.7	2	33.3	1	16.7	3	50
'O' Level	31	31.6	4	66.7	4	66.7	0	0
Primary	26	26.5	0	0	0	0	0	0
None	2	2.0	0	0	0	0	0	0
Total	**98**	**100**	**6**	**100**	**6**	**100**	**6**	**100**

Data on Table 4 shows that most of the households 85 (86.6%) had between 1 and 4 males and females in the households. This indicates that most of the respondents were literate and were aware of the issues that the study investigated.

Table 4: Population in administrative units

Population in administrative location	Male population in administrative location		Female population in administrative location	
	Frequency	%	Frequency	%
Between 1000 and 1499	2	33.3	3	50
Between 1500 and 1999	3	50	3	50
2000 and above	1	16.7	0	0
Total	**6**	**100**	**6**	**100**

The study's findings on Table 5 indicates that all the chiefs 6 (100%) had served for 5-10 years as chief while 2 (33.3%) church leaders had served for 5-10 years in church leadership, 2 (33.3%) had served for 11-15 years and 2 (33.3%) had served for 16-20 years. This study further sought data on years of service of chiefs and Church leaders and the information captured is shown on Table 5.

Table 5: Years served in current position

Years served in current position	Years served as chief		Number of years served in church leadership	
	Frequency	%	Frequency	%
5-10	6	0	2	33.3
11-15			2	33.3
16-20			2	33.3
Total	**6**	**100**	**6**	**100**

Majority of the church leaders 5 (83.5%) said that they have 300 or less male members while 4 (55.6%) said they have 300 or less female members. Only 1 (16.7%) church leader said has above 300 male members while 2 (33.3%) they have more than 300 female members as shown on Table 6. The study established that the possible reasons for church membership gender differences include the fact that in urban setting males are more attracted to issues of modernity and less in church faith. In addition, it emerged that males are more attracted to business activities than female. The study captured data of Church membership and obtained data shown on Table 6

Table 6:Church membership

Church membership	Male church membership		Female church membership	
	Frequency	%	Frequency	%
Between 101 and 200	3	50	2	33.3
Between 201 and 300	2	33.3	2	33.3
Above 300	1	16.7	2	33.3
Total	**6**	**100**	**6**	**100**

Changing family transitions on gender roles among Chuka community in Meru south district

Designated duties for males and females

Information shown on Table indicates that only fifty percent 5 (50%) of the chiefs said that among the Chuka community duties are not designated for males and females and 1 household respondent did to comment. However, most of the respondents 97 (97%) of households, 6 (100%) of women leaders, 6 (100%) of church leaders and 3 (50%) of chiefs indicated that the duties are designated according to gender. The women explained the state of affairs as arising due to the fact that males are believed to be stronger and tradition bestows upon them the role of being heads of families. Therefore, some duties especially those requiring a lot of effort are designated for males while light duties are designated for females.

Designated duties for males and females	Households		Chiefs		Women leaders		Church leaders	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Yes	97	97	3	50	6	10	6	100
No	0	0	3	50			0	0
No response	1	1					0	0
Total	98	100	6	100	6	100	6	100

Table 7: Designated duties for males and females

The church leaders indicate that traditional male household responsibilities includes providing security, building family house (i.e. providing shelter), organizing the family, providing basic needs, paying dowry, dividing family property and making decision on behalf of the family. For them, traditional female household responsibilities include serving males, showing respect, maintaining hygiene, doing laundry work, handling kitchen work and nurturing children. These leaders observed that male traditional dominated family roles include cultivation, settling disputes, construction, dowry issues, providing security, among others. Some of the female traditional dominated family roles include child bearing, grinding, cooking, laundry work, kitchen work and babysitting. This concurs with Duncan, Edwards, Reynolds, & Alldred (2003) who argued that women are still more likely to perform household labor than men and, in practice, the division of work and household labor is still gender differentiated. This is so because if males do the female roles, they are termed inferior and outcast and the vise versa.

Women leaders identified a number of traditional family gender duties performed by males to include providing security, fathering children, providing education, among others. They identified traditional family gender duties performed by women to include cooking, washing clothes and child care. According to the households' respondents, male household duties include disciplining family members, safeguarding the homestead, keeping records and organizing the family. The female household duties include taking care of children, childbearing, cleaning and cultivating land. Some of the family gender dominated male roles in the households include maintaining cash crop, construction and overall discipline, while family gender dominated female roles in the household include preparing meals, washing and ironing. This agrees with Rogers &Amato, (2000), who argued that although division of household labor has become more equal over time in that men's contribution to housework has increased and women's contribution has decreased. Half of the women leaders' respondents 5 (50%) said the male is given more attention in education while the other half 3 (50%) said both the male and female. This is because children are gifts from God (Fig. 1)

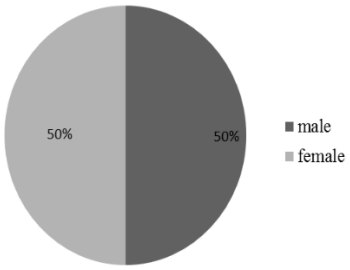

Fig 1. Who is given more attention in education? – Women leaders

All the church leaders 6 (100%) were unanimous that leadership positions in the church are held by males. Explanations for this state of affairs include the fact that the church does not recommend women for senior jobs in the church, the church constitution is gender biased, females tend to shy off from leadership i.e. refer themselves as weaker sex and traditional believes that men should lead in public sections. The main gender challenges church leaders encounter in their leadership, include gender bias in leadership, homosexuality, infidelity, HIV/AIDS and males denied conjugal rights. The strategies that are used to deal with these include group counseling, seminars, group therapies, support groups and family life counseling.

Traditional family gender roles and gender household responsibilities

The study's findings indicate that traditionally it was the male who owns land and title deeds. All the church leaders 6 (100%) said traditionally the male owns land and has possession of title deeds. The males were expected to be community leaders and thus owners of the land. Most of the chiefs 5 (83.3%) indicated that the female should be the one to prepare and serve meals in a traditional family, while 1 (16.7%) said both can prepare and serve meals. Aulette (1994) supports this claim and argues that in the nuclear family, the wife/mother typically assumes the expressive family role which means she does the housework, cares for the children, and ensures that the relational and emotional needs of those within the family are met.

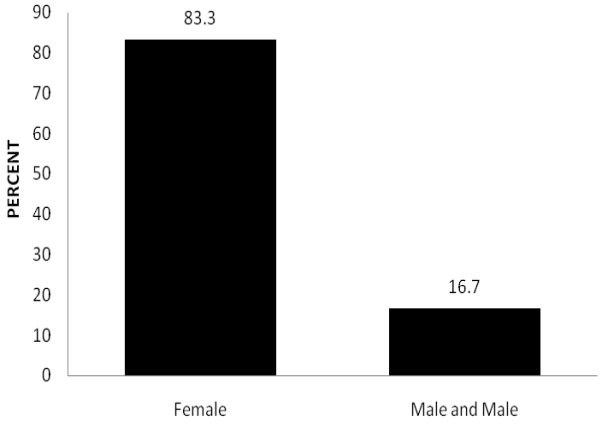

Fig 2. Who should prepare and serve meals in a traditional family?-chiefs

It emerged from the study that most household respondents 55 (56.1%) were of the opinion that it is the male who determines the household budget, 13 (13.3%) said the household budget is determined by the female and 30 (30.6%) said it is determined by the breadwinner (Fig. 3).

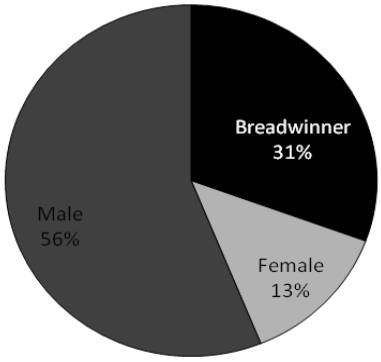

Fig 3. Who determines household budget? -household

The study's findings indicate that the traditional household male barriers, include society's expectation that males are supposed to maintain security in the household, valuing of polygamy, age difference, inability to maintain and sustain a family, uncircumcised limited from mixing with the circumcised, the initiated males cannot stay in their parent's house, some hard tasks are left to male, female oriented duties like cooking and grinding, if one impregnates a girl he was forced to take dowry, lack of finances, inability to select the marriage partners of their own. The other male barriers include societal discouragement of a male marrying a girl from another community, divorce and separation, many sexual partners, sexual crimes e.g. rape, homosexuality and drug abuse. The research revealed that though men are benefiting from patriarchal structures, a majority is caught in a paradoxical and frustrating situation where the male roles are being seriously undermined. On the one hand, men are the acknowledged heads of the households, and they have the formal authority. On the other, lack of employment or low/insufficient income prevents men from fulfilling their expected roles as men, husbands, and in particular as providers of the needs of wife, children and other dependants. In this process, many men have become figure heads of household.

Some of the ways of dealing with traditional male barriers, include encouraging monogamy so as to maintain family cohesion and for the man to be answerable to a single family setup, being free to marry regardless of ethnic group or culture, holding seminars on change from tradition, sensitizing the public on the roles that are expected to be played by either gender to make them more responsible and productive, changing law that discriminates and that allow males to sell family property without consulting females, involving clan members so as to avoid intermarriages, building separate houses for female children to avoid interactions of male parents with their daughters and initiating male children at an early age so as to make their future decisions as early as they can.

Women leaders indicated that some of the traditional female role barriers, include females being forced to early marriages due to poverty, exalted to child labour so as to feed their younger siblings, being taught household chores while still young, lack of powers to give ideas and decisions, lack of self-esteem, traditional practices such as FGM, isolation of females who get pregnant before marriage, particular foodstuffs being restricted to females, style of dressing e.g. wearing trousers, poor education, early pregnancies and abortion.

According to church leaders, ways of dealing with traditional female barriers include, encouraging females to pursue higher education to overcome outdated traditional practices and restrictions, parents advising

their daughters on ways of handling family matters before marriage to reduce family gender conflicts, readdressing historical imbalances to allow women to access to title deeds, males also participating in household chores and seeking guidance from church leaders.

The households' respondents identified modern male gender barriers that they experience in their households to include, irresponsible drinking, poor clothing, severe punishment for males who impregnate girls especially those who are uninitiated, domestic violence, shake hands with in-law, male who are financially unstable feel unwanted and the possibility for a female to leave her husband for another man.

They identified female gender barriers to include polyandry, restriction on wearing trousers, being dismissed from the husband's land or being humiliated by in-laws after the death of a spouse, females being forced to leave their children behind in case of a divorce, females being denied access to land use and ownership, household duties such as cooking and fetching firewood or water being left to females, females being burdened with the household chores, males being given the mandate to give orders to females and head the family, polygamy and early marriages.

Conclusion

The study's findings demonstrate that traditional family gender roles (i.e. household duties, family headship and the control of family budget) have been changing over time among the Chuka community in Meru South District, thereby impacting on the cohesiveness of the family. Based on the findings of the study, the following conclusion are drawn: With regard to objective one of the study, the study found that traditional gender roles existed among the Chuka community and that family transitions have made men and women in Magumoni division to adapt to new gender roles with most women taking to undertake the role of breadwinner in the family as most men were preoccupied with alcohol abuse and engagement in petty trade.

Recommendations

The study's findings indicate that to mitigate the negative impacts on gender household responsibilities and ultimately the cohesiveness of the family household arising from the changes in the traditional family gender roles, counseling and other intervention programmes will have to be put in place.

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World Café Method: The Possibility of Understanding Active Methodologies in Remote Learning

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Abstract

The great challenge in these last decades in education is the growing search for innovative teaching methodologies that enable a pedagogical praxis able to form subjects with ethical, historical, critical, reflective, transformative and humanized profile. The present study stems from the following problematization: what is the contribution of the active teaching methodology called "World Café" in teaching and learning processes, so that it favors teaching innovation in remote learning during the COVID-19 pandemic? In facing this problem, the following objectives were listed: a) understanding the contributions of the World Café Method in teaching and learning process innovation; b) analyze the viability of the World Café Method in remote learning. A quali-quantitative, descriptive and applied methodological strategy is employed, drawing on Barbosa (2013), Berbel (2011), Brown and Isaacs (2007), Minayo (2010), Moran (2014) and Triviños (1987). The data were analyzed using discourse analysis techniques (Bardin, 2016). We conclude that it is possible to use the World Café Method in virtual, remote learning, as it enables the promotion of ideas, discussions, reflections, questions, and engages participants, that is, a collective learning process.

Keywords: active methodologies; World Café Method; remote teaching

1. Introduction

During the last decades, major changes have been observed in several areas of knowledge. The exponential growth of these changes, typical of the globalized world, has also impacted teaching and learning processes, especially in teaching methodological strategies, thus prompting reflection in search of new pedagogical alternatives for the improvement of education in basic and higher education.

It should be noted that the inclusion of information and communication digital technologies (ICDTs) in a traditional, lecture-style classroom does not abate collective student dissatisfaction, as technology alone does not guarantee learning.

Thus it is necessary to switch to other teaching methodologies, which enable to a more dynamic and interactive construction of knowledge, promoting student autonomy, and developing critical sense for each situation addressed in the classroom. Attitudes that provide opportunities for listening to students, valuing their opinions, promoting empathy, answering questions, and boosting self-esteem promote motivation, and create a favorable learning environment (BERBEL, 2011).

Active methodologies come into being in order to largely minimize the learning deficit problem, and move away from a mechanical and often out-of-context lecture-based teaching.

The development of active methodologies for their use in remote teaching during the COVID-19 pandemic prompted the following problematization: how may the Word Café Method contribute to teaching and learning processes, so as to favor teaching innovation in remote learning during the COVID-19 pandemic? In facing this problem, the following objectives were listed: a) understanding the contributions of the World Café Method in teaching and learning process innovation; b) analyze the viability of the World Café Method in remote learning.

Therefore, this paper will initially present the importance of active methodologies in teaching and learning processes, focusing on the World Café Method, its concepts, features and history, as well as the fundamental methodological principles for its applicability. It then comments on the virtual viability of the World Café Method in remote learning during the COVID-19 pandemic, and concludes with the description and analysis of the experience report, that is, the application of the method in remote learning, presenting the results achieved with its use, as well as some suggestions for further application.

2. Active Methodologies in Teaching and Learning Processes

Active methodologies promote student engagement, and stimulate the development of their critical and reflective skills; in addition, their application changes teachers' attitudes, that is, their teaching methods are re-purposed, as they move away from being knowledge safe-keepers, and begin to stimulate students to seek their own knowledge, in addition to guiding them in this search.

According to Freire (2006), active methodology consists of an educational conception that stimulates the constructive processes of action-reflection-action, where students have an active attitude towards their learning in practical situations, by challenging problem-situations, thus stimulating them to research and discover solutions applicable to reality.

Valente (2017, p. 464) claims that active methodologies are characterized by "situations created by the teacher with the intention that the learner has a more active role in their teaching and learning processes". However, for this teaching methodology to become beneficial, it is important that students are truly engaged in this learning process, so that they can "read, write, ask, discuss or be busy solving problems and engaging in projects" (BARBOSA; MOURA, 2013, p.8).

In today's world, there are several types of active teaching methodologies widely used in basic schools and universities, which are centered on students, who cease to be passive subjects, and start to reflect on the contents developed in the school environment.

2.1 The World Café Method: concepts, features and history

The World Café Method was developed by Juanita Brown and David Isaacs in 1995, at an event discussing the strategic dialogue of the "California intellectual property". As it was raining on the occasion, they, as hosts, organized a space that was used for breakfast to welcome a group of 20 participants. The participants were then distributed in various tables, forming groups of four to five members. As discussions unfolded, participants changed places with others, who were sitting at different tables. A greater interaction of ideas was observed with this, a good way to perceive collective intelligence, and thus the World Café Method was created.

This "World Café" developed by Brown and Isaacs (2007) is anchored in the understanding that conversation is the central focus of the process that drives personal and organizational business (WORLD CAFÉ COMMUNITY FOUNDATION, 2015).

Currently, the World Café Method is known not only as a simple method, but also as a research and practice community, easily accessed by people all over the world (BROWN, 2001). Brown asserts that the World Café Method can also be seen as a metaphor, that is, an image that allows understanding of the world as a

shared space, in which everyone must be heard, and have their thoughts and emotions respected, and where dialogue is a necessary part of encountering others.

Brown views the World Café as a provocative metaphor, as the invisible and natural power that conversations have in work groups organized to discuss a situation, in universities or in any other work environment, is often ignored.

2.2 The World Café in Remote Learning during the COVID-19 Pandemic.

The world was devastatingly impacted by the January 30 World Health Organization (WHO) Declaration that the COVID-19 pandemic (SCHMIDT *et al*., 2020) constitutes a Public Health Emergency of International Concern (PHEIC), the highest emergency alert level of the organization, according to the International Health Regulations.

In the face of a pandemic of the new coronavirus (COVID-19), the Ministry of Education (MEC) answered the request made by the Brazilian Association of Higher Education Maintainers (ABMES) and the guidelines of the National Education Council (CNE), and issued ordinance n. 343 of March 17, 2020, which regulates the replacement of face-to-face classes by classes in digital media during the COVID-19 pandemic (BRAZIL, 2020).

With the increasing spread of the virus in the country, educational institutions and teachers complied with MEC recommendations, and closed their dependencies temporarily. However, they were taken by surprise with the suspension of face-to-face learning activities, and the abrupt change to online activities and emergency remote teaching.

This situation of social isolation caused by the COVID-19 pandemic poses great challenges to most teachers, students, families, and basic and higher education institutions.

The main difficulties observed are the lack of technology skills to handle tools such as digital platforms and applications, and the lack of Internet access. In any case, we observe a growing search for technological alternatives that may meet the educational needs of all those involved, as a result of the new teaching model.

Thus, it is hypothesized that the World Café Method may be feasible in remote teaching, but it is necessary to create virtual learning models that incorporate it, and promote collaborative and constructivist environments on the chosen platforms (MONTEIRO; MOREIRA; ALMEIDA, 2012; MOREIRA, 2012; MOREIRA, 2018).

These questions about the applicability of the World Café Method in remote teaching will be answered in the report of an experience with 15 subjects, some of whom were doctoral students in Education and faculty members of a state university in Ceará, Brazil.

3. Methodology

The present study takes a quali-quantitative, descriptive and applied approach, drawing on Barbosa (2013), Berbel (2011), Brown and Isaacs (2007), Minayo (2010), Moran (2014) and Triviños (1987). The data were analyzed using discourse analysis techniques (Bardin, 2016).

A consistent national and international theoretical review in specialized literature, in printed and digital formats, was undertaken, especially concerning models, methods and innovative technologies in the field

of education. A previous research was conducted in the main paper repositories, such as Scielo and CAPES Directory.

The participants of this research were 15 professors, some of whom were doctoral students in Education of a state university in Ceará, Brazil, and faculty members of same institution. The duration of the activity was approximately two hours. The choice of the participants was not random, but motivated for two reasons: the specificity of their profile as education professionals, whose knowledge, perceptions and feedback would be qualitatively differentiated and necessary to the objectives of this research, as well as the convenience for carrying out this activity, as it was performed during an Active Methodologies in Education class.

The research was conducted in a virtual environment, with the use of Google Meet software, which offers communication services for desktop and mobile platforms, and can be used as digital educational technology. Such an alternative has proved to be indispensable in the current pandemic context, which the world and education are facing, given the pressing needs of social distance necessary for public health.

The dynamics of the experiment with the participants followed the rules and protocols of the active methodology chosen to conduct the activities, that is, the World Café, allied with the 5W2H metacognitive method, having as main theme and trigger "active methodologies in the context of teaching and learning". Data was collected at the end of the research experiment (pedagogical workshop), by means of a digital Google Forms questionnaire, applied to all participants.

Qualitative analysis of the collected data used Bardin's content analysis method, which comprises a list of communication analysis techniques, thus conferring greater rigor to the process of content investigation, and protecting the researcher so as not to be confused by the possible heterogeneity of ideas and contents detached from the research object (BARDIN, 2016).

Qualitatively relevant data were analyzed by elementary statistical analysis. Data normality was analyzed using the Shapiro-Wilk Test. The Mann-Whtiney test was performed to assess whether there was a statistically significant difference between the groups. For data analysis, the GraphPad Prism software, version 6.0 (GraphPad Software Inc., La Jolla, CA, USA), was used. Data showing $p < 0.05$ were considered statistically significant.

Based on this volume of data, a quali-quantitive analysis was conducted that produced the results discussed in the following session.

4. Results and Discussion

The challenge was to think of the virtual application of the World Café Method, providing the participants with theoretical and practical support regarding the importance of using a technique, so it may contribute to teaching innovation, and provoke reflections on proposing strategies that collaboratively favor the construction of knowledge, through conversations based on horizontality.

In addition, the applicability of the technique, as well as its success, were verified in a previous work carried out by the same mediators in a workshop held in January 2020 at the "Congresso Internacional de Ensino e Formação Docente" [International Teaching and Teacher Training Congress] held in Redenção, Ceará, which culminated in the publication of a paper entitled: "*World Café*: metodologia ativa para a

compreensão da Política Nacional de Educação Especial na perspectiva da educação inclusiva" [World Café: Active Methodology for the Comprehension of the National Policy of Special Education in the Perspective of Inclusive Education] (OZÓRIO *et al*, 2020). However, the current proposal differs in that the present one is based on a virtual environment.

The idea was to remotely execute the activity, by means of digital educational technologies, due to the current context, as, according to Bacich and Moran (2018, P. 53), "today, the combination of active methodologies with mobile digital technologies is strategic for pedagogical innovation".

It is important to note that we did not find records of the use of this technique as here proposed, that is, applied in a virtual environment, so it may be considered innovative. However, it should be noted that everyone has the capacity to innovate, but it should be taken into account that: "innovation involves two fundamental elements: creativity and the production of new ideas, which must be able to be implemented and generate impact"(CAMARGO, DAROS, 2018, p.29).

The workshop was held by a synchronous communication service, which "requires all participants to engage at the same time, but not necessarily in the same place" (BATES, 2017, p.264). Four virtual rooms were created (room 01, room 02, room 03, room 04) so that, after the mediators had introduced the theme, the 15 participants could move among these rooms. Thus, each room had an average of four participants, one of which was elected as secretary/host by the group members themselves. The overall theme was "active methodologies"; other sub-themes were: 1. Definition, features and types of active methodologies; 2. Benefits obtained from the use of active methodologies; 3. Difficulties encountered in the implementation of active methodologies; 4. Possible uses of active methodologies in remote teaching.

Each group was responsible for discussing one sub-theme, always starting from the exploratory questions prepared in advance by the mediators, according to each theme.

It should be noted that, for the elaboration of these questions, the "5W2H" technique was used, in which a certain theme is mapped onto 7 essential questions: what?, when?, where?, why?, who?, how?, how much impact? (PAIM, 2016). After approximately 10 minutes, participants should move to the next room, where they would discuss new questions. Thus everyone would go through all the proposed themes. However, only secretaries/hosts would not move. They would systematize what was discussed by taking notes, which would later be presented to the whole class, in order to share the discussions in all groups.

Thus, we would allow the general context to be discussed, instigating, guiding and mediating groups during discussions. We would realize the wealth and connections that would arise. At the end, after all the room-switching participants had joined all rooms, the original groups would rejoin in room 01 (the main room), where the secretaries would present their notes, which would synthesize the knowledge on the sub-themes. This final moment was called "harvest".

To enrich the discussion, bringing contributions and raising the debate, the participants were previously instrumentalized, by e-mail, with papers and books on active methodologies, so they may improve their knowledge on the subject, thus enriching discussions. This action refers to the inverted classroom, in which: "the basic information about a topic or problem can be searched by students so they may acquaint themselves therewith, starting from previous knowledge, and expanding them with references given by the teacher (curation)" (BACICH, MORAN, 2018, P.55).

In order to evaluate the use of the World Café Method with the 15 participants, we developed a questionnaire with the following questions: "Concerning the World café Method applied virtually, were the exposition and the goals clear? Justify your answer." Participants were unanimous (100% of answers) in stating that they had understood how the method was applied, as well as the goals to be fulfilled. However, there were some caveats, such a need to improve room-switching management, for clearer and firmer guidelines regarding the use of microphones, as well as a fuller grasp of the chosen application.

It is noticed that the goal of promoting engagement, motivation and responsibility, creating conditions for a more active participation of the members was achieved, however, according to the above, the teacher conducting the technique needs to master digital technologies so as to achieve success in the execution of the activity. As Moran (2004, p. 2) rightly states: "technologies are only support, a means. But they allow us to carry out learning activities in different ways than before. We can learn by being together in distant places, without having to always be together in a room for this to happen."

When asked about whether they perceived a favorable environment for the debate of ideas, even in a virtual way, most participants agreed. The answers obtained were the following:

> Yes. The only thing that was missing was a small adjustment regarding the use of the technological tool adopted when planning the execution of the activity. (Participant 1)
>
> Yes, ideas are exchanges between participants, and I think we feel even more comfortable and relaxed virtually than in person. (Participant 5)
>
> Yes, it is totally possible, but Meet should be better used, as it allows you to change rooms without interference among them. The initiative was extremely relevant, but adjustments are necessary. (Participant 7)

We may infer from the responses of the participants that active methodologies are indeed applicable in virtual environments, because there was a connection of ideas; in addition, the relaxed and informal environment allowed them to engage, generating a collective pollination of learning.

Regarding the feasibility of participation of all members with the World Café Method, it was noticed that, as in the previous question, the majority admitted that the technique allows the participation of all, and also presented some suggestions:

> Yes, because it involved collaborative learning through interaction between the smaller groups and the larger group. (Participant 4).
>
> Yes, even if the division into groups was not as planned, each group managed to discuss the question it was assigned; unfortunately, it was not possible to present each small group's answers to the big group, so that we could debate each group's opinion. (Participant 5).
>
> It does allow us to participate, but room coordinators need clearer roles; I think there could be one coordinator, controlling time and room dynamics, and one secretary, focused on how the debate is unfolding, and how concepts are being built. (Participant 7)

The above reports show that, as an active methodology, the World Café Method allows for the transformation of the teaching and learning method, in which the classroom dynamics (whether virtual or not) is reconfigured, that is, students and teachers take up other roles, so that students becomes more active, autonomous and engaged in their learning process, as well as, "creative, critical, collaborative, able to work

in groups and solve real problems. Active learning methodologies are developed in this context as a necessary alternative to this end" (CAMARGO, DAROS, 2018, p. 29).

Regarding the difficulties perceived in the use of the World Café Method, we obtained the following answers:

> It [the World Café Method] is still new to this environment. Training, feedback and pointers will put these difficulties behind. (Participant 2).
>
> I thought it was very good, but I felt a certain insecurity in the use of the Google Meet tool, because speaking on the microphone and group productivity were a little confusing. Given it was the first time, I think it was good. (Participant 7).
>
> Organization in smaller groups. It would be interesting going to the smaller group having chosen a leader, so as to better direct it. (Participant 10).

It is clear from the above answers that one of the factors that contributes considerably to the success of this activity in a virtual environment is the preparation of mediator-teachers regarding their grasp of digital technologies. It corroborates the studies of Bacich and Moran, when they state that: "students who are, today, inserted in formal education systems require from their teachers didactic and methodological skills for which they have not been and are not being prepared" (BACICH, MORAN, 2018, p. 16).

Participants were asked to score traditional teaching compared to teaching using the World Café Method. Their answers are represented the table below:

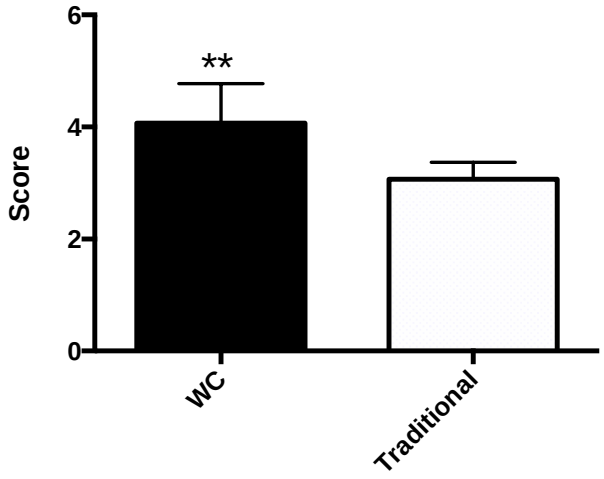

Table 1. World Cafe Method (WC) perception assessment compared to traditional teaching. Values were expressed as mean ± SEM. For statistical analysis, Mann-Whitney test was used, where $p < 0.05$ vs Traditional group.

It was observed that there is a statistically significant difference between the perceptions of teaching with the World Café Method (WC) when compared with the traditional group (p <0.05), that is, students perceive better learning with WC online when compared with traditional teaching.

When asked about the importance of active methodologies for contemporary education, the answers were directed to the promotion of significant learning by Ausubel (1963): "especially in the promotion of significant, contextualized, critical and reflective learning, corroborating for the development of skills

and competencies required by the scenario of educational and social technological advances of the XXI century" (Participant 2).

Participants also mentioned metacognitive aspects, of which Flavell (1979) presents two constituents: the knowledge of one's own knowledge and the regulation of this knowledge. We highlight metacognition as a learning strategy, reflecting the autonomy and reflection of the action of learning, in a construction of autonomy, which refers to the work of Paulo Freire (1996). In this regard, the observation of Participant 8 stands out:

> Being well conducted and planned, it is a very rich and highly knowledge-fostering strategy. Learning by doing and understanding that I can build concepts from my own ability to interact with the environment, with other people and with my vital knowledge, makes learning much more meaningful and transformative of my reality. In education, as a practice of freedom, as claimed by Paul Freire and for Engels, "a gram of action equals a ton of theory". (Participant 8)

Teacher training was also taken into account, as working with active methodologies requires better preparation: "contemporary education needs well-trained teachers and the availability of basic resources in the classrooms. Innovating is of no use if we don't have a well-trained teacher" (Participant 10). For Bates (2017), society expects teachers who are trained to deal with rapidly evolving technologies, but, in general, teachers or teaching instructors have little or no training for this.

With regard to the use of technology to support social distancing-driven e-learning, the use of active methodologies associated to technologies, both co-operating to increase learner motivation and interest, was questioned, with particular reference to the following question: "Using interactive and ludic softwares, such as games, provided their use is pedagogically motivated, as well as the possibility of constant feedback on the part of the teachers by synchronous communication […]" (Participant 2). Therefore, pedagogical intentionality is one of the items pointed to good class planning with active methodologies.

On the challenges teachers currently face to arouse students' interest in class, we note the following answer:

> Currently, we face a big challenge in teaching, initially having students pay attention and focus in class, especially in basic education, as the teacher must compete with the alluring effects of technological tools. In my point of view, in order for teachers to achieve their real goal, they must adhere to the use of these technologies, also applying active methodologies, as resources allied to learning. I think this is a way to achieve student learning. (Participant 13)

According to Bates (2017), in the digital age there are much more interesting ways to teach, which will result in better learning along the course or program, such as classes that involve students, causing them to actively participate.

Finally, we questioned about the main difficulties encountered by teachers in their daily lives regarding the use of active methodologies, and obtained the following answer:

> Lack of interest and prejudice towards the methodology; 2) lack of mastery of the methodology; 3) lack of creativity and willingness to change their practices; 4) lack of time, as working with active methodologies requires a much longer time of planning and execution… The convenience

> many teachers find in passively transferring knowledge is still the biggest challenge of today's education. (Teacher 1)

A more centralizing teacher with a more traditional take on teaching embodies the above obstacles, but, faced with training that contemplates student needs, and champions various teaching perspectives centered around social objectives, this same teacher can arouse the desire to learn in students, but through the knowledge of students' lives (BATES, 2017).

Other points presented by the participants concern limiting beliefs, tradition-centered pedagogy, infrastructure and teacher training:

> First of all, there are limiting beliefs that active methodologies are for lazy teachers who do little "role plays" to deceive students; there is also a great challenge in fostering a culture of innovation among teachers, because it is not an easy task to get them out of their comfort zones; I use free apps in graduate courses, as universities do not purchase them, because they see them as a cost, not as an investment. Tradition-centered school management wants to provide quality education, but there are still many infrastructure and financial difficulties, while undergraduate faculty members often lack teacher training, and act empirically. In short, teachers and teaching institutions, from basic education to graduate programs, should invest on a new culture of digital literacy, because there is no turning back, taking advantage of what is good, in each of the pedagogical trends. (Teacher 8)

According to the above, maximum action-reflection and action must be present in teaching and learning; we therefore agree with Bates: "teachers who not only know a wide variety of teaching methods, but also theories of learning and their epistemological foundations are in a much better position to make right decisions about how to teach in a particular context" (BATES, 2017, p. 149).

> I believe that there is lack of training fit to teachers' realities. For example, hybrid teaching only works if digital technologies such as the Internet are available for the student both in the classroom and at home. If my student does not have Internet at home, it becomes pointless to talk about hybrid teaching, and so on. We need to talk about training that indeed meets the reality of teachers who work in basic education, especially in public schools, which, as we know, do not meet students' basic needs. (Teacher 10)
>
> Given this, I can say that the greatest difficulties may be beyond teacher training, both in terms of use of technologies and knowledge and appropriation of methodologies, and in terms of access of basic education students to technological resources. (Participant 13)

The answers obtained in the workshop lead to the consideration that there is a long way to go before classrooms become more active learning environments, however, some skills need to be part of the training and daily teaching practices: "conceptual skills, such as knowledge management, critical thinking, analysis, synthesis, problem solving, creativity and innovation" (BATES, 2017, p.151).

Several strongpoints and learning challenges based on active methodologies were observed in this workshop using the World Café Method. It was noticed that the difficulties with face-to-face or remote teaching bring in themselves the same challenging situations, however:

> By mastering and providing the new means, teachers reinvent their practice day after day, and assume a new attitude towards knowledge and learning; they cease to be knowledge safekeepers

> to become facilitators and mediators of the teaching and learning process. In this change, care is needed, because technological evolution requires more creativity, and focuses mediation on the teacher, who has the possibility to develop students' critical thinking, helping them to select information, building new knowledge in a significant way. (FRANCO, 2016, p.14)

It may be said that, whether face-to-face or remote, the big difference lies in how the learning process is conducted, demanding intentionality and a good grasp of the method and medium used for pedagogical purposes, that is, in both contexts, active learning happens if well conducted. There must be investment in teacher training, so they may work with these tools and use various resources, thus expanding their repertoire of work materials, and understanding that these more flexible models are the ones that can be used in this moment of social distancing, meeting the needs of their students, who are active in this digital age.

5. Final Remarks

The use of active teaching methodologies provides an opportunity for dynamic and interactive action, which develops autonomy in the subject in a critical and reflexive way, with the teacher as a mediating agent of this process. In this perspective, the active teaching methodology World Café was the object of study of this investigation. Its use gave the teacher a more dynamic, welcoming and reflective look at teaching and learning, especially when used in a virtual environment, that is, during remote teaching, in which this pedagogical strategy has become a challenging and productive action.

The use of the World Café Method was found to provide participants and mediators with theoretical and practical contributions in teaching and learning, triggering reflections on the collaborative construction and structuring of knowledge, awareness, motivation, and responsibility, creating the conditions for a more active participation of the subjects involved in this proposal.

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Decoloniality and University Management: Unveiling Knowledge in Managerial Narratives

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ABSTRACT

The research analyzes critical this points on talk twenty-one managers of a Federal University, dedicated to the Cooperation International Solidarity, having as theoretical support the South Epistemologies Project, which includes the Interceptor translation ultural and ecology of knowledge, and the Academic Dependency. By means of the speeches Critical Analysis examines four themes and two developments. The themes: "Novelt " and Symbolic Power , unfolding from the perspective of organizational identity, adhesion and participation of its members; Academic training of students and the training of employees , including the perspective of training; Integration, Mobility, Excellence and Internationalization ; Research and Circulation of Knowledge, unfolding in the configuration of Knowledge, Experiences and Knowledge. Some questions are conclusive: a set of arguments that intend the vision of science, within its Eurocentric aspect, institutionalized and reproduced in academic dependence; the affirmation of interculturality as a power, which manifests itself in the exclusion of difference; the significance that the Institution assumes and that propagates as power struggles; identity fragmentation, in the context of managerial actions; and

in the "struggle" "decolonial", which addresses the confrontation of multiple knowledge in the conformation of "other" possibilities of social life.

Keywords: Epistemologies of the South. Academic Dependence. Interculturality. Interculture translation.

Introduction

The University institution is the subject of the most varied discussions, while historically it is called upon to establish close relations with society, at the same time that it is required to constantly change, due to university reforms (ALMEIDA FILHO, 2007; MARTINS, 2012; MENEGHEL; NOGUEIRA; VIEIRA, 2017). In this reality, it is very concerned about the future and how the university can reconstitute itself in the face of a commitment to social groups, in the face of urgent problems such as, for example, poverty, discrimination, social exclusion and unemployment. The analyzes, however, comprise internal points, without clea propositions that affirm their commitment to society (MELLO et al., 2015), with social relevance (SPATTI; SERAFIM; BRITO DIAS, 2016).

Bringing the discussion to the way and production of the capitalist system, there is knowledge produced in international ranks function when excellence is achieved by productivity and service of economic interests (MENEGHEL; AMARAL, 2016), associated with the idea of "services" that accentuates the commercialization of higher education (PÉREZ; SOLANAS, 2015; SGUISSARDI, 2015). In this case, the importance that academic productivity has assumed in this system is evidente (RASMUSSEN, 2015).

Within the scope of the Southern Epistemologies Project, central to the research by Boaventura de Sousa Santos (BONET, 2010), it is understood that the knowledge conveyed from the market perspective, reflects a hegemonic Eurocentric model of knowledge produced from the North, imported by universities in the South globally, those that have a history of colonization processes (GAÑAS; GALLEGO, 2016). And import entails problematic consequences with regard to the coloniality of knowledge (within the academic dependence and intellectual) (Dussel, 2016; LANDER, 2005; MIGNOLO, 2014; QUIJANO, 2009) and be (within the ontological dependence) (ALATAS, 2003), as an expression of a "[...] colonial matrix or pattern of power [...] that justifies the violence of coloniality" (MGNOLO, 2017, p. 13).

In the discussion of Southern Epistemologies in the university field, the idea of crises in the university (hegemony, legitimacy and institutionality) is used, associating them with challenges of modern science in the context of the expansion of society that is affirmed under economic regulation (SANTOS, 2010). Specifically, in the projection of this study, the hegemony crisis is considered, when the academy is questioned as the only institution capable of giving rise to knowledge, because it fails to equate contradictory, classic (elitist) and emerging (popular/workforce) functions. The crisis of hegemony, therefore, entails criticism of the very conception of knowledge and social function of this (SANTOS, 2010).

In the defense that university management represents a specific field of study and intervention of organizational theory (SANDER, 2007), it is argued that universities have typical characteristics that differentiate them from other social organizations (SOLINO, 1996). This argument is opposed to the idea

that the concept of organization assumes generalized formulas, available to any institutional configuration (GARCIA; CARLOTTO, 2013). Thus, university management is considered an area of study in the scope of Social Sciences, supported by an interdisciplinary investigation and which occupies a position between the field of Administration and that of Education (COLOSSI, 2015).

With this, this research deepens the analysis, by delineating the Southern Epistemologies Project, which is a reference to support a new idea of knowledge in consideration of differences, diversity and social practices (MOZZATO; GRZYBOVSKI, 2013). From these arguments, university management is discussed from the perspective of decoloniality, as an alternative epistemological conception that understands the multidimensionality of human beings and social systems (as a critique of economic instrumentality). An attentive management for interculturality at the university level (CORTÉS; DIETZ; ZUANY, 2016),debates about a "decolonial" university (REYES, 2013).

Thus, the research aims to analyze critical points presente in Barney RSOs managers of a Federal University, dedicated to the International Partnership for Development. In this way, the discussion situates university management, based on the narratives of its managers in interaction with a proposal for management within the horizon of "[...] realizing the commitment to the relevance and social relevance based on the innovation and boldness inherent to the solidarity cooperation" (MENEGHEL; NOGUEIRA; VIEIRA, 2017, p. 34).

Southern Epistemologies Project : From Ecology of Knowledge to Intercultural Translation

The emerging discourse on the epistemological field in the social sciences inserts cultural disputes and counter-hegemonic battles with a focus on emancipation, independence, autonomy and liberation (GIURLEO, 2014). Boaventura de Sousa Santos is a reference in this field, as he demarcates a critical-emancipatory proposal from the perspective of reinventing social emancipation (BONET, 2010). The Epistemologies of the South Project is the result of the trajectory of the author who, since 1960, has made academically transgressive efforts, when many of his theoretical proposals take on modalities of action strategies (BONET, 2010), in the possibility of unveiling the frameworks of domination of Western modernity (SALATINO, 2014).

In recent years, however, there has been a growing concern about the limited capacity to adequately address issues of power, race and coloniality on the part of science with a Eurocentric tradition (BHAMBRA, 2014). In this movement, the concept of the "South" is expressed in dispute. In addition to the good fortune of Sousa Santos, Raewyn Connel emerges with theoretical notions about this concept (ROSA, 2014). The first associates "epistemologies of the south" with the rupture of the abyssal logic, around lines that demarcate valid knowledge of knowledge not considered by modern science, which is linked to the achievement of a project of capitalist society. The second focuses its debate not on epistemologies, but on sociologies produced outside Europe. In this case, it argues about the need for theoretical consideration in relation to what is produced in the south.

The "South" project, still, brings together a heterogeneous group of researchers, with different focuses of analysis, which still makes it a subject in dispute and with elements not yet stabilized, a fact that

gives rise to a challenge about the concrete difficulty of gathering different knowledge and certify it academically (ROSA, 2014). In this way, it is considered a concept under development, as it represents a movement of colonial liberation from an oppressive system, being critical to globalization and its consequences (MENEGHEL; AMARAL, 2016).

The "Epistemologies of the South" concept questions Eurocentrism, not only in a geographical perspective (from a "knowledge" that is done outside Europe). Post-coloniality, in turn, centralizes criticisms of modern rationality and its implications for the denial of the diversity of knowledge (MENESES, 2013). The new moment expands the attention of peripheral cultures, seeks to expand the history of the world and calls for intercultural and symmetrical dialogue, between southern researchers (DUSSEL, 2016). Underlying this challenge is the recognition of the exhaustion of the intellectual and political model that has sought to impose itself as global in the last centuries (MÁRQUEZ-FERNÁNDEZ, 2012).

With the post-colonialist panorama, it is argued in favor of a transition paradigm, in the proposal of an epistemic "decolonization" (MIGNOLO, 2017). The transition places the perplexity of the problems arising from the Euro-American domination model, a direct, political, social and cultural domination, which greatly violated the peoples of Latin America and Africa (QUIJANO, 2009). The transition also brings a new perspective of knowledge that, operated in terms of a Southern Epistemology, is moving towards emancipation, by transforming people into social agents with respect for their knowledge, cultures and social practices.

As a path to emancipation, Santos (2002) defines the recognition of the other as an agent of relevant social practices based on solidary reason, in the perspective of overcoming the colonial logic based on hegemonic knowledge. Knowledge-emancipation, in this case, assumes the ecology of knowledge as an epistemological change, considering modern scientific knowledge as necessary and important, but calls for other knowledge for a dialogue that enhances sustainable and dynamic interactions of social agents (SANTOS, 2007a, 2007b).

Because it originates from the principle that the world is epistemologically diverse, defined by the search for a horizontal dialogue, the ecology of knowledge brings unintelligible social experiences and practices (through modern discourse) into intelligible ones (through ecological discourse) (SANTOS, 2007a, 2007b). With this, it becomes possible to establish futures through a political act, which converges scientific analysis with utopian thinking, considering that alternatives are considered based on people's creativity in overcoming their social problems (SANTOS, 1999).

The ecology of knowledges is configured as an essential dialogic exercise for the Epistemologies of the South project. Thus, this idea is confronted with the following demand: a) how to promote dialogue between social agents that have different cultural, social and political bases? The idea of intercultural translation seeks to answer this question.

The innovative step of intercultural translation comes from the need to establish emancipation with a mainstay in a new relationship between respect for equality and the principle of recognition of difference, and, through modern thinking, the principle of equality is discussed, not that of difference. (SANTOS, 2007b). In this sense, intercultural translation acts as "[...] epistemological support for emancipatory practices" (SANTOS, 2002, p. 206).

Thus, through intercultural translation, it becomes possible to make understandable knowledge and practices silenced by modern logic. With that, there is talk of transposing the abyssal logic, in the idea that the knowledge and practices of the north (in the perspective of modern science) and those of the south can dialogue and produce other knowledge, which are closer to the concrete demands of the people involved in this production (SANTOS; ARAÚJO; BAUMGARTEN, 2016).

The Epistemologies of the South project represents a set of proposals articulated to confront coloniality. The Project reflects a post-colonialist thinking and, therefore, its conduct needs to cultivate a "decolonial" sociological imagination (SAVRANSKY, 2017), in the perspective of recognizing that there is no cognitive justice without existential justice and this is marked by the constitution of possible futures with preservation of the intellectual heritage of the peoples of the "Global South" (TILLEY, 2017).

The limits of the project, however, meet the institutionalization processes of modern science, in this case, at the university, which, for assuming a millennial *modus operandi*, receives bureaucratic and hierarchical organizational-administrative structures (SOLINO, 1996). Academic dependence deserves particular consideration, since it generates not only obstacles to the practice of intercultural translation, but also poses concrete obstacles to university management.

Epistemologies of the South and University: the challenge of academic dependence

Thinking about the development of society from a post-colonial perspective gives the project Epistemologies of the South the need for new theories and scientific interpretations (MÁRQUEZ-FERNÁNDEZ, 2012), which discuss the primacy of technical-instrumental approaches from the perspective of academic colonialism (ALATAS, 2006; MOTA DÍAZ, 2016), as well as political actions to institutionalize other modalities of knowledge through the problematization of academic domination (SALATINO, 2014).

The project also brings to the debate the epistemological trajectory that gave science, in its modern version, the requirements for the validity of knowledge supported by an institutional range (universities, research centers, journals, for example) that made the dialogue between science unfeasible and other knowledge (SANTOS; MENESES, 2009). Being, so it is beneficial to design the speech and academic practices are problematized and provide conversational spaces and community debate, critical, creative and meetings promoter (MENESES, 2013), even before tensions and asymmetries, experienced in these spaces (GIURLEO, 2014).

In the conception of Dussel (2016), the institutionalization of these places, in the perspective of an intercultural dialogue, favors the encounter of "critics from the periphery" between continents, between realities of the "Global South", given the fact that recognizing the problems themselves of the south-south reality, in networks for discussion, activates the affirmation of these subjects. Indeed, the dialogue between scholars is questioned, marked by academic domination, oppressive fundamentalisms and teleological certainties, in order to open spaces for the multiple experiences and voices that weave the complexity of societies (MENESES, 2013). Therefore, new concepts are discussed as urgent, other readings of the world, capable of problematizing the management of society, of higher education institutions (SALATINO, 2014), as well as Administration's own theorizing (JUNCKLAUS; BINI; MORETTO NETO, 2016).

Salatiano (2014), in this way, warns about the challenge of the Southern Epistemology Project and contextualizes academic dependence as a field of research in development, representing an important concern in the last decade (BEIGEL, 2016). The theme advances as it emphasizes an aspect of colonialism that had not been explored in the 1960s, when concerns were analyzed in terms of domination / dependence in the economic, political and social spheres (BEIGEL, 2014a).

Intellectual dependence, which spreads in academic dependency, gained great expression in the 1970s. In the social field, movements took on demands for equality and access to social and political rights, when unemployment, social inequality and the awareness of exclusion increased and social discrimination (GUIRALDELLI, 2014; NUNES, 2014). In the Brazilian reality, and in countries in Latin America, "altermundista" or "transnational" movements, rural and urban, took on democratic struggles to slow the advance of globalization, whose expansion put the destruction of local cultures in danger (GOHN, 2011).

These movements echoed in the debate on intellectual dependence over the centuries, when the coloniality of knowledge took shape in works such as those by Edgard Lander and Aníbal Quijano (BEIGEL, 2016); now, no longer limited to national realities, but facing a global phenomenon of exclusion, violence and denial of peoples and cultures, affected in regions that have undergone colonization processes.

In the perception of Salatino (2014), intercultural translation brings problematic elements of analysis in the face of academic dependence and the institutionalization of other knowledge and regulation of their practices, since producing reciprocal intelligibility has political implications, they are institutional arrangements that impose resistance to the legitimation of others knowledge, practices and their agents. The author asks: who is the historical agent? Intellectual representative of a social group or an intellectual who lends skills in favor of a social group? How is a cosmopolitan intellectual chosen and legitimized?

In this perspective, Salatino (2014) points out that it is the public authorities (universities, ministries responsible for education, science and technology, among other public spaces) that need to reflect the perpetuation of colonialism and grant global vision to alternative projects through practices and academic policies that give rise to influences, surpassing a mere rhetorical culturalism.

In the tension manifested by the competitive disputes over knowledge within universities, corporations and nations (SUBRAMANIAM; PERRUCCI; WHITLOCK, 2014), the institutionalization of academic dependence proves to be a difficult problem to overcome. Thus, the theme denotes a tension between intercultural translation and the institutionalization of centuries of oppression, which may, on the one hand, raise the question of who has greater scientific capital and, with that, provide new resistance structures (BEIGEL, 2013).

Some strategies for coping with academic dependence are designed by Connell (2012). From the affirmation of national traditions, recognition of indigenous knowledge denied by the hegemony of the Metropolis, post-colonial criticism of European thought and legitimizing alternative theories, when considering approaches conceived outside European and United States traditions. The latter is a reflection of the social sciences' "indigenization" movement (NDLOVU, 2017), spread after the 1980s, like theorists such as Syed Hussien Alatas, Syed Farid Alatas and Alberto Guerreiro Ramos, considered representatives of alternative theories, Southern theorists (BHAMBRA, 2014; ROSA, 2014).

Alatas (2010) defends the argument that these speeches no longer dualize Eurocentrism and Orientalism, or advanced/ civilized and backward/ barbaric, because the current debate revolves around the

recognition of non-Western thinkers, conceptions and theories. Alternatives are "[...] those speeches informed by *historical experiences and native cultural practices*, in the same way that the Western social sciences are" (ALATAS, 2010, p. 230, emphasis added). It is with this reading that Alatas (2010, p. 230, emphasis added) defines academic dependence, the idea that "[...] *there is little work oriented towards the constitution of alternative theories and concepts*, *while there is much discussion about the need for such alternatives".*

From this perspective, social sciences in intellectually dependent societies are subordinate to thought and research molded in Western institutions (possibilities of publications, internationalization and obtaining resources), based on a system of scientific-academic publication and recognition, supported by three principles: institutional development, discipline and English proficiency (ALATAS, 2003; BEIGEL, 2014b).

With this, universities located in countries considered peripheral, for example, define agendas, research problems, working methods according to standards imported from centers of excellence. Thus, the "location" of the theory in the south, for example, is not a sufficient condition to face the problem - it is necessary to reflect on the theoretical elaboration itself. In this case, "*The forms of work that constitute and direct the knowledge production process are concentrated mainly in elite institutions in the global North*" (CONNELL, 2012, p. 11, emphasis added). The metropolis produces theory (including methodology) and the development of applications that are later exported to the periphery (CONNELL, 2013). These divisions imply academic functions that perpetuate academic colonialism (ALATAS, 2003).

Indeed, within the scope of this dependency, are the trips of peripheral intellectuals to obtain advanced knowledge in the metropolises, with the premise of publishing in their *journals* and "joining the *invisible colleges*" (CONNELL, 2012, p. 11). These are consolidated by the neoliberal governance of universities, concerned with the competitive position in international ranks (CONNELL, 2012, p. 11). In such a way, the dependence on ideas follows that of technology and support for research and teaching, at the same time that there is a dependence on investments in education and the skill of Third World scientists who have mastery of "science of excellence" (ALATAS, 2003, 2010). In this case, there is a psychological problem, mentioned by Alatas (2015), as a captive mind, and the structural constraints within which it occurs.

The financial dependence has confluence with the competition for money and rewards, reflecting on a social closing (competition and competition) and an intellectual closing (prestige and access to more resources) (SUBRAMANAMI; PERRUCCI; Whitlock, 2014), affect ing the perception that everyone is part of the system (PATRUS; DANTAS; SHIGAKI, 2015).

The dependence on recognition is manifested in the effort to follow international ranking protocols, in search of reputation and circulation of knowledge (BEIGEL, 2014a, 2014b, 2016). The consequences of this type of dependency include low involvement with local magazines and the underdevelopment of social scientific discourse in local languages (ALATAS, 2015).

These points raise Beigel's reflection (2013, p. 76-77) before the tension of "[...] publishing globally and appearing locally *versus* appearing globally and publishing locally", when "[...] publication count and patent, citation rates, impact factors of the journals, ranking by peers are among the sober devices to make the production of university research measurable and then auditable"(CONNELL, 2017, p. 88).

With regard to management, smart indicators seek levels of excellence, whether counting the number of publications and citations, or identifying which of them are in high impact magazines, considering that jobs and survival depend on this mechanism (HALFFMAN; RADDER, 2015). And, thus, the competitiveness indicates that those who do not reach the score remain marked as minors and, thus, with this illusion of excellence, the knowledge that reproduces the circuit propagates (HALFFMAN; RADDER, 2015).

Academic dependence, therefore, is an expression of that of intellectual content, and some of its consequences (dependence on resources, division of academic work, academic circulation, theorization process) impose an important challenge on the Southern Epistemologies Project. If academic dependency manifests a great challenge to international solidarity cooperation, it is suggested that opening spaces for intercultural dialogues supported by alternative theories can bring out subjects, their peculiarities, knowledge, practices and potential.

Methodology

The research analyzes twenty-one interviews with managers of a Federal University, dedicated to International Solidarity Cooperation, totaling 11 hours, 55 minutes and 42 seconds of transcribed audio. The Vice-Rectory, the Implementation Commission and the Academic Advisory are represented in the narratives; the **Pro-Rectories** 1. of Planning, 2. of International Relations, 3. International Relations, 4. of Graduation, 5. of Research and Graduate Studies, 6. Extension, Art and Culture, 7. Of Affirmative and Student Policies; The **coordinations** 1. Planning, 2. Education, 3. Policy and Access and Student Selection, 4. Logistics, 5. Personnel Management, 6. Affirmative policies, 7. National and International Cooperation; The **Institutes** 1. of Health Sciences, 2. of Engineering and Sustainable Development; The 1. Regulatory, Institutional and Evaluation **Directorates**; 2. Open and Distance Education, 3. Information Technology, 4. Library System.

All analyzes mischaracterize the direct relationship between speech and interviewed the exercise sought to equate the critical mediation of research with protection of respondents. The signing of the Live and Informed Consent Term was also required, as well as the recording of the interviews was made available, forwarded to the interviewees who showed interest.

For the interpretation of the interviews, the Critical Discourse Analysis (ACD) was chosen, which is based on critical studies of language (speeches, discourse genres, text, ideology and power), inserted in a proposal of Social Discourse Theory (TSD), inspired by Foucault, Althusser, Giddens, Pierre Bourdieu, Gramsci and Roy Bhaskar (MAGALHÃES, 2001). It is believed that, when the speeches are unveiled, the power of change opens up, through the reflection they can provide, which derives from the logic of the ACD in the sense of reflecting on possible overcoming of impasse, with the design of solutions (FAIRCLOUGH, 2001, 2005).

The ACD is enriching in the scope of the exam, given its attention to the texts in the search to understand how to say, what is said, in what context it is said, and, still, what is not said. The ACD moves towards problematizing speeches that emerge within the scope of management, considering that a given

semiotic diversity can behave hegemonic due to the naturalized legitimation that sustains domination relations (FAIRCLOUGH; MELO, 2012).

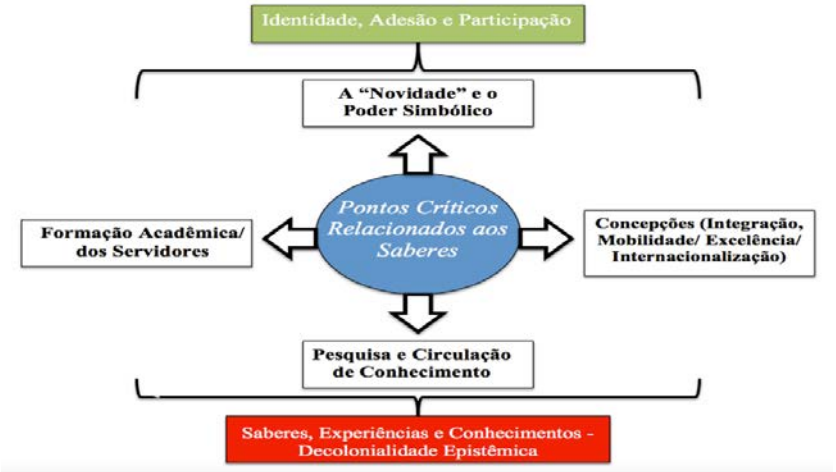
The idea of "theme" is considered and not thematic analysis that refers to Content Analysis. By "theme", we assume representation of "[...] a bundle of relationships [which] can be graphically presented through a word" (MINAYO, 2014, p. 315). Thus, instead of attributing to the "theme" the *frequency* of categories or words, it refers to the idea of the *presence* of something that has meaning to the object of analysis and that can "[...] denote structures of relevance, values of reference and behavior models present or underlying in the discourse" (MINAYO, 2014, p. 316). With the thematization process, the research advances in order to understand how managers approach difficulties in the management of their actions within the scope of International Solidarity Cooperation.

The Narratives of Managers: Points critical knowledge related to

Considering the report of the critical points associated with the narratives and which refer to the manifest knowledge, the discussion will take the discussion of the points taking without reporting the segments of texts of the interviews. This option considers the logic of Critical Discourse Analysis, and the volume of statements present in the research report.

Regarding the critical points associated with the idea of knowledge, four themes and two developments were related. Initially, the theme "*Novelty*" and *Symbolic Power* is aborted, unfolding from the perspective of organizational identity, adhesion and participation of its members. In this theme, the idea of *the Academic Formation* of the students and the *Formation of the Servers* is discussed, including the perspective of the qualification; the varied conceptions that are manifested in relation to *Integration*, *Mobility*, *Excellence* and *Internationalization*, considering, even, that these conceptions are organizational of the very idea of university from which the practices emerge; *Research* and *Circulation of Knowledge*, unfolding in the configuration of *Knowledge, Experiences and Knowledge*, having as a point of debate the *Epistemic* "*Decoloniality"* within the scope of the University Project. Figure 1 illustrates the critical points related to knowledge.

Figure 1 - Critical points related to knowledge



Source: Authors' elaboration, based on research data

The relationship that is established between "Novelty", Mayr Symbolic and Adhesion initiates reflection on the University Project, as well as introducing the demarcation of contradictions and conflicts in the narratives related to the idea of this Institution and its challenges.

The "Novelty" calls for the idea of temporality and internationalization, entirely marked by the concrete experience of daily challenges, when the MEC is located, with the support instance in the face of the news of setting up an International University. Cultural integration comes in line with the perception that the University also deals with a "romanticized" perspective regarding the initial project, which involves the representativeness that the institution develops in relation to African issues. The same novelty, which is exotic to the external eye, is relaxed in practice, in the normative rites that bring it closer to other federal public education institutions. Through narratives, experience prevails.

The problem arises in the absence of content that deepens the "novelty" of the Institution in the sense of a differentiated philosophy and that reflects on challenges to the project itself. This absence, however, can reveal this distance (manifest, felt and resentful). The "Novelty" is also attributed to the volume of foreign students who circulate the University and challenges it to adapt to their profiles, including their cultural diversity. Due to the absence of models and standards, there is a need for creativity to exercise management. These standards are even a point of conflict, given that the "know-how" shaped by experiences confronts a different worldview, a deconstruction of knowledge and the constitution of new ones, which requires other supports. It is in this way that the narratives problematize not only the "know-how" of the subjects directly involved with the project, but also the institutions that support it, such as the MEC, for example.

"Novidade", still, places an essential point to the privileged epistemological discussion in the University's guiding documents, the meaning of excellence associated with internationalization, particularly in the condition of its location in Latin America. This excellence, according to the statements, may imply a vision of the project, when the University is evaluated in the parameters of First World Institutions, those located in the North. In this idea of excellence, there is also a university philosophy that translates into a model to be followed, to be empowered, to be conducted. In this, the competitive concept is adopted, "it is in the front", "high level", "internationalization standard", which contrasts with the perspective of solidarity cooperation, also located in the statements, in an opposite way, before the statement that the interaction with countries "must" to the pursuit of what is "advantageous". Additionally, being a new proposal incorporates its meanings both in the sense of "having to do", "desire to be" and "wanting to be".

The "Novelty", therefore, is remembered before the challenges, including the constitution/deconstruction of the romanticized idea of the project, in view of the concreteness of its daily activities. On the other hand, there is the diffusion of a given philosophy, which integrates not only internationalization, but, on the one hand, solidarity cooperation, on the other, the concept of excellence.

The narratives indicate the existence of power to those who "join the project," implying not the distance and the possible exclusion of those who do not adhere when these can not be given the opportunity of integration and subsequent knowledge and dissemination of the philosophy of partnership for solidarity. When this point is raised to academic formations more "sensitive" to the themes of diversity, it is even possible to naturalize non-adherence as the result of a political decision, instead of assuming that this

decision may result from less awareness by the very formation of these subjects, as Lima (2010, p. 18, emphasis added) explains, "The relationship that the intellectual maintains with the school and with its school past *has a determining weight* [or rather, an important influence] *in the system of its unconscious intellectual elections*".

As a result of the appreciation of the symbolism attributed to the Institution, "Integration, Mobility, Excellence and Internationalization" are themed. In this course, integration is triggered as a representation of a training process that privileges the particularity of countries, such as the study of the legislation of each nation. As training is a point of conflict, perceiving it to flow based on Brazilian parameters is considered problematic to integration. Considering that this training is involved in a process that promotes the reproduction of science and knowledge standards that are experienced in schooling (LIMA, 2010). Advancing towards thinking academic curriculum and training of civil servants involves an attitude of adherence (commitment) to a welcoming epistemological conception of cultural diversity.

Along this path, the idea of a "ready-made package" involves several issues: the training of civil servants and the difficulty of finding specialized literature that addresses these national contexts. In addition, the concern regarding the influx that this "point package" can raise in terms of professional performance is revealed, considering the ability of these students to adapt the knowledge of the "ready package" to their realities.

It is a challenge that is set, and that "[...] faces questions that demand a prompt answer. Among them, the accreditation and evaluation of institutions and courses (accreditation), at an international level [...] under predominantly isomorphic quality concepts" (FRANCO; MOROSINI, 2003, p. 140), offering" [...] minimum standards of quality in diversity, bearing in mind the quality of equity whose demands suppose a fairer distributive character [...] It is the oscillation between isomorphic, diversification and equity "(FRANCO; MOROSINI, 2003, p. 143)

In such a way, escaping from the idea of a "ready-made package" is not done in dialogues that disregard the power of academic dependence (intellectual and financial), that do not echo cultural diversity through the constitution of facilitating spaces for the emergence of knowledge and practices of plural men (SANTOS, 2002). It is considered that "[...] the concept of *quality as a practice of collective constitution* is central to the program that encompasses a critical and creative institution and the training of competent professionals who are aware of their public responsibilities, *with inclusion as the main consequence of quality social*"(FRANCO; MOROSINI, 2003, p. 142-143, emphasis added).

In effect, the idea of an integration that occurs at the level of the composition of the curriculum is conveyed, as, if it is not well observed, it can negatively influence what Rémy (2017, p. 383) marks: "*This can also consist of a kind of recolonizac, will these territories and their peoples, specifically a new colonization, this intellectual nature".*

Mobility, in turn, is translated in line with the importance of its costing, making the institution's accountability in this process less emphasized, given that this costing can (should) be sought by external institutions, to encourage research. This narrative particularly involves teaching activity, considering the involvement with research and participation in scientific events, giving mobility an independent aspect of institutional policy, which requires the involvement of these actors in research groups and in financed projects, especially internationalized. It is in this regard that the concept of excellence arises, while being

internationalized is important, and this recognition requires movement, mobility, money. The volume of foreign students helps as a bridge in this internationalization process, but does not guarantee an international career, which is important in the teaching narratives.

It is giving weight to internationalization in the scope of mobility, but in search of excellence, that is, focused on the United States and Europe, considering that it is in these continents where the best, the main references, the best groups and money are. With this, the perspective of South-South Cooperation is intended, conveyed as an institutional mission, such as "Novelty", but linked to the idea of internationalization, to be pursued within the scope of a career that should excel for excellence, located in the North. At this point, we resort to the dangers of multicultural neoliberalism, when narratives place the student's place in a scientific circuit seen as competitive.

Tin that mobility, excellence and internationalization left designed against a mixture of positions, to validate an internationalization model that comprises institutionalized, including certified by organizations that direct teaching career (BEIGEL, 2016), for example, the Coordination for the Improvement of Higher Education Personnel (CAPES), in Brazil; and an idea of internationalization that reflects integration, specifically within the scope of South-South Cooperation, not yet endorsed by institutions that credit validity, recognition and funding for research and its subjects. Here, it is not indicated that the views towards the South are not received by organizations that promote research, and, due to the advance of interest in the field of cultural diversity in the world (ROSA, 2014), one can even see its progress. The place that the South receives in the scope of these researches is questioned, given the imperative of academic dependence (SALATIANO, 2014), of the captive mind (ALATAS, 2015), which is contrasted by the epistemic decoloniality (MIGNOLO, 2017). With this last question, one can think of research that seeks to identify the way in which the South is represented in these studies. Here, at this point, the question arises: where is this mobility intended for? Who are the "elected" in relation to mobility?

When it looks at citations that refer to the training of civil servants, this mobility in the scope of the research becomes even more aggravated, when it is noticed that in the Institution there are new civil servants (in age and length of service) managing a new University in structural aspects and normative and new in the sense of a unique mission. The process of getting to know the countries, an emblematic aspect in the speeches, would be linked to those who already have knowledge, research path and resources that may (or may not) be destined to the task of South-South Cooperation, under the pressure of the scientific consecration of the circuit of publications under the Northern connotation (SABEA; BEIGEL, 2014; ROBERTS; CONNELL, 2016).

On the other hand, training is remembered when it is perceived the need to situate employees in relation to a given institutional philosophy, which involves multinational management and diversity management. The introduction of institutional aspects seem involved in the very idea of giving meaning to the actions, make sense of institutional existence, which can be a cause of conflict not only by "non – identification", but, also, by ignorance, distance, and even neglect of such a philosophy. If only a few catch a glimpse of this philosophy, possession, defense, and struggle are likely, when much of the energy can be directed to conflict.

In any case, it is also important to add to the debate the idea that the invitation to training and mobility shows a possibility of deviation of focus, when what is read between narratives and context is the difficulty

of living with difference, with the other, with the new, as it "[...] produces an uncertain reality, lived under the sign of fear of the other from its stereotypical categorization. A symbol that, while fulfilling an organizing function, makes the atmosphere of uncertainties and doubts proliferate"(TEIXEIRA, 2007 p. 166-165). To the extent that, "[...] integrating creative and innovative people, or accepting diversity, is often perceived by community participants [...] explicitly or not, as threatening to the system" (ZANELLI; SILVIA, 2008, p. 46), it is understood that changing in this context means "[...] to denaturalize or distance ourselves from the *habitus* that constitutes us, which is both structural and structured, to separate ourselves from these ways of feeling, thinking and acting" (MESSINA, 2001, p. 228).

The instability before the adoption of another work logic imposes something that deserves attention, and from this derive other aspects that involve the training of civil servants. This instability can be observed with the following narrative, [...] we will continue to have everything atomized and doing what is already part of our comfort zones. Of course it is good to be in the comfort zone, which I already have a tradition of knowing how to do.

The current discussion, still, is how to favor the constitution/ unconstitution of ways to manage the University, considering the formation of the protagonists and the students of the Institution. In this way, the managers' call for an institutional policy that is attentive to this lapse seems to emerge, given that "[...] challenging and breaking with it can lead to disorder and inconsistency. It demands a support infrastructure [...] capable of providing support for *new mental models*"(ZANELLI; SILVIA, 2008, p. 66). In this case, autonomy derives from a context of negotiated cohesion in relation to the various internal fields of the University (CUNHA, 2005).

The discussion moves towards deepening the debate on research, within the scope of the circulation of knowledge. In this, the idea of mobility linked to the participation of public notices to promote research gains emphasis, as it suggests a perspective of competition based on convergence of interests, networks, and previous experience, which make internationalization at Unilab standardized by the requirements that govern all other public higher education institutions, also competing in these notices. Those who do not adhere to this cycle can not only lose the external opportunities in terms of research capital, but they can also lose the possibility of better experiencing the institution's own philosophy, when it is limited to understanding its mission within the scope of an internationalization policy .

In the context of convergence between personal interests, collective interests (research groups already constituted or to be formed), institutional partnerships and external notices, the demand for a policy arises again, given that the natural focus of this circuit meets the requirements of excellence, already highlighted. Questioning whether, then, if you are prepared for South-South Cooperation involves not only considering this cooperation in the scope of research and knowledge circulation, but also involves problematizing the idea of triangulation (Brazil, partner countries, developed countries).

The theme is also represented by speeches that introduce another perspective of internationalization, appropriated by the institution, making use of the same institutionalized instruments (postgraduate courses, journals and scientific events), including echoing the idea of a "weight magazine". Some narratives put weight on the problem of thinking about these issues in the South-South Cooperation circuit, when the condition of excellence is a strong imperative for the teaching career, for representativeness and

recognition; on the other hand, this cooperation becomes instrumentalized within the standardized internationalization, built on the idea of triangulation.

Still, in this context, the "coming out of the boxes" reinforces the way the circuit is endorsed by the "comfort zone", favorable to the reproduction of the research logic that situates the trajectory built under the canon of Eurocentric science. In fact, resorting to other modes of circulation, in other ways of institutionalizing "other" knowledge, involves not only the individual effort of researchers, as it is difficult to counteract a whole social set that standardizes research activity and that tames its production. Leaving this scope can come to represent a "myopia", or "a shot in the foot", after all, walking towards a "decolonial" discourse can lead to the exclusion (or expulsion) of the researcher from this circuit.

The importance of advancing the knowledge of European and North American nations is not questioned here (SANTOS, 2009). It is thought that the denial of other knowledge, or of what does not converge with Modernity (MIGNOLO, 2017), is the object of reflection and action, in order to provide another social architecture through the reinvention of social emancipation, having as support a scientific and political project, Epistemologies of the South (SANTOS, 2016).

Final considerations

The research reveals critical points present in the speeches of managers of a Federal University, dedicated to International Solidarity Cooperation. With the critical points, some questions are conclusive: a set of arguments that intend the vision of science, within its Eurocentric aspect, institutionalized and reproduced in academic dependence; the affirmation of interculturality as a power, which manifests itself in the exclusion of difference (from "non-interculturality"); the significance that the Institution assumes and that propagates as power struggles; identity fragmentation, in the context of actions affirmed in the routine of managerial practices; and in the "struggle" "decolonial", which addresses the confrontation of multiple knowledge in the conformation of "other" possibilities of social life, more based on the integration and inclusion of difference in the making of society.

The weight that this internationalization assumes in the academic imagination is also debated, when, in teaching, professional recognition derives from it (BEIGEL, 2013; CONNELL, 2017). Such issues flourish in the field of the institution's philosophy and how it can equate these problems that intend the daily exercise of its employees, the protagonism in relation to research, institutional actions and, also, absorb these subjects in possible disputes that rival these different visions of cooperation and university.

In these terms, the epistemic "decoloniality" is situated as a political mission of epistemological affirmation in the academic and administrative field, in which it is possible to jointly build an inclusive University of cultural diversity, which is formed by the varied composition of the academic community (which does not end differentiation of countries).

As a reflexive point, which derives from the discussion of critical points related to knowledge, it is observed that changes generate "[...] ambivalence and difficulty to share the meaning of the action". So, "[...] changing means changing the rules of the game, learning new cultural codes, denaturalizing or reflecting on the usual patterns" (MESSINA, 2001, p. 231-232). In view of the fragmentation that change produces, some fields may overlap with institutional objectives and, with this, internal disputes fill the

space that should drive the development of the mission, which is marked by important social relevance. Management, therefore, has an important role in the sense of negotiation, the constitution of cohesion in the face of fragmentation of identity, while strengthening the exercise of university autonomy and professional freedom mediated by institutional (substantive) objectives in attention to normative (instrumental) aspects.

If resources and the standard of excellence are located within the North and its developed countries, what is the place given to the South in this relationship? What place can the Institution give to the South in the face of the idea of the circulation of knowledge guided by the internationalization standardized in development institutions? Yet, when the graduate enters the idea of the circulation of knowledge, at this juncture, does he assume the role of protagonist? In this way, it is inferred that the South may come to be seen as an object of knowledge, an object of science (CONNELL, 2012).

The limits of this research meet the possibilities for its progress. As the University is an intensely dynamic social institution, even more changeable, some of the arguments may place managers' narratives that are far from the organizational context of the institution, or even the positions defended today may be different from those expressed. On the one hand, internal and external changes to the institution can influence different architectures of power, placing different narratives; on the other, the narratives are apprehended as discourses, which are social practices, which reinforces the idea that they have implications in the context and contribute to their history.

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The Influence of Background Music Teaching on Accuracy and Fluency of Freshmen 's Oral English in China

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Abstract

Many students like listening to music through mobile phones or computers when they are studying after class. Some students stated they were more efficiency when they were studying with the background music;some claimed they were distracted by the background music.In English teaching, students tend to have anxiety due to various subjective and objective reasons. If students are too anxious, it will affect their oral performance, especially accuracy and fluency. Therefore, to help students improve their oral English, we need to help them overcome their anxiety. In oral English teaching, an effective way to relieve students' anxiety is to play background music. Because the musical background helps to create a relaxed atmosphere in which anxiety and tension are relieved and attention to the new content is aroused. The paper studied the influence of background music teaching on accuracy and fluency of freshmen' s oral English. The results were in the following: 1). Background music teaching did not facilitate clear effect on oral accuracy of college students. To be specific, background music teaching only could help to reduce the rate of students' pronunciation error. In terms of syntactic errors and self-repair, the traditional teaching has decreased more than background music teaching. Background music teaching did not help to reduce lexical errors. 2). Compared with traditional teaching, oral fluency in background music teaching has not improved significantly. 3). This research results challenged the traditional idea that background music could achieve better teaching effect. Although background music might reduce the pressure and relieve the atmosphere, it could not help students to acquire more comprehensive input. Students need more quiet teaching environment and relevant module training, especially the flexible use of vocabulary, are needed to improve the accuracy and fluency of students' oral English to a greater extent.

Keywords: Background Music Teaching, Oral Fluency, Oral Accuracy

1. Introduction

Traditionally, the two main indicators of oral competence are accuracy and fluency [1]. In English teaching, students tend to have oral anxiety due to various subjective and objective reasons. If students are too anxious, it will affect their oral performance, especially accuracy and fluency. Krashen's Affective Filtering Hypothesis [2, 3] gave a more influential explanation. Krashen believes that motivation, confidence, anxiety and other emotional factors affect second language acquisition by influencing language input. In the above emotional factors, the role of anxiety cannot be ignored. If learners are too anxious, they will filter the language input, which is not conducive to second language acquisition. Therefore, if we want to help students improve their oral English, we need to help them overcome their anxiety. In oral English teaching, an effective way to relieve students' anxiety is to play background music. Because the musical background "helps to create a relaxed atmosphere in which anxiety and tension are relieved and attention to the new content is aroused"[4]. In the 1960s, the Bulgarian psychotherapist Georgi Lozanov, put forward "Suggestopedia," which is also called "heuristic foreign language teaching methods." He suggested one of the teaching forms is background music teaching. This is a teaching method that makes

use of the unique charm of music to generate suggestive power. Its effective implementation is conducive to creating a good atmosphere, so that students can relax, overcome anxiety, generate a sense of pleasure, and achieve the maximum teaching effect [5]. The"Mozart effect" proposed by American scientists in the early 1990s also proved that background music had a positive effect on language learning. Kenji Saeki [6], a Japanese scholar, proposed ten methods of using background music in middle school English classes based on his own teaching experience. Domestic scholars have also studied background music teaching. Wu Ailan [7] analyzed the influence of background music teaching on English proficiency of secondary school students. Cao Guangfa [5] discussed the psychological basis of background music teaching; Gong Jufang [8] studied the influence of Mozart background music on college students' English reading comprehension scores. To sum up, scholars at home and abroad have studied the relationship between background music and English learning from different perspectives. However, up to now, there has been no empirical research on the relationship between background music and oral accuracy and fluency of non-English-major freshmen in colleges and universities. This paper made an exploratory attempt in this regard.

2. Related Concepts

2.1. Background Music

Gong Jufang [8] defined background music as any type of music played when the listeners′ attention is focused on a task or activity rather than purely listening to the music. Classroom background music refers to the use of music in classroom to create an atmosphere or background environment conducive to students' acceptance of classroom teaching content. Background music serves as an auxiliary means to help students eliminate anxiety and other tension, so as to create a relaxed and happy learning atmosphere. In this paper, background music is defined as " classical light music without lyrics played by teachers for the purpose of auxiliary teaching in English class ".

2.2. Oral Accuracy

Accuracy refers to " conformity of the second language produced by learners with respect to the target language norm " [9].

" Oral accuracy " refers to the degree to which the language produced conforms to the standard of the target language, measured by the "error-free clause ratio "[9].

Zhang Wenzhong and Wu Xudong [10] defined language errors as a clear violation of grammatical rules or the use of words that are not acceptable in Standard English.

In this paper, Foster and Skehan's error-free clause ratio and Kong wen' s self-repair [11] rate are used to determine the accuracy of oral English. Error-free clause ratio refers to the percentage of clauses that completely conform to those grammatical rules of the target language in all clauses. The higher the percentage, the higher the accuracy. Self-repair [11] refers to the subsequent adjustment of learners' language behaviors according to their self-monitoring during the process of expression. Such adjustment includes not only the correction of the mistakes made, but also the addition, reduction and reorganization of the content of the expressed language. In determining the error clause in this paper, all syntactic errors, lexical errors, pronunciation errors and self-repair were included.

2.3. Oral Fluency

Domestic and foreign researchers have tried to define oral fluency from different aspects, of which some are representative: Hu Weijie [12] believed that fluency was a simple linguistic behavior phenomenon; Sajavaara [13] believed that while the second language learners express their ideas fluently and coherently, their language should also be acceptable.Skehan [14,15] believed that fluency was measured in 3

dimensions, namely, speed fluency, interrupted fluency, and repair fluency. Yu Hanjing [16] measured the repetition and self-repair of modified fluency more completely.

The paper adopted the following five time indicators put forward by Kong wen [11] for testing oral fluency:

1. Speaking Rate (SR): is calculated by dividing the total number of syllables produced in a given speech sample by the amount of total time (including pause time), expressed in seconds, required to produce the speech sample. The resulting figure is normally then multiplied by sixty to given a figure expressed as syllables per minute.

2. Phonation/Time Rate (P/TR): gives the percentage of time spent speaking as a percentage proportion of the time taken to produce the speech sample.

3. Articulation Rate (AR): is calculated by dividing the total number of syllables produced by the amount of time taken to produce them, excluding pause time. It is expressed as the mean number of syllables produced per second over the total amount of time spent speaking during the speech sample.

4. Mean Length of Runs (MLR): is calculated as the mean number of syllables produced in utterances between pauses of 0.3 seconds and above, by dividing the total number of pauses of 0.3 seconds and above (initial and final excluded) by the total number of syllables produced in the speech sample.

5. Average Length of Pause (ALP), is calculated by dividing the total amount of pause time by total number of pauses.

3. Research Design

3.1. Participants

The participants in the paper were non-English major freshmen at Zhengzhou Electric Power Technology College. Two classes in the same grade at the same school were selected. Each class had 40 students, and the two classes had 80 students in all. The same teacher taught the two classes English, including listening, speaking, reading and writing. The teacher used the same teaching program, textbook, teaching plan and teaching activities. Class A adopted background music teaching while Class B adopted traditional teaching.

3.2. Research Thought

"Pretest——Experimental Teaching——Post-test" research design was adopted. Pretest was conducted in September 2020 (at the beginning of the term) and post-test was conducted in January 2021 (at the end of the term). During the experimental teaching, Class A (Experimental Group) received background music teaching while Class B (Control Group) received traditional teaching. Pretest and post-test were conducted by speech. In the two tests, these 80 students were asked to deliver a two-minute speech about the same topic "My Self-Introduction". As it is a familiar topic to students and everyone can say something about the topic, which can reflect students' real oral English level. The speeches on the two tests from the two classes were recorded and transcribed into written text materials for quantitative and qualitative analysis. At the first recording, the students did not know that they would deliver the same topic on the second recording. The students did not receive the same topic during the teaching time. Practice effects have been minimized. The recording environment and equipment quality is good; the sound recording is clear. There is no any technical difficulties while transcribing the sound recording into written text materials. The background music is classical light music without lyrics.

3.3. Data Collection

The speeches made by these 80 students on the pretest and post-test were recorded. Before the speech

on the pretest, the teacher gave students three minutes to prepare. The total recording time was about 140 minutes, with about 7280 words in all.

3.4. The Definition of Pause

Pause is a key concept that analyze oral fluency and its development, as all the calculations of time indicator depend on the definition of pause. In the paper, the definition of pause from Liu li [18] was used and he defined " a break of seconds or longer either within a sentence or between sentences".

4. Research Findings

4.1. Oral Accuracy

"Error-free clause ratio" and "self-repair rate" were used to analyze oral accuracy. According to data analysis, table 1 and table 2 showed the features of development of the students' oral English accuracy in this term.

4.1.1. The Results of Pretest

Let us look at the results of the pretest. Class A with 40 students received background music teaching; while Class B with 40 students received traditional teaching. Table 1 showed "error–free clause ratio" (EFCR for short) of Class A and B in the pretest.

SPSS software was used to calculate the average and difference of error-free clause ratio and standard deviation in the pretest of Class A and Class B in Table 1.

Table 1. *Average and Difference of EFCR of Class A and B in the Pretest.*

Class	Average EFCR	Standard Deviation
Class A	0.714	0.215
Class B	0.793	0.188

Table 1 shows that: in the pretest, the average of EFCR from Class A was 0.714, and standard deviation was 0.215; while the average of EFCR from Class B was 0.793, and standard deviation was 0.188. At the significance level of 0.1, there was a significant difference between Class A and Class B. Therefore, we can assume that the difference in post-test accuracy is mainly due to different teaching methods.

4.1.2. The Results of Post-test

Let us look at the results of post-test. Table 2 showed the results of EFCR of Class A and B in the post-test.

Table 2. Average and Difference of EFCR of Class A and B in the Post-test.

Class	Average EFCR	Standard Deviation
Class A	0.714	0.158
Class B	0.774	0.147

Table 2 shows: in the post-test, the average of EFCR from Class A was 0.714, and standard deviation was 0.158; while the average of EFCR from Class B was 0.774, and standard deviation was 0.147. At the significance level of 0.1, there was a significant difference between Class A and Class B. Table 1 and table 2 show: the average of EFCR from Class A (background music teaching) was 0.714 in the pretest and post-

test respectively (pretest: 0.7136; post-test: 0.7138), which means the effect of background music teaching was not clear. As for Class B (traditional teaching), in the pretest, the average of EFCR was 0.793; in the post-test, the average of EFCR was 0.774. Therefore, we can assume that the differences in the post-test results are due to the different teaching methods adopted.

To make analysis more accurate, four types of errors (syntactic, lexical, pronunciation and self-repair) in the audio-recordings were counted. See Tables 3 and 4 for the statistics:

Table 3. *Percentage of the Four Types of Errors in the Pretest.*

Class	Syntactic Error	Lexical Error	Pronunciation Error	Self-Repair	Total
Class A	60 (24%)	24 (10%)	36 (14%)	129 (52%)	250
Class B	53 (34%)	19 (12%)	6 (4%)	79 (50%)	157

From Table 3, we can see: in the pretest, the total errors of Class A were 250, of which 60 were syntactic, taking up 10%; 36 were pronunciation errors, taking up 14%; 129 were self-repair times, taking up 52%. The total errors of Class B were 157, of which 53 were syntactic errors, taking up 34%; 19 were lexical errors, taking up 12%; 6 were pronunciation errors, taking up 4%; 79 were self-repair times, taking up 50%. The error number in Class A had 93 more errors than Class B. Both Class A and B reached 50% in self-repair rate, of which Class A had 50 more (2% more than Class B. The pronunciation accuracy of Class B was 10% higher than that of Class A, and the syntactic error rate of class B was 10% higher than that of class A. The lexical error of Class A was 2% lower than that of Class B.

Table 4. *Percentage of the Four Types of Errors in the Post-test.*

Class	Syntactic Error	Lexical Error	Pronunciation Error	Self-Repair	Total
Class A	62 (22%)	50 (18%)	33 (12%)	132 (48%)	277
Class B	54 (29%)	46 (24%)	14 (8%)	74 (39%)	188

From table 4, we can see: in the post-test, there was a decrease in the rate of syntactic errors in both classes, of which Class B decreased by 5% compared with the pretest, and Class A decreased by 2%. The pronunciation error rate of the two classes showed opposite trends: in the post-test, Class A decreased by 2% compared with the pretest while Class B increased by 4% compared with the pretest. In the post-test, the pronunciation accuracy of Class B was still 4% higher than that of Class A.

Of the four types of errors, lexical errors and self-repair changed significantly. Lexical errors: The post-test of Class A and Class B was higher than the pretest of their respective classes. The number of Class A was 24 in the pretest and 50 in the post-test, increasing 26; the number of Class B was 19 in the pretest and 46 in the post-test, increasing 27. Self-repair: both Class A and Class B decreased respectively. The number of Class A was 129 in the pretest and 132 in the post-test, decreasing 4%; The number of Class B was 79 in the pretest and 74 in the post-test, decreasing 11%. The above statistics showed: background music teaching did not help to reduce lexical errors; it could help to reduce pronunciation errors; syntactic errors and self-repair. However, the decline in syntactic errors and self-repair was more significant in the

post-test of traditional classes than that of background music teaching.

4.2. Oral Fluency

Five time indicators: speaking rate (SR), articulation rate (AR), phonation/time ratio (PTR), mean length of runs (MLR), average length of pause (ALP), were used to test students 'oral fluency.

4.2.1. Results of the Pretest

Firstly, Let's look at the results of the pretest. Table 5 shows the results of the five time indicators of Class A and Class B in the pretest.

Table 5. *Fluency Time Indicators of Class A and B in the Pretest*

Note: 1.syl.=syllables; percent.=percentage; sec.=second.

Class	**SR (syl.)**	**AR (syl.)**	**P/TR (percent.)**	**MLR (syl.)**	**ALP (sec.)**
Class A	135.49	3.61	62	6.78	1.12
Class B	164.54	4.09	67	7.86	2.93
	0.011*	0.003**	0.185 n.s.	0.227 n.s.	0.000**

2. P>0.05= Class A and B are not significantly different, n.s.=not significant; P<0.05= Class A and B are significantly different, * =significant; P<0.01= Class A and B are very significantly different, **= very significant.

Table 5 shows: in the pretest. Class A was better than Class B in average length of pause, Class A and Class B were very significant (P=0.000, P<0.01). Class B was better than Class A in speaking rate, articulation rate, phonation/time ratio and mean length of runs: Class B was 29.05 syllables more thanClass A in speaking rate per minute, which was significant.

4.2.2. Results of the Post-test

Let's look at the results of the post-test. Table 6 shows the results of the five time indicators of Class A and Class B in the post-test.

Table 6. *Fluency Time Indicators of Class A and B in the Pretest.*

Class	**SR (syl.)**	**AR (syl.)**	**P/TR (percent.)**	**MLR (syl.)**	**ALP (sec.)**
Class A	142.46	3.55	66	7.43	3.18
Class B	174.52	4.04	71	10.89	0.90
	0.001 **	0.000 **	0.101 n.s.	0.008 **	0.000 **

Note: 1.syl.=syllables; percent.=percentage; sec.=second.

2. P>0.05= Class A and B are not significantly different, n.s.=not significant;
P<0.05= Class A and B are significantly different, * =significant;
P<0.01= Class A and B are very significantly different, **= very significant.

SR: The average of Class A was 142.26, lower than Class B (174.52), There was a statistically significant difference between the two classes. In the pretest, the average of Class A was 135.49, lower than Class B (164.54), the two classes were significant different. This shows that: after a term's background

music teaching, the speaking rate of the two classes improved clearly. However, the average of speaking rate of Class A was not improved as fast as that of Class B.

AR: The average of Class A was 3.55, lower than Class B (4.04). There was very significant different between the two classes. This shows that: after a term's background music teaching, the average articulation rate of the two classes was lower than that of the pretest (Class A decreased 0.06; Class B decreased 0.05). The articulation rate of Class A was not as fast as Class B.

P/TR: The average of Class A was 66, lower than Class B (71). There was not significant differentbetween the two classes. In the pretest, the average of Class A was 62, lower than Class B (67). There was not significant different between the two classes. This shows that: after a term's background music teaching, the phonation/time ratio of Class A was less than that of Class B, and from being lower than that of Class B at the beginning of the semester.

MLR: The average of Class A was 7.43, lower than Class B (10.89), there was very significant different between the two classes. In the pretest, The average of Class A was 6.78, lower than Class B (7.86), there was very significant different between the two classes. This shows that: after a term's background music teaching, the mean length of run in Class A was shorter than that of Class B, and from being shorter than Class B at the beginning of the term.

ALP: The average of Class A was 3.18, longer than Class B (0.90), there was very significant different between the two classes. In the pretest, the average of Class A was 1.12, shorter than Class B (2.93), there was very significant different between the two classes. This shows that: after a term's background music teaching, the average length of pause of Class A became a bit longer than Class B, from being a little bit shorter than Class B at the begging of the term.

5. Discussions

From the results of the pretest and the post-test, we can see: background music teaching did not improve oral English accuracy obviously. Error-free clause ratio: results of Class A in the pretest and post-test were almost the same (0.714); results of Class B in the post-test was lower than that of the pretest. This shows that: background music teaching can facilitate students' oral English accuracy, but not very clear effect. Background music teaching can create a light atmosphere and relieve the pressure and anxiety [4]. There was no background music at the traditional teaching class, the pressure and anxiety were not relieved. Therefore, oral accuracy declined.

Let's look at the results of syntactic errors, lexical errors, pronunciation errors and self-repair in the pretest and post-test: in the post-test, the number of syntactic errors, pronunciation errors and self-repair of Class A declined obviously. However, the number of syntactic errors and self-repair of Class B declined more than that of Class A; the number of pronunciation errors of Class B in the post-test increased 8 (4%) more than in the pretest. In other words, traditional teaching was more helpful in promoting students' syntactic errors and self-repair in oral output, while background music teaching was more helpful in reducing the rate of pronunciation errors. However, the number of errors in the two classes was almost the same (Class A increased 26 and Class B increased 27). This shows that background music teaching had no help in reducing lexical errors. Background music had no significant effect on reducing syntactic error and self-repair. The reason may be that students' syntactic and self-repair were more vulnerable to the influence of background music, so that students could not concentrate on speaking more correct sentences. On the contrary, if students have a quiet environment to learn, they will speak oral English calmly, thus reducing the rate of syntactic errors and self-repair.

In terms of lexicon, the number of lexicon errors in the two classes increased almost uniformly. This

shows that: after a term's study, the students expanded their vocabulary, but they were not proficient in the flexible use of these words, and background music could not help them to use these new words flexibly. In order to reduce the students' lexical error, it is necessary to strengthen lexical teaching, explain the differences between lexical synonyms and the use of fixed collocations. Let students use these words to make sentences and the teacher point out mistakes in time to ensure that students can use them correctly and skillfully.

As far as oral fluency is concerned, we can see from the results of pretest and post-test that: the post-test results of background music teaching were better than that of pretest, however, the traditional teaching was more significant than that of background music teaching. In the pretest, Class A was shorter than Class B in average length of pause. Class A lagged behind the Class B in speaking rate, articulation rate, phonation/time ratio and mean length of run. In the post-test, Class A in speaking rate, phonation/time ratio and mean length of run was higher than that of the pretest. However, Class B was much higher than Class A in these three aspects. Both Class A and Class B declined in articulation rate and the decline was almost the same. In average length of pause, Class A in the post-test became longer than in the pretest and far lagged behind Class B, while Class B surpassed Class A and got better than the pretest of Class A. In general, background music teaching could promote oral fluency, but it was far less advanced than traditional teaching.

In order to get more accurate research result, we made a questionnaire titled *The Impact of Background Music on Learning/Work*. Due to the new coronavirus epidemic, we use the network questionnaire by WeChat scan code going into the answer part. The participants included the students from Class A, with other participants from other universities and some employees. Questionnaires were handed out 130 and 107 were handed in. We analyzed and concluded the research findings as the following:

Question 1: Those who listen to music when study or work were 32, taking up 30%; sometimes listen to music when study or work were 62, taking up 58%; never listen to music were 13, taking up 12%.

Question 2: Those who could speak out the name of background music were 10, taking up 9%; those who could speak out some of the music were 84, taking up 79%; some could not speak out any background music were 13, taking up 12%. we can assume that: those who could speak out the name of background music were already influenced by the music; those who could speak out some of music were already influenced, when they heard unfamiliar music, they may be wonder or think about what music it was. Therefore, they were also influenced. To sum up, those who were influenced by music were the sum of the first and the second options, that is 88%.

Question 3: Those who could hum all the music were 26, taking up 24%; those who could hum some of the music were 65, taking up 61%; those who could not hum any music were 16, taking up 15%. We can assume that: those who were influenced were the sum of the first and the second options, that is 83%.

Question 4: Those who could not finish the task with the background music were 13, taking up 12%; those who could finish the easy task with background music and could not finish hard task with background music were 49, taking up 46%; those who could finish any task with background music were 45, taking up 42%. We could assume that: those who were influenced were the sum of the first and the second options, that is 58%.

Question 5: Those who were influenced by background music were 20, taking up 19%; those who were sometimes influenced by background music were 50, taking up 47%; those who were never influenced by background music were 37, taking up 34%. we could assume that: those who were influenced were the sum of the first and the second options, that is 66%.

Question 6 is a subjective question: 93 people, 87% of participants believe that background music could bring positive effects; five, 5% were neutral; six, 5% thought it had negative effects. Three, 3%, did

not do the question. Conclusion: the majority of people believed that background music was a positive factor, which improved work efficiency and did not affect people's study or work.

According to the 6 answers and analyses, objective facts and people's subjective concept were obviously inconsistent: people like to study or work in a comfortable environment with background music, but they do not know at all they were distracted by the background music when they were working or studying! The results further proved the previous data analyses: background music could distract people from work or study. This conclusion challenged the concept "background music is conducive to creating a good atmosphere, so that students can relax, overcome anxiety, generate a sense of pleasure, and achieve the maximum teaching effect" [5].

6. Conclusions

This paper examined the influence of background music teaching on the accuracy and fluency of non-English-major freshmen' s oral English. The results show that: 1) The effect of background music teaching on students' oral accuracy was not obvious. Specifically, background music teaching did not help to reduce the lexical errors. Background music teaching could effectively help students reduce the pronunciation errors, syntactic errors and self-repair, but the traditional teaching in the syntactic errors and self-repair decreased more than background music teaching. The reason: students' syntactic and self-repair were more likely to be affected by background music, making them unable to concentrate on speaking more correct sentences. On the contrary, if students have a quiet learning environment, they will learn more input during the learning process and speak English freely in the post-test, thus reducing the rate of syntactic errors and self-repair. As for lexicon, background music could not make them think of and use unfamiliar words automatically and expertly. Instead, after they learn new words, they shall practice words again and again so that they could truly master the flexible use of lexicon. 2) Compared with traditional teaching, oral fluency of background music teaching was not improved as much as that of traditional teaching. Five indicators of oral fluency: speaking rate, articulation rate, phonation/time ratio, mean length of runs and average length of pause. The pretest and post-test of these five indicators showed different trends challenged the traditional idea that background music could achieve better teaching effect. Although background music might reduce pressure and relieve atmosphere, it could not help students to acquire more comprehensive input. Students need more quiet teaching environment and relevant module exercises, especially the flexible use of vocabulary, so as to improve the accuracy and fluency of oral English to a greater extent. There are also some limitations about the paper: 1) The number of the participants is comparatively small. It is necessary to investigate different areas, different types of colleges and universities of non-English-major freshmen to compare the results of these investigation. 2） These participants are from two different majors, with different English level. It is hard to compare them and get exactly results. We should investigate several the same major students of the same grade to compare to get more accuracy and efficient results. 3) The test is about the participant' oral output on a topic, not real communication. The oral performance we observe is not exactly the same as their actual oral performance in real communication. Therefore, it is necessary to use real communicative language tasks, such as in the form of discussion or problem solving, to induce the oral output of the participants, so as to verify the findings of this study.

Appendix

A questionnaire from Part 5 Discussion

The Influence of Background Music on Learning/Work

1. Do you listen to music when you are studying or working? (Multiple choice * required)
   a. listen
   b. sometimes listen
   c. never listen
2. If background music is playing in your study or work place, can you speak out the name of music?(Multiple choice * required)
   a. can speak out all names of the music
   b. can speak out some of the music
   c. can not speak out anyone
3. Can you hum the melody of the background music while studying/working? (Multiple choice * required)
   a. can hum all music
   b. can hum some of the music
   c. can not hum any music
4. Can you complete tasks on time with background music playing?(Multiple choice * required)
   a. can not
   b. can finish easy tasks, can not finish hard tasks
   c. can
5. When you are studying or working, do your moods ebb and flow with background music? (Multiple choice * required)
   a. yes
   b. some music influence, some music do not influence
   c. never

What do you think of background music when you study or work ? (Positive and negative） No limit words. ds. There was no significant difference in the phonation/time ratio, and the change was the least. 3) This research result (Fill in the blanks * required answers)

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Lessons Learned During Turbulent Times to Weather and Thrive in the Storm of COVID-19

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Abstract

This article describes the lessons learned by our university during the global healthcare crisis of COVID-19. It highlights the agile solutions employed to continue learning under extraordinary circumstances. While we have captured the stories that allowed our students to power through this tumultuous period if they so desired, these lessons may also provide guidance to other higher education institutions not only for the current turbulent times, but also enhance their ability to pause and pivot by utilizing agile management to weather this and future storms.

Keywords: Agile management; higher education; COVID-19; strategic partners; future business

1. Introduction

1.1 Background

The University is a four-year regional institution that sits in a rural northwest area of the state of Louisiana. It and all its assets relating to the agile management process which is a business within the University system and its role to the students (future business leaders), our business partners, and the town. The classes are our product, and the students are our customers. The strategic partners, our advisory boards, provide the latest skills and technology needed, which puts our students at the top of the hiring pools. The ongoing relationship with these partners helps our students obtain employment after graduation (Prejean, Liao, Aldredge, Parker, & Kilcoyne, 2020).

1.2 Problem Statement

During the COVID-19 pandemic, universities were forced to continually pause and pivot to meet the demands of the university - the class, the students, the employers, the frontline workers (our faculty) (Jackson, 2020a). How can universities achieve this goal during the turbulent times while facing uncertainties and fast changes? As many businesses have already embraced agile to meet their customers' demands from a fast-changing market, universities can also weather and thrive the storm of COVID-19 through agile management.

2. Literature Review

2.1 What is Agile Management

Agile management is about adjusting to any situation quickly using teams to provide innovative` solutions to problems. Agile management relates to the quick response between business, industry, and education to the many challenges and changes daily in the corporate climate. The concept is used in organizations by identifying three core characteristics: the law of the small team, the law of the customer, and the network (Denning, 2018). Livorsky (2016) stated that agility at a leadership level is a mindset that facilitates rapid growth and the adoption of key business strategies giving leaders the ability to adapt to change while remaining resilient and learn from their experiences. In this reality, education and industry must work together to provide the right talent to enhance the workforce (Prejean, 2017).

It can be "an approach, a method, a practice, a technique, or a framework," depending on the situation where it is used (Project Management Institute, 2017). Since agile teams run more efficiently, there is more time to work on quality defects and low-value product features, which increase revenue (Rigby, et al., 2016, Prejean, et al., 2019). Surveys by Deloitte and McKinsey show that more than 90% of senior executives give high priority to becoming agile, while less than 10% see their firm as currently highly agile (Denning, 2019). In a recent poll by Gallup, a global analytic and advice firm, eighty stakeholders and other leaders in industries were interviewed to identify agility aspects, which helped employees identify their organization with the term agile. They also interviewed 5500 American 4,000 European workers to determine their perception of agility in their organization. (Nink, 2019). The results identified eight factors driving skill in business as follows:

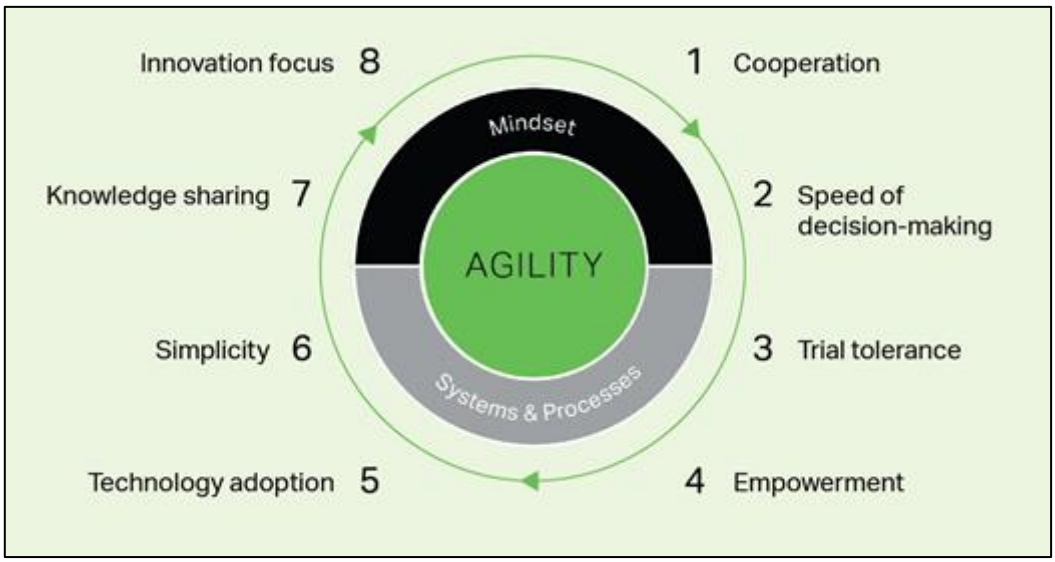

Figure 1. Factors That Drive Agility (Nink, 2019, p.1)

Most companies use scrum teams, Kanban, and work sprints for discrete projects and seldom employ the concept in the company's overall management. The Gallop Poll survey concluded that the cultural and process fundamentals needed to support agile frameworks are scarce in many companies (Nink, 2019). An Economist survey found that 90% of managers interviewed believed that agility was important to performance today (Barrows & Neely, 2019). The authors propose a four-step process called the Fast Cycle Performance as follows:

> Step 1. Modeling Performance Transform strategic planning into a dynamic process referencing Michael Porter's 1996 process of the activity map to show how business activities relate to each other.
> Step 2. Managing Projects: Create clear business cases for the project linking to strategic objectives and manage them efficiently with accountability.
> Step 3. Measuring Progress. Leaders need to summarize project plans, critical objectives, and review critical milestones with leaders regularly – ideally monthly to improve organizational agility.
> Step 4: Make rapid decisions based on improved processes developed in steps one through three. (Barrows & Neely, 2019).

Expanding on these concepts, it is essential to find all strengths and remove weaknesses in the organization. Ensure that all crucial information of projects is shared daily, keeping the group on schedule, and ensuring cohesion. When organizations need to make quick adjustments to priorities or essential tasks, agile methodology is vital. The agile approach ensures optimal use of all resources and helps you to eliminate issues during the process (Nedelkovic, 2020).

Business agility is a company's ability to adapt and respond to changes. Sullivan (2020) defined agility as:

- Being more than just fast
- Being nimble, flexible, adaptable, and responsive

- Being able to shift direction
- Anticipating a range of possible events
- Dealing with multiple fluctuations simultaneously (churn)
- Shifting direction, focus, and resources accurately (into the right areas)

In order to remain agile, business must continually adopt quickly to every interruption in the normal operations of the business (Yahoo Small Business, 2020). The new COVID-19 environment has changed all of this as companies have had to respond quickly to survive. Now business and education must *always pivot or change* to serve their customers. Education is also a business with students as its customers.

2. 2 Agile Methods and Practices Focusing on Education

Cooke (2010) also stated that the purpose of the agile philosophy was based on the "iterative delivery of business value in short time-frames, with ongoing planning based on the feedback received from key stakeholders at each iteration" (p.1). This is certainly true in business environments, including educational facilities constantly adapting to necessary industry changes to ensure that graduates are prepared for the workforce.

2.2.1 Current Trends in the job market and its impact on higher education institutions

There are uncertainties and dynamic changes in the job market. In many industries and countries, the most in-demand occupations or specialties did not exist ten or even five years ago, and the pace of change is set to accelerate (World Economic Forum, 2016).

According to the Board of Regents (2019, p.9), 96% of Louisiana's workforce is comprised of Louisiana residents who must be prepared for an evolving economy. By 2020, the Georgetown Center projections indicate that 65% of jobs nationally, and 56% of jobs in Louisiana, will require education beyond a high school diploma (Board of Regents, 2019, p.9). "It is estimated that 85% of jobs that will be available in 2030 have not yet been created or even imagined" (The Next Era of Human/ Machine Partnerships, 2017, p.14). This uncertainty and dynamic change atmosphere supply a mandate for urgent and informed action by developing talent in our state.

How should higher education institutions react to uncertainty and dynamic change? Agile management is critical for us to have fast responses and flexibility. Several papers discuss student engagement in the use of virtual learning systems and on the quality of activities available in AVA's (Action Plans for Self-Evaluation, Periodic Evaluation, and Accreditation, used in European countries) (Agredo-Delgado, Pinto-Corredor, Collazos, Ruiz, & Fardoun, 2019), which are fundamental aspects of maintaining students engaged in activities proposed by the environment. Controlling the students' testing environment is an essential aspect of maintaining course integrity (Aldredge, DuBois, Mobley, Prejean, & Vienne, 2019).

2.2.2 Current agile practices and effects on higher education

Education and industry are working together to ensure that the classroom's skills are transferrable to the workforce. Higher education institutions worldwide are making changes in educational settings, instruction means, teaching methods, international exposures, and culture to be agile to satisfy the more customized learning demand of the students (Liao et al., 2019). Changes in delivery modes are in use in classrooms today. Classroom instruction in higher education has also changed to a more agile method as a larger percentage of classes are offered online for the convenience of working students and are now provided in face to face and HyFlex (half of the students meet one day and the other classes meet another day, and asynchronous).

Today's classrooms include focused teams working together to review case studies relating to current events, which allows them to adapt quickly to the industry's changing needs. This will enable students to unleash creativity, adapt through fast learning cycles, and iterate towards success. Education and industry are working together to ensure that the classroom's skills are transferrable to the workforce. Experiential Learning Models developed providing real-world analysis of local and global sectors necessary for a quick transition into business; Service-Learning Models showcasing business students' strengths in non-profit arenas crucial.

3. Case of Agile Management: The University's School of Business (SoB)

In the School of Business at the University, we offer a Bachelor of Science degree with three majors – Accounting, Business Administration, and Computer Information Systems. We embrace analytical thinking, technology, and the tools necessary for our business graduates to compete and succeed in a global economy.

"Change is the only constant in life," stated Heraclitus, the Greek philosopher (Yahoo Small Business, 2020). During the trying events of 2020, the SoB team rose like the phoenix and seized the COVID-19 challenges and created opportunities. Our philosophy was those organizations that refuse to embrace change would not survive.

March 13, 2020 was a day that served as the educational world paused at NSU. At the collegiate level, students and faculty were sent home the following week. COVID-19 left some students stranded at the university due to international flights being canceled. A plan to address their needs was developed within a matter of days. It was developed alongside the plan to ensure that learning continued virtually. Our entire university went from a traditional delivery mode to online in three days. Like the School of Business, some departments already had digital footprints that could handle such a decisive switch because the school already offered most of its classes via the internet. Those not initially offered online classes were transformed to accommodate the new reality of the educational plan.

3.1 The agile management in NSU School of Business

Before the COVID-19 pandemic, each of all our courses had been delivered both face-to-face and online. Our fast response to the COVID-19 pandemic in spring 2020 included transition face-to-face classes online within three days, opening communication among faculty members, students, staff, etc., identifying necessary training and equipment needed, and testing through WebEx meetings. Practically, the School of Business has followed the three agile management laws proposed by Denning (2018) to deliver value to our students and their future employees through small, autonomous, cross-functional teams and collaborating with all stakeholders.

3.1.1 Stakeholders of SoB: who are our strategic partners?

The School of Business is blessed to have several active internal and external stakeholders who diligently work to improve faculty, staff, and students (see Figure 2). For example, the School of Business Advisory Council is made up of prominent alumni and local business leaders to align our stakeholders' needs with our academic offerings. These advisory board members are significant supporters of the SoB and frequently provide financial support and employment opportunities for students. (School of Business, 2019) The School consistently partners with various departments in the university to bring dynamic programming and events to ensure that students know the multifarious avenues of assistance and opportunities that await them around and off-campus. It does not stop there. The department regularly provides events for other schools, the community, and for students to become involved in furthering their education. The Hour of Code, QuickBooks Training, Continuing Legal, and Accounting Education are just a few of the School's outreach programming to achieve this mission of aiding our strategic partners. (M. Kilcoyne, personal communication, March 19, 2019)

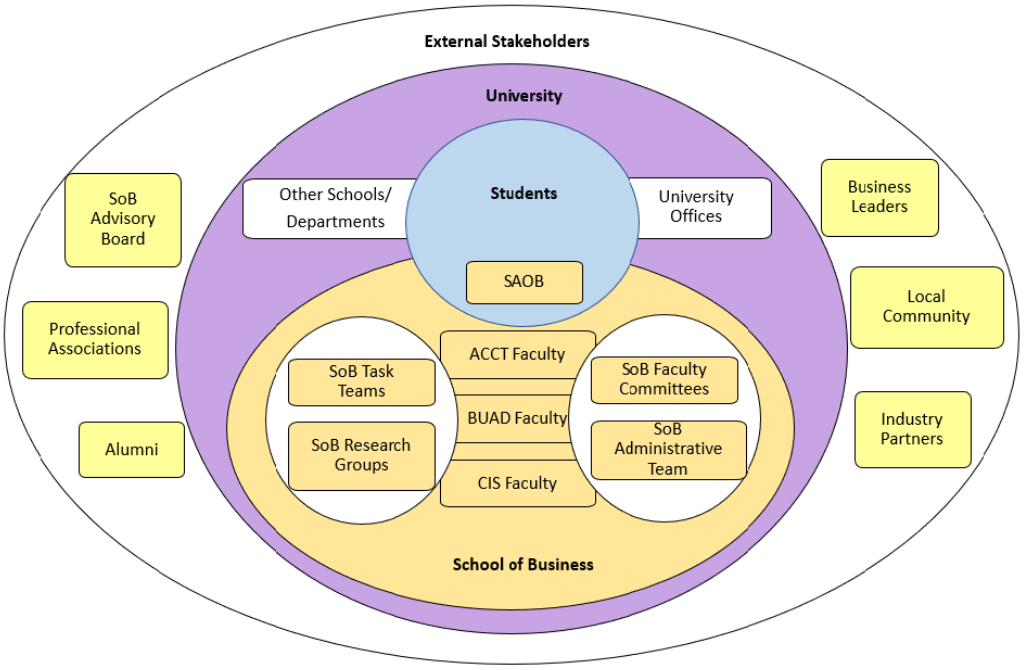

Figure 2. School of Business Stakeholders

3.1.2 How BUAD works with our strategic partners to be agile?

The Business Administration major faculty have worked with strategic partners to be agile. We listen to the needs of the stakeholders and respond as quickly as possible. An example is our Entrepreneurship concentration. Our strategic partners explained how entrepreneurship is needed in Northern Louisiana since many students and businesses believed that they could be successful only if they moved to Southern Louisiana or another state such as Texas or California. The group informed the administration that one of their stated objectives was to develop an ecosystem of entrepreneurs in the region to help create future jobs in the area. Upon hearing this, the Business Administration faculty members went to work upon crafting our very first entrepreneurship concentration to support this initiative. This process was completed within a matter of days. Once completed and approved by another internal partner, the concentration moved to the Registrar's office to be reviewed and deliberated by a select committee. The committee thankfully approved the concentration, and it was offered the very next academic year. This listening and acting process is the same process employed to create the Business Analytics and International Business concentrations for the Business Administration major.

Another partner that the School of Business has is, of course, our students. Our students have an advisory council as well. This council provides feedback to our faculty, Dean, and coordinators. The Student Advisory and Outreach Board are dynamic and work to improve the School and curriculum as well. An example of their effectiveness is that the students reported that it was difficult to locate all the students' services on campus. As a result, the students believed that a fair showcased as many of the auxiliary departments would be beneficial. This initiative was established and entitled "Empowerment." This event included departments such as Financial Aid, Health Unit, Counseling, Library, and Career Services who were invited to Russell Hall to help the students get acquainted with the support services available to them at the university. (M. Kilcoyne, personal communication, March 19, 2019)

The students decided that they wanted additional lessons from the faculty to enhance their professional development. From that, they requested a segment called "Advisor's Advice." The faculty obliged. The faculty member prepares a fifteen-minute lesson to an hour-long lesson to increase their knowledge. These mini lessons help students from networking, rethinking artificial intelligence, networking, professional dress, and dinner etiquette. Again, an example of our ability to hear and act quickly to implement.

3.1.3 How ACCT works with our strategic partners to be agile?

Feedback from our strategic partners is crucial in determining how we educate our students, particularly in accounting. Industry partners, public accountants, and the School of Business Advisory Council members have all expressed interest in revamping accounting education to include the skill sets and competencies needed in this rapidly changing workplace. These stakeholders have indicated that the skills they desire in accounting graduates have evolved. They now look for much more than technical competence. Employers are looking for:

- Soft or people skills –communication (this is a profession where we need to communicate with clients/stakeholders both orally and written); critical thinking (it is great to have or gather data,

but do you know the appropriate way to analyze and interpret the data); emotional intelligence (the ability to navigate relationships, work as a team, accept constructive criticism and make changes).

- Technology – data analytic skills (what data is available, where and how do we access, secure, verify, manipulate, and visualize it); artificial intelligence (use of machine software to analyze data and complete tasks).
- Continuous learning – ability, and attitude (willingness to embrace change, grow with the changing workforce and redesigned job).

(M. Aldredge, personal communication, March 30, 2019)

The literature also supports this needed shift in accounting education, highlighting technology as the underlying factor for change (Landsman & Peasnell, 2018). Siegel et al. (2010) address the use of technology to focus on Artificial Intelligence (AI) as a major skills gap in the accounting workforce. Current research by the AICPA involving the state of the profession indicates that newly licensed CPAs "must not only have a data-oriented, digital mindset but a keen understanding of core business functions as well" (M. Decker, personal communication, January 10, 2020). Agile skillsets are needed by accounting graduates now more than ever if they want to succeed in today's work environment. As a result, the NSU accounting department has revamped its curriculum to build these components into its existing courses. In addition, a new capstone accounting course has been added to the course rotation beginning in the fall of 2020. These changes respond to stakeholder feedback and are intended to provide long-term career success for our graduates (M. Aldredge, personal communication, March 30, 2020).

3.1.4 How CIS works with our strategic partners to be agile?

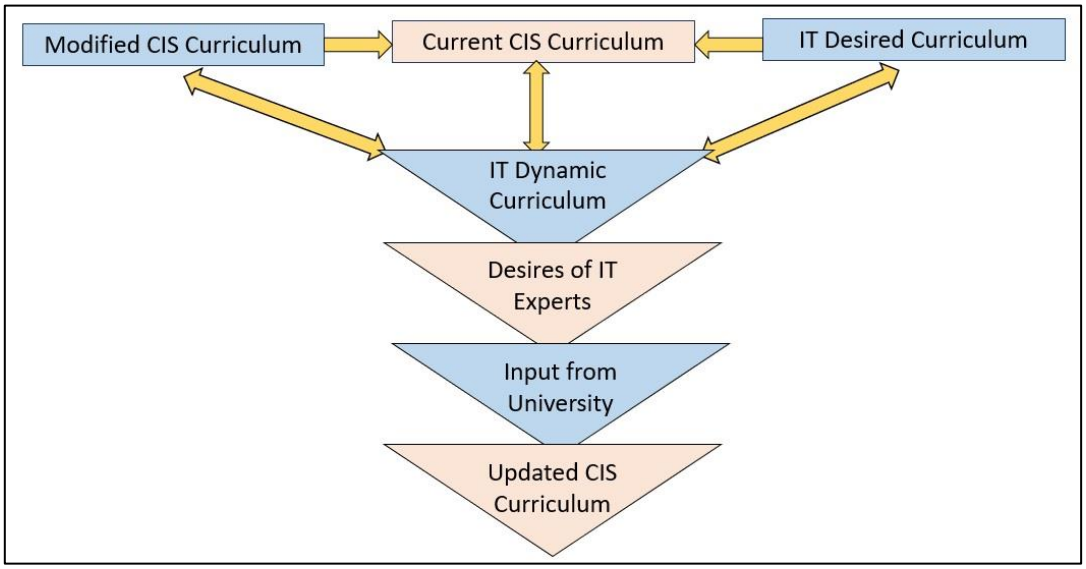

Figure 3. CIS/IT Assessment Process

Prejean (2017) developed the model in Figure 3 showing how the Computer Information System Department at the University collaborates with their strategic technology partners to ensure that students learn skills that will help them transition easily into the workplace. The steps are described below:

(1) Current CIS Curriculum. Current CIS Curriculum was developed based on the general functionality of IT technology. Current CIS Curriculum at NSU has comparable program with parallel schools.
(2) IT Desired Curriculum. IT Desired Curriculum is seeking for the integration of latest technology into CIS Curriculum. IT Desired Curriculum is based on the latest knowledge & skills for developing futuristic products which are integrated into CIS curriculum systematically. They work with stakeholders to obtain latest development information to ensure employability of their graduates.
(3) Modified CIS Curriculum. Based on Desired Curriculum, modification should take place. Modification should be dynamic and methodical.
(4) IT Dynamic Curriculum. The outcome of above stage is creating a practical and functional curriculum for IT.
(5) Testing. The IT Dynamic Curriculum will be tested for maximization of product improvement. (Prejean, 2017; Prejean et al., 2020)

3.2 How NSU SoB is weathering the COVID-19 storm

Initially, the ULS System President met with his leadership team that includes the presidents of all nine universities and a member of the student body to discuss the COVID-19 crisis and determine how they would implement the recommendations from the CDC. In turn, the Presidents gathered their respective leadership teams to determine how to incorporate these recommendations or establish their own within the existing framework. Those leadership team members met each of their units to discuss the resources needed to transition from a face to face environment to an online environment.

From that point, the School of Business was able to pause and pivot because our former Dean believed that processes and policies must be proactive and embrace change to survive and thrive in storms, whether economic, natural, or medical. (Crom, 2020; M. Kilcoyne, personal communication. March 30, 2020)

In the early 2000s, online classes were established and created to not have any significant differences in the course content from the face-to-face classes; in fact, the classes mirror one another. When the COVID-19 crisis hit, SoB could weather the storm, because we were already prepared. Once the students were sent home, SoB leadership team zeroed in on efforts to ensure connectivity for both the students and faculty. Further, it became critical to ensure that communication between the faculty and administrators continue unabated. As such, the Dean of SoB established a weekly WebEx meeting to ensure that faculty members were provided updated information and allowed her to check on the professor's and instructors' well-being. (M. Kilcoyne, personal communication, March 19, 2019)

Research continued despite COVID-19. Individuals and teams have met virtually to facilitate business research and prepare to showcase the research for virtual conferences. Most had not delivered information on the various platforms utilized; however, given our commitment to agile management, members of the School simply met the challenge. (M. Aldredge, M. Kilcoyne, personal communication, March 30, 2020)

An additional way we weathered the storm was to continue our commitment to engaging our community stakeholders. Given that several of our supporters are small business owners, the School uniquely positioned itself with the area's chamber of commerce to provide relevant information to help businesses manage the new economic reality of COVID-19. As such, the School and its Advisory Board has a depth of talent and knowledge. These members have banded together to present information on different business topics to give innovative ideas and hope that they can make it. The discussions have been on employee safety, the Paycheck Protection Program, computer security, and exploring their international business potential. These talks have been led by an amazing array of instructors and advisory board members. They have been attended equally by an amazing array of business owners or their representatives. (C. Parker, personal communication, March 30, 2019)

An example of an actual agile management project was our graduating class experiential learning project. As part of the capstone or senior class, business students collaborated with local and national businesses to analyze their overall business position in the marketplace. As part of this effort, they worked with several local businesses enhancing their social media and marketing platforms and other areas. It was a beneficial experience for all, as businesses were forced to change quickly to service the COVID-19 marketplace. It was a great learning experience for all who took part in the project, and their efforts were highlighted in the local newspaper. (Jackson, 2020b, Prejean, E, personal communication, March 30, 2019)

As a result of the pandemic, NSU's accounting department was forced to pause, pivot, and redefine its delivery of course material in the spring 2020 traditional classes. Virtual learning became a reality for many students, even if they had avoided those platforms before. WebEx was used extensively to provide one-on-one assistance to those students needing help. (M. Aldredge, personal communication, March 30, 2020)

NSU will continue to revamp its programs in this COVID-19 era and beyond, all while maintaining the rigor and integrity of its accounting courses. New models will be introduced and the traditional internet sections to meet the health/safety restrictions of the pandemic. When there is not enough capacity for everyone enrolled to be in the same classroom due to COVID-19 constraints, distance learning courses will be offered. These courses will be conducted with a face-to-face component in one room while broadcasting the class lecture in real-time to another room in the same building or an off-campus location. All students will be able to see and communicate with the instructor.

Alternatively, some courses will move to a HyFlex instruction method (Sowell, Saichaie, Bergman, & Applegate, 2019). Students in a HyFlex course will participate in online and face-to-face learning during the semester. Virtual participation in a HyFlex course differs from that in a traditional, online system. Students are required to "attend" the live class in the virtual environment on the same day/time each week and can, in real-time, engage with the instructor and/or other students. For example, if a course was initially scheduled to meet every Monday and Wednesday of the semester, in the HyFlex mode of delivery, the course would be split into two parts:

- Half of the students would participate in person every Monday and virtually every Wednesday.

- Half of the students would participate virtually every Monday and in-person every Wednesday. (Parker, C., personal communication, March 30, 2020)

According to Dr. Curtis Penrod, the Senior Coordinator of Business Programs at College of Business and Technology of the University, students were able to complete their experiential learning projects in our capstone learning courses Computer Information Systems 3900 and Computer Information Systems 4600. Students transitioned to the online environment and used online collaboration tools to create an application for a business. Students still worked together to bring the project to completion. (Curtis Penrod, personal communication, August 20, 2020)

4. Conclusions and Implications

In conclusion, Figure 4 shows a typical agile process for all three programs in SoB to improve the curriculum. This agile process in SoB continues to weather the storm adapting most recently to a devastating hurricane in the State of Louisiana, working with students individually and collectively to provide an excellent academic experience. Students helped in all parts of the state with clean-up, delivering supplies, and other service projects, making a difference for the community.

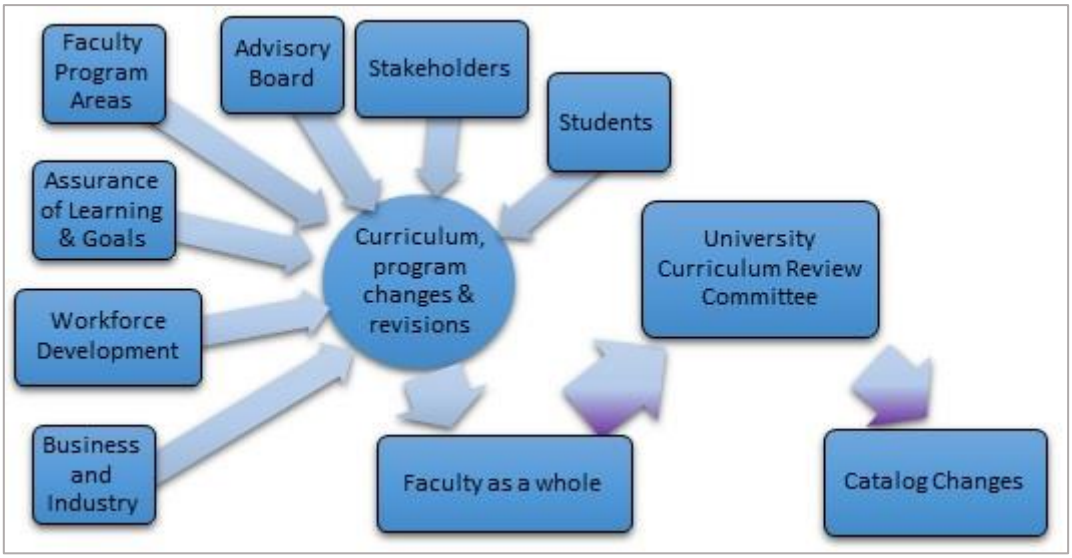

Figure 4. A Typical Agile Process in SoB to Improve the Curriculum

This research has practical meaning to other schools and businesses as they also thrive in the storm of life, pausing, and pivoting to deal with each situation. Our university has used the pause and pivot method of agile management to inspire our students to do the same in their work. In fact, some of the management students are currently developing a Sustainability and Disaster Plan after the last hurricane to help the area in its quest to become more efficient, moving the agile process again to the community. Others are working on individual projects with a local Entrepreneurial Accelerator Program. This gives the students a chance to understand responsive in turbulent times. This learning opportunity will combine personal and business development and community development to continue the changes using an agile process.

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Influence of Individual Counselling on Self-Actualisation Of Students in Public Technical Colleges of Kisumu County, Kenya

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ABSTRACT

Individual counselling is slowly gaining popularity as a measure for matching student's sense of fulfilment with the general goals of technical and vocational education. The purpose of this study was to investigate the influence of individual counselling on self-actualisation of students in public Technical colleges.The study was conducted in public technical colleges in Kisumu county, Kenya. A sample size of 120 students was selected at random. The findings indicated that individual counselling has a significant beneficial influence on student self-actualisation tendencies at the p<.05 level [F(1, 366) = 30.221, p = 0.000]. This indicates that those who had less benefitted from individual counselling had a low self-actualisation tendency while those who had highly benefitted from individual counselling had higher self-actualisation tendency. Implications of this finding are discussed.

Keywords: Fulfillment, Influence, Self-Actualisation, Technical colleges, Individual counseling, Kisumu County

1. Introduction

From the Greeks worldview, individual counselling is a joint process between a counsellor and counselee so as to inspire better quality of life also referred to as psychotherapy (Godwin & James, 2008). In a college perspective, individual counselling provides to a student the opportunity for personal and direct psychological help from a counsellor. A student is therefore led towards coping with their inherent challenges and continuing to grow towards self-actualisation. Individual counselling helps the students to deal with a myriad of personal topics in life such as career choice and development, anger, anxiety, substance abuse, intimacy in relationships, childhood problems and other personal and career related challenges (Robinson & Gordon, 2011).

Individual counselling is also referred to as talk therapy because through this process, the students work one-on-one with a counsellor in a therapeutic experience. In order to compete with rapidly changing socio-cultural demands due to globalization and ubiquitous culture of technology and evils of commercialism a study by Richardson (2015). Among Technical training institutes in United Kingdom revealed that it is imperative that students should be committed to personal growth which never quits. Robitschek et al (2012) who developed Personal Growth Initiative Scale (PGIS) says that PGI is concerned with intentionality of growth, an individual's willingness to engage in the improvement of themselves or their lives. These Personal growth initiatives (PGI) drive people towards continuous pursuit of challenge and growth that is

deemed helpful in achievement of life goals and personal fulfilment. These things substantiate rationale behind measuring Personal growth initiative among students in order to ensure their general growth and development (Butler et al, 2012).

Through counselling, the students are provided with an opportunity to explore their feelings and beliefs, work on their challenges and diversionary memories, identify aspects of their lives that they would like to change, understand and accept self and environment, set relevant goals and work towards them. By helping students towards attainment of immediate or near future goals, individual counselling leads to fulfilment and self-actualisation (Krems & Kenrick, 2017).

According to Abraham Maslow, Self-actualization can only be achieved by a peaceful mind and therefore individual counselling in TVET institutions attempts to reduce relapses of common conditions such as moderate anxiety and depression among students. after counselling sessions, it is expected that the students will encounter improved college life conditions long after therapy has ended (Green, 2013). While most student issues are handled with short-term individual counselling the complex issues are usually referred to specialized practitioners so as to free the Institutional counsellor for more students. Client centred approach has continuously resonated well with the students in Africa based technical colleges due to its client-therapist relationship that is based on warmth, congruence, unconditional positive regard, empathy and respect (James, 2013). Much effort has been put in place to build mental capacities of the students and general Kenyan population by government of Kenya as well as professional associations such as Kenya Psychological Association and the Kenya Counsellors and Psychologists Association of Kenya. Individual counselling provides a learning opportunity for the counselee, to understand himself as a holistic being with strengths and weaknesses. Through this counselling process the client is able to own their weaknesses, appreciate them and build internal resources to control the effects of their personal weakness. The realized strengths may then be rolled out to benefit self and immediate society in meeting the demands of life and furthering their life goals.

2. Methods and Procedures

The study employed ex post facto research design on the variables and explained them in details resulting to a comprehensive study on the phenomenon in the area of study. The dependent variable for this study was self actualisation that is manifested at personal, social and academic levels. The independent variable was Individual counseling. Information on individual counseling and self-actualisation was collected using questionnaires. The study was conducted in the two public technical colleges in Kisumu County, Kenya.

3. Results

The objective of the study was to determine the influence of individual counselling on self-actualisation of students in technical colleges in Kisumu County, Kenya. Results are presented in Table 1.

Table 1: Individual Counselling and Self-actualisation

			Self-actualisation		Total
			High self-actualisation tendency	Low self-actualisation tendency	
Individual Counselling	Less benefited	Count	26	42	68
		% within Individual counselling	38.2%	61.8%	100.0%
	Highly benefited	Count	216	84	300
		% within Individual counselling	72.0%	28.0%	100.0%
Total student observation		Count	242	126	368
		% within Individual counselling	65.8%	34.2%	100.0%

Table 1 shows that out of those who had less benefitted from individual counselling, 61.8% had a low self-actualisation tendency while 38.2% had a high self-actualisation tendency. Those who had highly benefitted from individual counselling showed that 72% had high self-actualisation tendency while 28% had low self-actualisation tendency. In total, 65.8% of students who had interacted with individual counselling had a high self-actualisation tendency while 34.2% had low self-actualisation tendency. Findings from the two 100% counsellors indicated their conviction that students who interacted with individual counselling had higher self-actualisation tendencies. These results were found to resonate with the findings of Patton (2015) that individual counselling inspires a better quality of life in career; personal life and social interactions in technical colleges and that individual counselling of students should be enhanced for goals attainment and personal growth of students in technical colleges. Research by Mwiti & James (2013) indicated that individual counselling provides an opportunity for the counselee to learn and understand themselves as a holistic being with strength and weaknesses, therefore roll out to self-actualising tendencies

To determine whether the descriptive results of the influence of individual counselling was statistically significant, a one-way between subjects ANOVA was conducted to compare the effect of individual counselling on self-actualisation in individual counselling, less benefit of individual counselling and low self-actualisation tendency. The hypothesis posed was: There is no statistically significant influence of individual counselling on self-actualisation of students in selected public technical colleges in Kisumu town, Kisumu County, Kenya. Results are presented in Table 2

Table 2: ANOVA of individual counselling and Self-actualisation

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	6.320	1	6.320	30.221	.000
Within Groups	76.539	366	.209		
Total	82.859	367			

Table 2 shows that there was a significant effect of benefits of individual counselling on tendency of self-actualisation at the $p<.05$ level for the three conditions [$F(1, 366) = 30.221$, $p = 0.000$]. Therefore, the null hypothesis is rejected. This study showed that the respondents who had highly benefitted from individual counselling also indicated high self-actualisation tendencies. Those students who had less benefitted from individual counselling showed low self-actualisation tendencies. Therefore the hypothesis that there is no statistically significant influence of individual counselling on self-actualisation of students in selected public technical colleges in Kisumu town, Kisumu was rejected. Individual counselling was seen to positively influence the personal, social and academic life by improving self-value, personal goals, happy relationships, helpfulness to others, career choice and goals attainment in line with (Krems & Kenrick, 2017).

Individual counselling in technical colleges promote personal life functioning by identifying that each student has capacity and desire for personal growth and actualization. The student is therefore viewed as persons with enormous resources of self-understanding and self-direction to the level of influencing their attitudes and life concepts. A facilitative psychological environment is thereby created with empathy, genuineness and unconditional positive regard as postulated by Carl Rogers, 1957. The role of individual counselling therefore concentrates on guiding, support and creation of a structure through which a student can come up with own solutions to personal life challenges (Kabir, 2017)

Individual based counselling helps in career life functioning which is key to the academic success of students in technical colleges. Through individual counselling, these trainees are helped to find satisfaction in their technical and professional growth that cultivates self-actualisation tendencies. Sheu and Bordon's (2017) pointed out that self-efficacy, outcome expectations and Stress levels grow when college students are struggling to understand self as well as develop skills to integrate with others in cultural diversity. Individual counselling helps to brings down the stress levels and rise concentration on the learner of theory and practice of technical skills without cultural phobia (Sheu, Liu, & Li, 2017). The process of obtaining academic success is stressful and may require professional mitigation through individual counselling based on educational support, self-efficacy and achievement of set goals because academic well-being is related to overall well-being. (Sheu et al. 2017).

4. Implications

This research realized that a large number of the respondents had attended and benefited from counselling sessions. This study therefore identified that the beneficiaries of individual counselling had displayed appreciation for counselling services through a high self-assessment on self-actualisation tendencies. This

is an indicator that the technical colleges are making efforts to encourage students to attend counselling and the students appreciate the role of counselling. However the resources are not sufficient to support counselling. This research has determined that there is a high statistically significant influence of individual counselling on self-actualisation of students in technical colleges therefore this study recommends that the budgetary allowances be improved so as to cover the needs of the student body and that more counsellors should be recruited in technical colleges and facilitated with physical resources and continuous professional development.

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Upskilling and training of Critical Care Nurses for Pandemic- A Landscape for future

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Abstract

This writes up aspire to discourse current challenges encounter during COVID 19 pandemic and envisaging countermeasure to assert future-readiness.

This paper is adopting synthetization of literature review based on current experience through COVID 19 pandemic in outlining a considerably efficient framework for surge critical care training for future-readiness.

This article aimed to aspire to the challenges encountered during the COVID 19 pandemic and envisaging measures to ensure future readiness if a further outbreak of similar pandemics. This paper is adopting the synthetization of literature reviews based on current experience through COVID 19 pandemic in outlining a considerably efficient framework for surge critical care training for future-readiness.

1. INTRODUCTION

Healthcare leaders and human resources have been summoned with unforeseen necessity in provisioning institution readiness to meet demands of the healthcare workforce, namely, staff shortages, healthcare professionals' skills and competencies to meet the surge capacity of acute care setting attributed by the recent COVID 19 pandemic. Strategic workforce planning is crucial from leadership in all healthcare organizations to warrant public and healthcare professional safety while curtailing pandemic related repercussions. Priority has been centred on the reassignment of current staff to acute care and critical care settings and the deployment of non-clinical employees to ensure delivery of care during the precipitous hospitalization of patients with COVID-19. Additionally, the organizations thrive on capitalizing human resources to meet the demand for swift acute care. Compensating for the variable number of clinical staff who need quarantine due to unfortunate acquirement of the virus infection and being vetoed from traveling back from the home country, had imposed additional challenge.

Safeguarding healthcare professional safety and well-being, while provisioning for the workforce readiness during a crisis should prerequisite all the effort and intended approaches of any healthcare organization. Henceforth, an efficient healthcare professional training to forthwith acute care and critical care staffing is paramount to endure current insurgency and future-readiness.

2. METHOD

This paper is adopting synthetization of literature review to discourse current experience and challenges encountered through COVID 19 pandemic in outlining a considerable framework for surge critical care training to assert future-readiness.

3. LITERATURE REVIEW

3.1 COVID 19 discording nursing and critical care continuous education

The outbreak of COVID 19 had overwhelmed the current critical care bed availability and workforce capacity. Given this, the necessity of critical care skills and knowledge for nurses, especially non-critical care trained nurses to augment the workforce availability, has become essential.

As the coronavirus rapidly spreading throughout the world, its detrimental impact on the global population and international health care organization was swift, evolving, and unpredictable. Its effects on nurses are predominantly direct, with rapid cessation of all essential education and training related activities in most organizations. Indeed, the challenge in addressing this problem has become more perplexed; however, to resolute, the setback and curtailing serious ramifications related to patient care, particularly patient safety is imperative (Durham et al., 2008)

3.1.1 Upskilling of healthcare workers for crisis; readiness, safety and proficiency

Goh and colleague 2020, proponents of the article, "Preparing your intensive care unit for the COVID-19 pandemic: practical considerations and strategies," stressed the importance of upskilling healthcare workers as one of the critical elements required to ensure sustainability of the workforce, particularly in term of infection control. They observed, through education and upskilling, logistical and technical challenges with routine or ICU care could be identified and addressed in time. Their approach was 'just-in-time' inter-professional and in situ simulation to upkeep the momentum of rapid training and skills retainment. In their simulation training, procedure such as resuscitation and rapid response team training, extracorporeal membrane oxygenation (ECMO), transport of critically ill patients, and procedures like tracheostomy, were performed with full airborne precautions and powered air-purifying respirator (PAPR). During the resuscitation simulation, they found the used of PAPR complicated the process of breath auscultation, whereby, to do so, participant had violated major infection control measure. Hence, in addition to critical care training, infection control has been their focus point in curtailing the unnecessary spread of infection, as well protecting front liners during direct patient encounter. "HCWs should be taught to inspect, disinfect, and dispose of PPE safely, and periodic refresher re-training is required to ensure staff readiness and proficiency" (Goh et al.,2020).

3.1.2 The experiences of health-care providers during the COVID-19 crisis in China: a qualitative study (Liu Q et al., 2020).

This qualitative study presented the predicament faced by Chinese nurses and physicians during the initial of COVID-19 pandemic. At the early phase of the outbreak, the Chinese health-care providers who were assigned to work in the COVID unit and facility were anxious and lacks confidence in caring for patients with this new disease. The risk, transmissibility, pathogenicity, and treatment of the disease were not well

understood, and worries exacerbate as they no longer had the opportunity of educating themselves with the nature of the emerging pandemic. Moreover, some health-care providers had no experience working in an intensive care unit or dealing with critically ill patients requiring mechanical ventilation, and they needed to learn and master new skill and technical procedures in a short period of time. In this empirical study, a semi-structured, in-depth telephonic interview was done. Participants narratives then transcribed verbatim and analysed using "Haase's adaptation of Colaizzi's phenomenological method" (Liu Q et al., 2020). The study findings revealed three main emergence themes; "being fully responsible for patient well-being is my duty", "challenges of working on COVID-19 wards" and "resilience amid challenges" (Liu Q et al., 2020). They summarized, that a comprehensive support and intensive training were necessary to promote preparedness and efficacy in crisis management, safeguarding difficult task/duty and well-being of the health-care providers, while cultivating resiliency with spirit of professional dedication to overcome difficulties despite of the task and allocation in completely new unit/environment.

3.1.3 Experience from Italy (Bambi et al., 2020)

Stefano, a registered nurse in the medical and surgical intensive care unit, Careggi University Hospital, Florence, Italy narrated their experience on how they responded to COVID pandemic. In his commentary article, he cited, Lucchini and colleague (2020), on a recent case series of critically ill patients affected by COVID-19, showing a 33% increase in nursing workload compared with the usual case mix seen with ICU patients. He suggested that surveys about nursing activities and nurse to patient ratios in COVID-19 ICUs could be useful to establish priorities in managing potential staff shortages. In their case and experience, staffing during this pandemic has been resolved by enrolling both nurses with previous ICU experience and recently graduated nurses to manage the surge number of COVID-19 patients. "This solution may have lowered the staff skill mix in these ICUs below the required standards, with potential risks to patients' safety and quality of care" (Bambi et al., 2020), but a great opportunity is available to increase each nurse's experience and competencies and to improve nurses' skills within multidisciplinary teams. He emphasized, broadening competencies and skills on regular basis could have beneficial effects for nurses during pandemic. Consequently, he believes that nurse's regular rotation between specialities will guarantee expanded skills and knowledge acquirement, increasing practical and theoretical knowledge in different specialities, and reducing psychological impact to nurses in case of sudden reassignment to a different clinical setting.

Hence, an upskilling program instituted for non-critical care nurses has become a focal point in the middle of this pandemic to safeguard workforce capacity. The essential of upskilling program is to supports non-critical care nurses, develops essential foundational knowledge in critical care patient management, monitors, and evaluates nursing interventions for critically ill COVID-19 patients.

3.2 The organization compels to recruit alternative in resourcing the insurgency of critical care patient

As the emergency department overwhelmed with patients due to unforeseen widespread pandemic influenza, a guideline to triage patients efficiently to the intensive care unit deemed salient. Notably, the vast number of patients succumbing to the virus infection leads to a scarcity of resources, even in developed

countries. A well-defined strategy in subjugating the surge capacity for huge critical care demand was indispensable.

3.2.1 Surge Capacity and critical care

Surge capacity in this writing context contemplates the ability of an organization to withstand a sudden increase in the number of patients in critical care (Goh et al., 2020) due to the nature of the disease progression. Though, the physical bed capacity of intensive care unit could be substantially increased, it depends on the management system's efficiency, availability of space, supplies, staff, and other pertinence considerations (Phua et al., 2020). New staffing models and strategies for reducing local variability in surge capability are urgently needed (Litton, et al., 2020).

3.2.2 Strategies implored to augment resources in critical care

Globally, there are different strategies exerted to overcome the increasing surge demand. Among those strategies are structuring alternatives practice to ensure that enough healthcare workers are available to provide support for COVID-19 acute clinical care; such strategies include face-to-face triage, promoting telemedicine particularly video consultation (Ohannessian et al., 2020), cancellation of non-urgent outpatient visits, and considering postponing or cancelling elective procedures and surgeries (American College of Surgeons, 2020). There is numerous course of maximizing the services capabilities in terms of mitigating the surge capacity in the critical care areas which include; “1) prepare and implement rapid identification and isolation protocols, and a surge in ICU bed capacity; (2) provide a sustainable workforce with a focus on infection control; (3) ensure adequate supplies to equip ICUs and protect healthcare workers; and (4) maintain quality clinical management, as well as effective communication” (Goh et al., 2020) and (5) training and deployment of nurses from less affected unit to the more saturated areas such as critical care (Raurell-Torredà M, 2020).

3.2.3 Maximizing the availability of containment areas for COVID 19 patient without compromising safety

In the cascade of an extended period of widespread community transmission, the emphasis shifted on supporting essential hospital services, such as critical care and emergency care to mitigate stretch in capacity while maintaining containment efforts. The response will be varied based on the scale and severity of the pandemic (Einav et al., 2014). Given the preparation of the critical care department, consideration of the alternative design of isolation rooms to safeguarding patient placement was instituted. Geographical separation of clinical areas allows the concentration and segregation of equipment and staff, contributing to more effective containment. Ideally, to be effective in the containment effort of the virus, Intensive Care Unit (ICU) should consist of negative pressure airborne prevention rooms or utilization of rooms with high-efficiency particulate air (HEPA) filters in the absence of negative pressure rooms (Phua et al., 2020). Patients are screened at the emergency department and inpatient wards, to expedite identification and isolation of suspected and confirmed cases. As been widely defined, suspected cases ascertainment was based on a combination of travel and contact history and the presence of signs of respiratory illness (Wee et al., 2020).

3.3 COVID 19 destitute critical care

3.3.1 Higher mortality rate due to overwhelming services

The COVID-19 pandemic notably challenging critical care systems worldwide at all levels and optimizing critical care management for acute respiratory failure is a cornerstone in saving patients' lives (Abe, R. et al., 2020). A recent publication in JAMA, through several large-scale observational studies describing the clinical characteristics and outcomes of patients with COVID-19 in a multi-international city. In New York City, 2634 patients were either discharged or died upon succumbed by the virus; 373 (14%) were treated in the ICU, with 320 (12%) received invasive mechanical ventilation (ISARIC, 2020). That is rounding up to 88% of patients who died while receiving mechanical ventilation. A similar finding was retrieved from the United Kingdom national registry; 62% of patients (n=2175/3508) with confirmed COVID-19 died while on advanced respiratory support in the ICU (Grasselli, G. et al., 2020). In Italy, a report from the Lombardy region; among 1591 patients who were acquiring the same virus admitted to ICUs, 26% died, 16% were discharged, and 58% were still in the ICU Griffin, K. M et al., 2020). The high mortality rates could be attributed to overwhelming ICU services owing to exponential surges in the number of acute respiratory distress syndrome cases related to the rampant spread of COVID-19 (Richardson, S. et al., 2020).

3.3.2 Deployment from other specialties come with a cost

High mortality rate is not an exclusive impact of COVID 19. The surge number of a sick patients who are requiring high ventilator support, and hemodynamic support due the nature progression of the infection has outnumbered the existing capacity of trained ICU nurses and intensivists. Deployment of the other specialties to the ICUs, namely anesthetist, in house non-critical care nursing team, with additional deployment of medical and nursing team from outside of the institution had been a prime alternative in aiding the outnumbered workforce (Raurell-Torredà M, 2020). The collateral impact of the deployment, arise from challenges in effective communication among the “intended team” member, risky staff-patient allocation/shift assignment due to unfamiliarity of the shift leader on the staff skill limitation, lack of sense of belonging in the “alien” unit influenced the staff adherence to common critical care patient bundles, and with all these cofounding factors, optimum patient care delivery and outcome will be affected. Therefore, development of a team-based approach for critical care patient management is paramount to minimize the cost (Phua et al., 2020).

3.3.3 Coping with the “tsunami” of COVID 19 update

The rapid spread of the disease and the appetite for updated guideline in understanding the disease and treatment has inspire many health clinicians, policy makers, and health care organization to publish project and research related to COVID 19. Though, generally research and academic writing is highly encouraged in healthcare, particularly when illness is related to complex critical care management, during this pandemic, these endeavors has notably posed a detrimental impact. Many publications at the realm of the pandemic are lack of appropriate peer review, “been sub-optimally designed, with small interventional studies are initiated, therefore statistically underpowered”(Pickkers, P. et al., 2020; Voss, A. et al., 2020)), which lead lack of clinically relevant conclusion. Consequently, the “prematurely publish” study/guideline

will stir anxiety among critical care front-liners, health clinicians, and public alike due to uncertainty of the disseminated info. Therefore, controlling and regulating the influx of info in the healthcare organization during pandemic is substantial (Pickkers, P. et al., 2020). A designated national level body/organization will be valuable in regulating and disseminating appropriate info related to their specific geographical evolution of the disease and resources.

3.3.4 Critical care break the norm of disposing the disposable PPE: The REUSE, do's and don'ts of N95 respirator mask

As COVID 19 primarily transmittable via droplet and aerosolized procedure, N95 respirator mask has been the essential personal protective equipment (PPE) for healthcare providers, in addition to impermeable gown, google, and face shield. However, N95 notably scarcely available in comparison to other PPE during recent pandemic (Livingston et al.,2020). To safeguard the availability of N95 respirator, the Centre of Disease Control (CDC) recommended the limited reuse of N95 as following.

- Do not reuse N95 respirators following use during aerosol generating procedures.
- Do not reuse N95 respirators contaminated with blood, respiratory or nasal secretions, or other bodily fluids from patients.
- Do not reuse respirators following close contact with any patient co-infected with an infectious disease requiring contact precautions.
- Do apply a regular mask on top on N95 respirator to minimize soiling on the outer surface of the mask.
- Hang or store used respirators in a clean, breathable area or container. To minimize potential cross-contamination, respirators must not touch each other, and the name of the respirator owner is clearly identified. Storage containers should be disposed of or cleaned regularly.
- Clean hands with soap and water or an alcohol-based hand sanitizer before and after touching or adjusting the respirator (if necessary, for comfort or to maintain fit).
- Do not touch inside of the respirator. If inadvertent contact is made, respirator to be discarded and perform proper hand hygiene.
- Use a pair of clean (non-sterile) gloves when donning a used N95 respirator and performing a user seal check. Discard gloves after the N95 respirator is donned and any adjustments are made.

4. RECOMMENDED FRAMEWORK AND GUIDELINES FOR NURSE'S PREPAREDNESS TO ADULT CRITICAL CARE DURING PANDEMIC

This framework and guidelines were designed to advance the competence of non-critical care nurses and nurses who worked in less saturated critical care areas within the organization in supporting the critical care workforce managing critically ill COVID 19 adult patients. The program includes a structured theoretical and clinical facet. It aims to equip non-critical care nurses and other intended nurses alike with the needed essential critical care knowledge and skills to perform efficiently in the critical care setting and ensure that the delivery of care is safe and holistic. However, with the advent of COVID 19, the mode of

delivery of this training program has been devised to prevent the spread of the virus and cross-infection of the disease and, at the same time, protecting the personal safety of the nurses.

4.1 Selection criteria of the participants

To warrant timeliness comprehension of knowledge and skill acquirement during pandemic, the participants selection for deployment preparedness training was limited to step down units, post anesthesia care unit (PACU), pediatric ICUs, and neonatal ICUs. Due to lack of availability on conclusive guideline for critical care training participant selection (Raurell-Torredà M, 2020), this criterion was deemed appropriate, presuming that nurses from the intended areas has basic knowledge on critical care concept, care and management.

4.2 Training design and delivery mode

The training encompasses of two-day theoretical interactive lecture using didactic mode, followed by three-day clinical exposure with preceptors (senior ICU nurses). Skill station and case discussion were incorporated between the theoretical session to enhance core skill and learning behavior. To obtain the target number of trained nurses to be ready for clinical deployment, training is to be delivered in weekly basis (one batch/one week).

4.3 Training contents

The program covers an integrated knowledge related on COVID-19, based on the organization's approve adaptation of published evidence-based practice on clinical practice guidelines. Ultimately, the fundamental concept in managing adult patients with ARDS, sepsis, and other related physiological impact of COVID-19 acquirement were extensively discussed and explored by the critical care nurse educators who assigned to facilitate the training. Core concepts such as airway management, assisting with rapid sequence intubation and invasive line insertion, care and safe management of patient on mechanical ventilator and artificial airway, invasive lines monitoring and care, management of hemodynamic and life sustaining drugs, and sedation analgesia with/without paralytic agents were included. Besides, the training inclusive touches base on emergencies responses in a critical care setting, namely basic life support, advanced life support, and mock drills tailored to the recommended guideline for healthcare during recent pandemic. Additionally, imploring return demo by participants on prone positioning patient (simulation) while on mechanical ventilator with multiple lines will warrant safe application of the skill on actual patient.

4.3 Safety guideline on PPEs and different set up of isolation

Safeguarding nurses' safety during clinical deployment is a primary consideration to promote health, well-being, and a sustainable workforce. During skill station, participants were briefed on the safe practice of reusing N95 respirator according to the CDC recommendation, complimented with practice while watching on proper hand washing and donning and doffing procedure of the required PPEs; mask, goggle, face shield, head cover, gown, glove, shoe cover and Hazmat suit.

As to increase the capacity of containment space in critical care, due to limited negative pressure room availability, all single room in the ICU was safely utilized to accommodate patient using high-efficiency particulate air (HEPA) filters. Knowing that these type of room were not build with ante-room (as in

negative pressure room set up) for preferably donning and doffing space, the participants were taught to remove all the donned PPEs except N95 respirator and the outer layer facemask, which to be doffed once they completely closed the exited door. During clinical deployment nurse participants were closely monitored by on duty Charge Nurse and Clinical Nurse Educator on adherence to the infection control endorsed safety guideline.

4.4 Skill checklist to guide and monitor clinical skill obtainment

Skill checklist is design to guide participants clinical exposure, as well to guide the preceptor and Clinical Nurse Educator on the progress of the nurse participants. This approach will encourage learner led learning with timeliness safe supervision.

4.5 Primary Outline of the framework and guidelines

The program's outcome was set based on the needs of the actual participants and the competence of staff required by the unit where they may be assigned; thus, the participant was aided to accomplish these primary outcomes:

Knowledge and Understanding

- Understand COVID 19, pathophysiology and transmission
- Define the significant concepts in the care of patients with COVID 19 in a critical care setting.
- Understanding the concept of mechanical ventilation.
- Understanding Acute Respiratory Distress Syndrome (ARDS) and sepsis.
- Recognize the psychosocial aspects of critically ill patients.
- Define the ethical and legal aspects of patient in the critical care unit.

Cognitive Skills (Thinking and Analysis)

- Utilize current data to tailor a comprehensive nursing care plan for the critically ill patient during surge capacity.
- Analyze the collected data according to priority and formulate appropriate nursing diagnoses related to patients with COVID 19.
- Evaluate the patients' outcomes and connect with the current situation, using the critical thinking process.

Practical and Subject Specific Skills (Transferable Skills)

- Demonstrate nursing care competencies specific to patients with COVID 19 in critical care units (e.g., proning of mechanically ventilated patients).
- Appropriate utilization of personal protective equipment (PPE).
- On the spot, bedside education for cross-trained nurses with their clinical nurse educators.
- Practice role-specific decision-making skills.
- Perform a goal-oriented problem-solving process.

One of the challenges faced in the implementation of the program was to educate a large number of nurses on the soonest possible time, observing social distancing hence ending up with multiple sessions having a maximum of twelve participants per session. This pandemic impacted so much on the execution of the training program. The construct of redesigning a training program where it meets the need to provide the essential skills and knowledge among health care workers is not only beneficial, but, become necessity for an organization that aims to look into staff competence and patient safety amidst pandemic. Therefore, foreseeing the future, training design like this during the crisis would benefit many organizations where the aim is to reach a more significant number of learners effectively and safely with or without a pandemic.

CONCLUSION

Undeniably, the significant predicament of the COVID 19 pandemic is towards the ICU community. As a pre-emptive effort, hospital administrators, policymakers, and critical care practitioners must work on strategies that hasten an organization is bracing itself in the future potentiality of an overwhelming surge of critically ill patients. The cornerstones for future-readiness to coherent collaboration at the local, regional, national, and international levels, focusing on high-quality research, evidence-based practice, sharing data and resources, and ethical integrity in the face of unprecedented challenges likely will be a key to the success of these efforts. Complementing the recommended framework and guidelines with data to evaluate strategy and approach will be valuable.

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Women in Vulnerability: Perceptions About Family and Reproductive Planning Policy

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ABSTRACT

***Introduction**: The family and reproductive planning program is offered in the instances of the Unified Health System (SUS), and makes free contraceptive methods and devices available to the entire population, seeking to make people aware of the advantages and disadvantages of each method. Despite citizens' rights, some communities live in a situation of vulnerability and have greater difficulty in accessing public services, as in that program. **Objective:** To analyze the knowledge and adherence of women to the family and reproductive planning program and contraceptive methods, in addition to carrying out health education activities on the subject, focusing on the copper IUD. **Methodology:** This is an action research, with random sampling and a quantitative-descriptive approach for data analysis and description. The target population is made up of women of childbearing age, or who have already started sex. The collection was carried out in the field by means of a questionnaire prepared by the researchers based on a literature review. **Results:** 195 (98%) women reported not knowing the reproductive planning program and, of these, 116 (59.5%) had at least one unwanted pregnancy; The contraceptive method of most frequent choice among women is ligation, of the 200 women 60 (30.5%) opted for it; and 30% of the population has had at least one abortion in their lifetime. **Conclusion:** There was little knowledge and low adherence to reproductive planning and contraceptive methods in this population, possibly due to the segregation of low-income, mixed-race and black women, with low education, who are marginalized, suggesting difficulty in accessing health services, lack knowledge and family structure, in addition to demonstrating gaps in the health system.*

Keywords: Family planning; Women's health; Social vulnerability; Perception.

INTRODUCTION

Brazil has be faced in recent years the largest housing deficit ever observed in the country, where, about 7 million families do not enjoy adequate housing due, mainly, to low income, causing the lack of financial conditions to sustain the high costs of a house, such as rent, energy bills, water, beyond financing difficulties for its purchase (BRASIL, 2018). On the other hand, 6 million properties are without occupation in the country due to their irregularities, abandonments, construction interruption, among other reasons (IBGE, 2010), which has caused the increase of urban occupations throughout the country.

Although the right of access to housing is provided for in the federal constitution, as several families do not find other solutions to get a house, these people have chosen to occupy abandoned places, unused land and spaces that are irregular (IPEA, 2016), what follows from the emergence of socioeconomic, educational and health problems, and considering that the regularization process of these dwellings occurs slowly, these communities tend to live in a precarious and vulnerable way.

In the search to solve or minimize some of these diverse social problems, public policies emerge, which constitute a set of actions, deliberations and programs determined by the public power and guaranteed by the federal constitution, which exists to guarantee the fulfillment of citizens' rights. , such as education, housing, health, food, leisure, transport and security (RITT; OLIVEIRA, 2016), but the incorrect application of these policies, which aggravates the various social problems mentioned, motivated

the union of groups of people dissatisfied with the State, a union that aims to propose transformations and claim rights before the duties of the State, giving rise to a social movement called Movement of Street Workers (MTST). “Currently, according to estimates of the movement itself, 50 thousand families live in some type of occupation or are organized in nuclei”. (TOMIZAKI, 2016).

When understanding the housing situation in Brazil, it is observed that public policies play a fundamental role in helping this population, which needs attention in all social spheres due to on the use of precarious housing, lack of basic sanitation, social exclusion, prejudice and xenophobia, resulting from the pejorative vision of forming an "invasive" and not legitimate community. All of these issues make it difficult to claim rights and generate greater reluctance by the population to seek care in public services, including health, providing a situation of greater vulnerability to the disease, unwanted or unprepared pregnancy, nutritional deficit, among others. (KESSLER, 2012). Thus, it is believed that one of the government projects of great relevance to the community is the family and reproductive planning program, which is part of comprehensive health care, and comprises the actions developed in the Unified Health System (SUS), in the search for adhering to the principles of equity, integrality and universality of service to the population, (BRASIL, 2013).

The reproductive planning policy provided for by Law n° 9263 of 12 January 1996, among several functions, provides for a set of educational and information actions that seeks to promote contraception and fecundity regulation, in addition to guaranteeing the sexual right of women and couples, and preparing them for the beginning and maintenance of healthy sexual life (BRAZIL, 2013). Among the actions established in the program, several contraceptive methods are offered free of charge to women of childbearing age, from 10 to 49 years, in the search to minimize some public health problems that exhibit an increase in their incidence, such as unwanted pregnancy, causing around 22 million unsafe abortions per year (WHO, 2013), and the transmission of sexually transmitted infections (STI), which every day presents 1 million new cases, equivalent to 376 million cases per year. (WHO, 2019).

The SUS provides several contraceptive methods, such as contraceptive pills, injectable contraception, the subdermal implant, male and female condoms, the Intrauterine Device - IUD - ofcopper, ligation and vasectomy, and presents through the meeting of reproductive planning the percentage of efficacy, the advantages and disadvantages of all methods, and the criteria determined for their use, besides referencing the service for patient follow-up, what makes this program extremely necessary and important to give autonomy to women and the couple about the choice of the method to be used by them(BRASIL, 2013).

Among all the contraceptive methods available by SUS, the only ones that prevent sexually transmitted infections are condoms, however, according to the Ministry of Health, the 380A Copper Intrauterine Device has been the best use option to avoid an unwanted pregnancy, since it is not a hormonal base, has long durability of up to 10 years, has a low cost as it is offered by the public service, is a reversible method and does not cause any problem on fertility, besides being able to be adopted in the postpartum and immediate postabortion, decreasing the chances of a new pregnancy at an inappropriate time (BRASIL, 2018). Despite all the benefits and justifications, the IUD still has a membership rate of only 1.9% in Brazil, according to the National Policy of Child and Women’s Demography and Health, because people still have several doubts about the method, reaffirming the importance of population accessibility to the reproductive planning program.

The existence of various contraceptive methods should be comforting, however, even if there are various ways of avoiding unwanted pregnancy, or a sexually transmitted infection, an estimated 222 million women who wish to have no children at the moment, do not make use of any contraceptive method, due to the failure of accessibility of the health service mainly by poor populations, young people and living in rural areas or urban slums. (WHO, 2014).

The objective of this study was to analyze the knowledge and adherence of women in vulnerability to the Ministry of Health's family and reproductive planning program and the contraceptive methods offered by SUS, in addition to carrying out health education activities on the subject, focusing on the copper IUD recommended by the World Health Organization and made available free of charge by SUS.

METHODOLOGY

Type of Study

This is it an action research defined as a methodological procedure that is based on carrying out the research simultaneously with the execution of the action, in this case, of the health education. This method aims to encourage reflections about the problems related to a professional practice, and with this find suitable and effective solutions to such problems, in addition to enabling the development and sharing of knowledge significant by individuals involved in the given environment. (MONTEIRO, 2010). A quantitative-descriptive approach was used in relation to the analysis and description of the data, chosen because it seeks to understand the reality from the raw data, and to propose an analysis of them mathematically, and concomitantly seeks to detail the data and phenomena observed and obtained accurately instruments. (GERHARDT, 2009).

Site and population

The research was carried out in the field, in an occupation area in the city of Uberlândia-MG, in July 2020. The population was composed of 200 women, a sample necessary for 95% reliability with a margin of error of 5%, according to G * Power (FAUL et al., 2007), aged between 10 and 49 years old, living in the occupation area, who have reached the childbearing age or have already started their sexual life. The choice of participants was made by random sampling.

Data Collect

Data collection was performed using a semi-structured questionnaire prepared by the researchers based on a literature review, containing 11 questions that covered the research objectives.

The recruitment of the 200 women was done verbally through a group or individual approach with women after their participation in general assemblies organized by community leaders. During recruitment confidentiality about the person's identification was guaranteed, in addition to being informed about the objectives, risks and benefits of participating in research.

After accepting to participate in the research, each woman signed the Free and Informed Consent Term (FICT) in two copies, one remaining with the researcher and the other with the participant. Minors

who consented to participate signed the consent form of the minor between 12 and 18 years of age and their guardian signed the consent form of the guardian for those under 18 years old.

After completing the questionnaires, guidance on contraceptive methods and on the reproductive planning program and the importance of the debate on the topic were presented, and other questions were discussed.

Inclusion, exclusion and ethical aspects

Women who had already started their sexual life or entered the fertile period (10 to 49 years) were included and agreed to participate in the research by signing the Informed Consent Form. We excluded all women who refused to participate or did not meet the inclusion criteria.

This project was approved by the Research Ethics Committee of the Federal University of Uberlândia, CAAE: 32023820.6.0000.5152 and Opinion Number: 4.104.083.

Statistical analysis

The research methodology comprises an approach with quantitative-descriptive variables, in which the analysis of the data obtained through the questionnaire was performed using the Statistical Package for the Social Science (SPSS) software, version 21.0, which has several advantages for quantitative research, such as performing tests simultaneously, creating a database, ease of data entry, among others. (SANTOS, 2018).

RESULTS

The results described below are derived from the analysis of 200 survey respondents, and will be presented by means of tables and graphs.

Table 1 presents the sociodemographic characteristics of the women participating in the study. It was observed that of the total of 200 participants 109 (54.5%) women are in the age group of 20 to 34 years, 86 (43%) of them did not complete elementary school, 114 (57%) self-declared as brown, 68 (34%) are single, 102 (51%) do not work with professional activity (from home) and 85(42.5%) are evangelical.

Table 1 - Socio-demographic characteristics of women living in the settlement, Uberlândia-MG, 2020 (n=200).

Variable	**n**	**%**
Age(years)		
20 a 34	109	54,5
35 a 49	75	37,5
Schooling		
Incomplete Elementary School	86	43
Complete High School	56	28
Coloured		

Black	49	24,5
Brown	114	57
White	25	12,5
Marital status		
Unmarried	68	34
Married	64	32
Stable union	57	28,5
Profession		
Housewife	102	51
General services assistant	18	9
Domestic	11	5,5
Student	11	5,5
Religion		
Evangelical	85	42,5
Protestant	63	31,5
Catholic	44	22

Source: The author.

Table 2 shows the nominal quantitative variables about the relationship between the amount of unwanted pregnancies and the knowledge or not of the reproductive planning program, showing that 195 (98%) women reported not knowing the reproductive planning program, and of these, 116 (59.5%) had at least one unwanted pregnancy.

Table 2 - Analysis of the relationship between the number of unwanted pregnancies and the number of women who know or do not know the reproductive planning program, Uberlândia-MG, 2020 (n=199).

Variable	**Unwanted pregnancy (n)**								**Total**	**%**
You know the reproductive planning program	No	1	2	3	4	5	6	7		
Yes	2	-	1	-	-	-	-	1	4	2
No	79	46	24	29	9	6	1	1	195	98
Total	81	46	25	29	9	6	1	2	199	100

Source: The author.

Table 3 shows the quantitative variables in relation to contraceptive methods of choice of the population and the frequency of women who opt for each, it is observed that the contraceptive method of choice most frequent among women is ligation (60/30.5%) while the least chosen was the IUD (5/2.5%), on the other hand 52 (26%) of the women reported not using any contraceptive method despite having an active sex life.

Table 3 - Contraceptive methods of choice of the population and the frequency of women who choose each one, Uberlândia-MG, 2020 (n=199).

Variable	Contraceptive method of choice n	%
No	52	26
Male condom	19	9,5
Birth control pill	33	16,5
Injectable contraceptive	24	12
Intrauterine device	5	2,5
Subdermal implant	6	3
Ligature	61	30,5
Total	199	100

Source: The author.

Table 4 expresses the quantitative variables related to contraceptive methods best known by the population. Among the 200 women surveyed, male condoms were cited by 195 (97.5%) followed by contraceptive pills (191/95.5%), injectable contraceptives (168/ 84%), and ligation (165/ 82.5%).

Table 4 - Contraceptive methods best known by the population, Uberlândia-MG, 2020 (n=200).

Variable	Best known contraceptive methods n	%
Male condom	195	97,5
Female condom	136	68
Birth control pill	191	95,5
Injectable contraceptive	168	84
Intrauterine device	154	77
Subdermal implant	42	21
Vasectomy	136	68
Ligature	165	82,5
Tabelinha	76	38
Coitus interruptus	69	34,5

Source: The author.

Table 5 presents the nominal quantitative variables related to the number of women who know or do not know the reproductive planning program, and the women who would or would not use the IUD.

Of the 200 women participating in the survey, 195 (97.5%) reported not knowing the reproductive planning program, and 107 (55%) would not use the IUD, for various reasons, such as having a preference for another method, because they reported having many complications, among others.

Table 5 - Relationship between the number of women who know or do not know the reproductive planning program, and women who would or would not use the IUD, Uberlândia-MG, 2020 (n=199).

Variable	**Would use the IUD**							
You know the reproductive planning program	Yes	No, I prefer the pill	No, there are complications	No, I don't know	No, it doesn't work	No, I don't feel like it	No, it must be uncomfortable	No, I'm afraid
Yes	2	2	-	-	-	-	-	-
No	88	6	21	17	23	5	3	11
Total	90	8	21	17	23	5	3	11

Source: The author.

						Total	**%**
No, pejudice, it hurts	No, I want kids	No, I think it bothers	No, I don't have a husband	No, I don't have a uterus	No, my husband is vasectomized		
-	-	-	-	-	-	4	2
4	4	9	1	2	1	195	98
4	4	9	1	2	1	199	100

Source: The author.

Table 6 shows a relationship between the variables of women's ages and the number of children that each one already has. It can be observed that of the 16 women aged 14 to 19, 10 (65%) of them have at least one child, of the 50 women aged 40 to 49 21 (42%) of them have at least 4 children, and finally of the 199 women who answered the question, 95 (48%) has at least 3 children.

Table 6 - Relationship between women's ages and the number of children each has, Uberlândia-MG, 2020 (n = 199).

Variable	**Number of children**										**Total**
Age	No	1	2	3	4	5	6	7	8	9	
14 a 19	6	9	1	-	-	-	-	-	-	-	16
20 a 24	10	11	6	5	1	0	0	0	0	0	33
25 a 29	2	6	17	9	3	1	0	0	0	0	38
30 a 34	2	8	6	13	3	3	2	0	0	0	37
35 a 39	1	1	5	11	4	1	0	2	0	0	25

40 a 44	3	2	2	5	10	2	2	0	0	1	27
45 a 49	0	0	6	11	0	3	0	1	1	1	23
Total	24	37	43	54	21	10	4	3	1	2	199

Source: The author.

Table 7 shows the variable related to the number of abortions suffered by women. It was found that 60 (30%) of the interviews reported having suffered at least one abortion in their lifetime.

Table 7 - Number of abortion reported by women, Uberlândia-MG, 2020 (n=199).

Variable	**n**	**%**
Abortion suffered in life, amount		
No	139	69,5
1	45	22,5
2	12	6
3	2	1
14	1	0,5
Total	199	100

Source: The author.

DISCUSSION

Sociodemographic profile in the settlement

Generally speaking, the socio-demographic profile of the population of this study, which showed that the majority of residents had self-declared brown, had incomplete elementary school education, and were engaged in informal work or in poor pay, is in agreement with a study conducted by Bacelar, and collaborators (2019), in which it was identified that 48.7% of the residents of the settlement were brown and 62% had no education or had incomplete elementary education, likewise, the Institute of Economic and Applied Research (Ipea) in 2016, it presents similar socio-demographic data, in which a large part of the population that lives in the settlements performs informal and low-paid work activities or are domestic, in addition to the population being composed mostly of pardos or blacks.

Analysis of the relationship between the number of unwanted pregnancies and the woman's knowledge of the reproductive planning program

The data from this study showed that almost all of the respondent population had at least one unwanted pregnancy, on what, of these women, most of them did not know the family and reproductive planning program. A survey of 36 countries conducted by the United Nations (UN) in 2018 found that more than half of women who did not intend to be mothers stopped using contraceptives on their own and for various reasons based on common sense, among them, almost 85% had a pregnancy in the same year of interruption of the use of the method, corroborating this study by reinforcing the idea that the lack of provision of family and reproductive planning services including guidance on contraceptive methods contributes to the increase of unwanted pregnancies in various contexts**.**

Contraceptive method of choice

In the analysis of the data, we observed that tubal ligation is the contraceptive method most chosen by the community, while the IUD, despite being the most recommended method in recent years by the Ministry of Health, recommended as the gold standard by WHO (2018) was the least chosen, and even more worrying, a portion of women who have an active sex life do not use any contraceptive method even if they do not choose to have a pregnancy at the moment. In a study by Abílio (2018), 98 patients who underwent tubal ligation sought the health service to reverse the procedure, with the aim of having more children, due to a new marriage, the loss of a child, among other reasons, a study also revealed that the average age at which they were performed as tubal ligations was 25 years, according to the criteria adopted by law.

One of the causes of the high rates of ligation found, and also of the high rates of regret, stems from the failure to implement the family and reproductive planning program, as it was observed that many of these women regret not having been well informed about the existing methods, their advantages, disadvantages and consequences (PEREIRA, 2018).

Contraceptive methods best known by the population

In this research it was also possible to observe the prevalence of male condoms, oral contraceptives and ligation as the most known contraceptive methods among women, although a lack of understanding about the other methods was also observed, its effectiveness, advantages and disadvantages. Similar results were also obtained in a study by Fernandes and collaborators (2018)noting that condoms together with oral contraceptives were the most well-known methods used by women prior to participation in reproductive planning meetings, with a rate of 25% and 12,5%, respectively, and ligation with a rate of 10.25% in third place in the preference for use, however, after the participation of these same women in the reproductive planning meeting, 24% from them reported that they would use a different method to what they previously knew. (FERNANDES et al. 2018), demonstrating that the implementation of the reproductive planning program influences the conscious choice of the method to be used, but requires greater dissemination and adherence.

Relationship between knowledge of the reproductive planning program and the use of the IUD

The data obtained in Table 5 reinforce the idea that women's awareness of contraceptive methods is important, since the interviewees' negative responses to the use of the IUD refer to the lack of knowledge about the method, and the common sense that the IUD it causes discomfort, it is not an effective method, will cause complication, among other reasons without scientific basis, which contradicts the fact that the copper IUD is currently the method recommended by WHO as the gold standard, and encouraged by the Ministry of Health, being distributed free by SUS, presents several advantages.

Ferreira and collaborators (2018) showed in their study that most of the women surveyed showed a lack of knowledge about contraceptive methods, and this lack of knowledge was related to sociodemographic issues with findings equivalent to those of this study, in which, women have low schooling, are mostly brown and black, "from home" or do not have work with registered license (HALL, et al, 2016), in addition to stating that the information obtained in relation to the methods and mainly to the IUD, came from experiences of use by friends, and family members, and not from orientations made by

health professionals or any reliable information vehicle, thus the choice of use of the method for these women is based on personal opinions, which is not effective due to the uniqueness of each organism and each physiological response.

Relationship between women's ages and the number of children each has

From the results of this study, it was possible to observe that most women had their first pregnancy before aging, and most of them have at least four children. Equivalent data was found in na analysis carried out by the UM Population Fund in 2016, which showed that 20% of Brazilian women become mothers before age 20, 40% of them dropped out of school and 46% of their pregnancies were not planned for. The moment, relating low education and the difficulty of social coexistence due to early pregnancy and the need to care for the newborn, in addition to depending on the partner or the help of family members to maintain themselves.

Number of abortions reported by women

Finally, the study showed that abortion is apparent in almost half of the interviewees in this population, which could be partially avoided with the implementation of the actions of the reproductive planning program and guidance on contraceptive methods and pregnancy itself. Spontaneous abortion occurs due to several problems such as fetal problems, congenital malformations, hereditary diseases, sexually transmitted infections or not, pregnancy in young women, among other problems (DULAY, 2017). Some of the possible causes of abortion can be treated with monitoring and awareness of how to avoid pregnancy, or by prenatal care to observe nutritional status, baby development, disease prevention, among others, which is a problem in vulnerable populations Due to the stigma of women and the difficulty of accessing health services. In addition, considering all cases of desired or unwanted pregnancies in the 25 to 49 age group, 31% of pregnancies in Brazil are terminated by spontaneous or induced abortion, that is, 3.7 out of 100 women will have at least one abortion in the life (DUARTE, 2015), na index that could be reduced by the incisive activity of family and reproductive planning.

CONCLUSION

From the data obtained and the literature review, which presented data similar to this study, it was possible to show ignorance and low adherence to the reproductive planning program and contraceptive methods among the population studied, possibly, due to the segregation of women in situations of vulnerability, residents of the settlement area, poor, brown and black, with low schooling. These conditions raise the difficulties of access to the health service, coupled with the lack of knowledge and life prospects that perpetuate situations of risk and harm to sexual and reproductive health.

The results only reinforce the hypothesis that these people do not receive the necessary care and care with their health and their health family, which is provided by law and should cover the entire population as a principle of universality and integrality. On the other hand, it shows the gaps in the system and the persistent care gaps in our health service network, in addition to revealing the great challenge for professionals who are at the forefront of care as well as health managers and authorities.

It should be noted that the family planning program of the Ministry of Health, established since 1996, aims, among other aspects, to establish a relationship of autonomy and choice, guaranteeing equal rights for the constitution, limitation or expansion of children by women, men or the couple . The Brazilian Unified Health System is responsible for promoting the training of human resources, with an emphasis on the training of technical personnel, aiming to promote actions of attention to reproductive health, promoting resources and conditions of information, educational, technical and scientific that guarantee free exercise family planning. In this sense, it is suggested a closer approximation between the academy and the service by strengthening and expanding extension and research projects, including professional training on the subject, strengthening research and teaching extension.

These strategies and initiatives are powerful tools from the point of view of expanding the dissemination / guidance and access of the community to a type of legally supported service, which has positive consequences and impacts on health.

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Water infiltration rate in the soil under different uses and covers in the Poxim River basin, Sergipe, Brazil

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Abstract

Watersheds are units of planning and environmental management having a great importance in the management of water resources and their use. To this end, knowledge about the soil's physical and water attributes is of paramount importance in the context of water dynamics in aquifer recharge areas. Water infiltration rate into the soil is considered an important variable in the hydrological cycle, as the increase in this process can lead to a reduction in erosion and consequently greater groundwater recharge. Thus, the present work aimed to evaluate the soil water infiltration rate in the phytophysiognomy of the Poxim River basin in the State of Sergipe, in the agriculture, eucalyptus and forest areas, and to observe the effect of the infiltration water rate in areas of no-till, minimum and conventional cultivation. The soil water infiltration rate was obtained through the use of double cylinder infiltrometer and estimated through the mathematical models of Kostiakov, Kostiakov-Lewis, Horton and Philip. When making comparisons between the models for estimating of soil water infiltration rates, the Horton model showed a better fit compared to the other models used, and the type of soil cover that obtained the highest infiltration rate was the forest. No-till areas provided higher water infiltration rates in the soil, contributing to greater groundwater recharge.

Keywords: Horton, No-Tillage, Eucalyptus, Forest, conventional cultivation.

1. Introduction

The problems related to the water availability amount are real in some areas of the planet, motivated by the edaphoclimatic characteristic as well as anthropic action. Thus, attention is focused on the possibilities of solutions that aim to structure the capacity of the natural replenishment of water sources in these regions environmentally.

In Brazil, the difficulties in environmental application and management of water resources were even greater, as the management bodies were challenged by the limitations of their established accusations. For this reason, there was a need to create more active and rigorous policies for the protection of water resources that aimed at planning to ensure quality and quantity of water for various types of use. In view of this, Law

9.433/97 was created which established the watersheds as drainage physiographic areas considered as representatives of the environmental planning units, being characterized both by the functionalities of its elements as well as by the integration of the entire land area. However, even with the importance of the functional knowledge of the watersheds, failures or lack of hydrological monitoring are present.

It is necessary to know the soil water infiltration in the management of watersheds in the area of water resources to solve issues related to water conservation. Characterized as a system of water entry through the soil surface, the infiltration favors the wetting of the soil, so there is a decrease in the rate of water entry into the soil, subsequently reaching a lower constant value, called the basic infiltration rate. The soil water infiltration is defined by the use, type and slope of the area. The dynamics of water in the soil is a reflection of changes in the soil.

Thus, considering the importance of obtaining greater knowledge about water recharge in the groundwater by the characteristics of soil water infiltration, this work aimed to evaluate the soil water infiltration rate in the phytophysiognomy of the Poxim River basin in the State of Sergipe under different soil use conditions.

2. Material and Methods

2.1 Characterization of the Study Area

The research was carried out in the Poxim River basin, which comprises an area of 346.72 km2, located in the eastern portion of the State of Sergipe, between the geographic coordinates of 10°55' and 10°45' South latitude and 37°05' and 37°22' West longitude (Ferreira et al. 2011).

The watershed is characterized by type A's Tropical climate (rainy with dry summer), according to the Köppen classification. The average annual rainfall is 1,200 mm, with concentrated rainy season from April to September (Ferreira 2015) and average temperature 23°C in the coldest months (July and August) and 31°C in the hottest months (December and January) (Silva 2001).

Inserted in the Atlantic Forest biome, currently the Poxim river basin is restricted to mangroves in the estuaries, restinga vegetation on sandy soils and little remnants of the Humid Tropical Forest (BRAZIL 2001). Litolic Neosolum, Quartz Geosolum, Gleissolum and the predominance of Yellow Red Argissolum or Ultisol for USDA soil taxonomy are present in this area.

To carry out the research, images from the GeoEye Satellite were initially obtained for making maps of soil use and occupation in the watershed, and later field visits were carried out in these areas located on the maps.

The technical methodological procedure based on the mapping approach developed by Moreira (2011) was used based on the high spatial resolution images captured from Google Earth, in addition to the visual interpretation technique described by Novo (2008). The acquisition of the GeoEye Satellite images of the watershed was carried out with support from Google Earth 7.1 software. To cover the watershed boundary, a set of six scenes was required, which were saved in JPEG format. The georeferencing parameters were inserted in the images, then a mosaic of the converted and recorded scenes in the Universal Transverse Mercator (UTM) coordinate system, 24 L spindle and Datum WGS84 and export the file in GeoTIFF format. During the process of interpretation, detection, recognition, analysis, deduction, classification and evaluation were performed almost simultaneously. Furthermore, the visual interpretation was based on

seven characteristics of the image in the process of information extraction, such as: tone/color, texture, pattern, location, shape, shadow and size (New 2008), allied to the methodological support to the orientation of the Technical Manual of Soil Use of IBGE (2006), as can be seen in Figure 1.

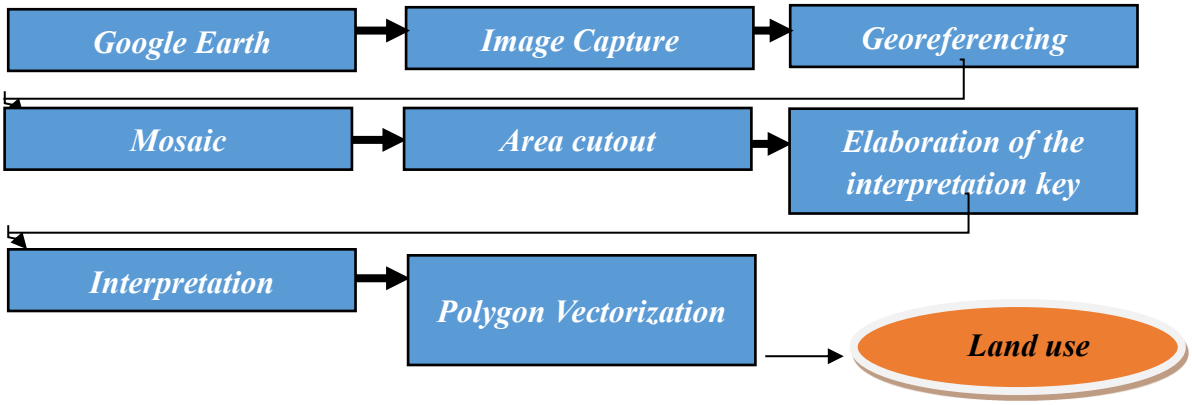

Figure 1: Flowchart of the operations performed to create the soil use map of the Poxim River basin, in the State of Sergipe, Brazil.

Based on the recognition of the study area through high resolution images, six classes of soil use and coverage were identified in the Poxim River basin. Native vegetation, water bodies, agriculture, exposed soil, pasture and urban area were identified on the map. The map of soil use and vegetation coverage of the Poxim River basin can be observed in Figure 2. The total area for each class mapped in the watershed can be seen in Table 1.

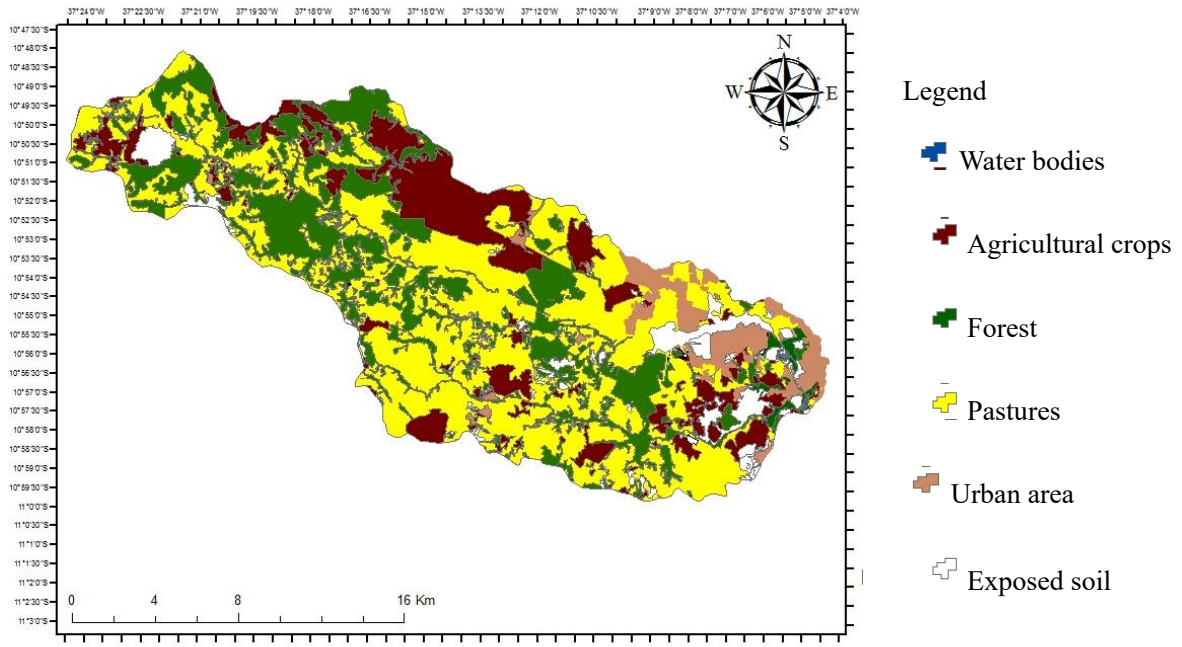

Figure 2: Map of soil use and vegetation cover of the Poxim River basin in Sergipe State, Brazil.

Table 1: Soil use classes in the Poxim River basin, Sergipe State, Brazil

Soil use classes	Area (km^2)	Percentage (%)
Pastures	158.81	45.80
Forest	91.52	26.39
Agricultural crops	58.36	16.83
Exposed soil	18.93	5.45
Urban area	18.63	5.37
Water bodies	0.47	0.13
Total	346.72	

2.2 Field sampling

The soil water infiltration tests in the soil and the determination of moisture, density and soil texture were reported in the areas of forest, eucalyptus and agricultural cultivation, using the sunflower (Helianthus annuus L.) as a cover plant in succession to corn (Zea mayes L.), which has been cultivated in three management systems (no-tillage, conventional cultivation and minimum cultivation). No-tillage has consisted of not turning over the soil. Conventional cultivation was composed of gradation with disc levelling + ploughing with disc plough + gradation. The minimum cultivation was composed of one or two gradations with disc levelling gradations, and the second gradation was only carried out when there was a considerable incidence of invasive plants.

Deformed soil samples were collected for moisture determination by the gravimetric and texture method (EMBRAPA 2013), as well as indeformed soil samples for soil density determination by the volumetric ring method, at depths of 0 - 10 and 10 - 20 cm. Soil texture analysis was performed by the pipette method (Table 2).

Table 2. Texture of a Yellow Red Argissolo in the different types of soil use in the Poxim river basin, from the surface layer of (0 - 20 cm)

	Texture (%)		
Soil use			
	Sand	**Clay**	**Silte**
Forest	70.61	15.13	14.26
Agricultural	68.76	18.00	13.24
Eucalyptus	64.95	16.55	18.50

2.3 Soil water infiltration test

Soil water infiltration tests were performed using the double cylinder infiltrometer methodology (Brandão et al. 2009). This test consists in using two concentric cylinders, the largest with a diameter of 50 cm and the smallest with a diameter of 25 cm, both with a height of 40 cm (Figure 3). The infiltration was

determined by measuring the height of water infiltrated into the soil by the smaller cylinder (internal) in successive times of readings.

Figure 3. Set of double cylinder infiltrometer.

The tests were performed until the infiltration rate became approximately constant over time. According to the experimental tests performed in the areas, the times for each reading of 2, 5, 10, 20, 20 minutes were established.

The soil water infiltration rate was estimated by means of empirical and theoretical models of Kostiakov (1932), Horton (1940), Kostiakov-Lewis and Philip (1957).

2.3.1 Kostiakov model

The empirical equation is based on the infiltration of the Kostiakov model developed in 1932, this one in the form of the connection of the field data curve.

$$I = kt^{\propto} \quad (1)$$

wherein:

I = infiltration;

t = time; and

k e α = constants that depend on the soil and its initial conditions, that is, they depend on the characteristics of the soil, such as soil texture, moisture content, density and other parameters.

2.3.2 Horton model

This equation developed by Horton (1940) has been widely used in hydrological models, as it reflects the laws and fundamental principles of soil physics.

$$i = i_f + \left(i_i - i_f\right)e^{-\beta t} \quad (2)$$

wherein:

i = infiltration rate;

i_f = the final balance or capacity of the infiltration rate;

i_i = the first infiltration capacity (t = 0); and

β = a constant that represents the rate of decrease of the infiltration rate capacity.

2.3.3 Kostiakov-Lewis ou Kostiakov modified

This equation was developed to eliminate the deficiency of the infiltration rate to tend to zero when time tends to infinity.

$$I = kt^{\propto} + i_f t \quad (3)$$

wherein:

I = infiltration;

t = time tending towards infinity; and

i_f = the equilibrium (the constant final infiltration rate).

2.3.4 Philip model

Combined with the Darcy equation for unsaturated media and with the continuity equation one arrives at a second order partial non-linear differential equation, also called the Richards equation.

$$I = \frac{1}{2}St^{-1/2} + F \quad (4)$$

wherein:

F = gravity contribution constant for a ground movement; and

S = determined by linear regression of I as a function of $t^{-1/2}$.

2.4 Statistical analysis

Residual mass coefficient (RMC) (Eq. 5), adjustment coefficient (AC) (Eq. 6) and efficiency (EF) (Eq. 7) were used to evaluate the performance between the values of the water infiltration velocity in the soil determined with infiltrometer cylinder and the values estimated by means of empirical and theoretical models.

$$RMC = \frac{(\sum_{i=1}^{n} O_i - \sum_{i=1}^{n} P_i)}{(\sum_{i=1}^{n} O_i)} \quad (5)$$

$$AC = \frac{\sum_{i=1}^{n}(O_i - \bar{O})^2}{\sum_{i=1}^{n}(P_i - \bar{O})^2} \quad (6)$$

$$EF = \frac{\left[\frac{\sum_{i=1}^{n}(O_i - \bar{O})^2}{\sum_{i=1}^{n}(O_i - \bar{P})^2}\right]}{\sum_{i=1}^{n}(O_i - \bar{O})^2} \quad (7)$$

wherein:

O_i = observed values;

P_i = estimated values;

n = number of observations;

$\bar{O}$ = arithmetic mean of observations; and

$\bar{P}$ = arithmetic mean of the estimated values.

The water infiltration rate was evaluated under three types of soil management (no-till, conventional and minimum cultivation), two soil cover (forest and eucalyptus) and the empirical and theoretical models in a subdivided plot scheme, according to an entirely randomized design with three repetitions. The results were submitted to the F test of variance analysis and the means compared by applying the Tukey test, at 5% probability.

3. Results and Discussion

The water infiltration rate curves are observed over time for no-till, minimal cultivation and conventional cultivation areas. The curves obtained in the tests describe well the process of soil water infiltration in the area (Figure 4).

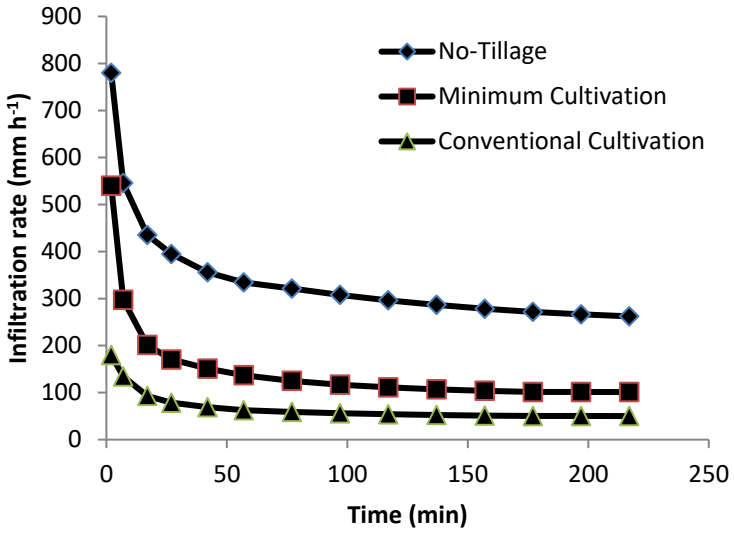

Figure 4. Curves of mean values measured of the soil water infiltration rates in no-tillage (NT), minimum cultivation (MC) and conventional cultivation (CC), as a function of the accumulated time in the agricultural area.

It was verified that the basic infiltration rate for the no-tillage area was 220 mm h^{-1}. The result found in the present work is in accordance with those obtained by Cunha et al. (2011) who obtained the stabilization of the infiltration rate at 160.32 mm h^{-1} when evaluating the infiltration of water into the soil submitted to the no-tillage system.

These high values of soil water infiltration rate can be motivated by the excellent drainage characteristics in the respective soils, since the no-tillage system allows the maintenance of plant remains. These no-tillage

areas are characterized by the non-return of the soil, or seja¸ by the permanence, for varying periods, of the residues of the previous crop and of the plant on the surface, which leads to an increase in the total porosity of the area, especially the macroporosity that exerts a great influence on the infiltration of water into the soil. It is noted that the effect of plant cover provides sufficient protection for the dissipation of the kinetic energy of raindrops, offering barriers to the sealing of the soil surface and consequently to the runoff of water, improving the soil water infiltration (Santos and Pereira 2013; Montenegro et al. 2013; Nicholls and Altieri 2012; Nunes et al. 2012).

Almeida et al. (2016) concluded that no-tillage is an efficient system for soil conservation or its recovery and in it, the organic matter assigned, improves the soil's physical conditions.

Costa (2013) stated that porosity values lower than adequate can be found, but due to good connectivity between the pores, this situation is not restrictive and there is good water conduction. For Silva et al. (2006), the soil condition provided by its management is a factor that clearly influences the soil water infiltration. Farias (2015) mentions that the water infiltration rate is one of the best parameters to assess soil structural quality. Stefanoski et al. (2013) further clarifies that, when discriminating soils with signs of degradation, the indicators of soil physical quality show the need to adopt systems that favor soil structuring, such as those that raise the levels of organic matter.

The minimum cultivation system presented an intermediate value between no-tillage and conventional cultivational systems, with the basic infiltration rate stabilizing when reaching the value of 82 mm h^{-1}, which was already predicted, since the reduction in the use of agricultural implements in the respective area allows for a better infiltration rate, i.e., there is an inverse proportionality, so that the greater the soil turning over through agricultural mechanization, the lower the soil water infiltration rate. According to Figueiredo et al. (2008), this soil management and preparation system consists of minimal soil development, reducing the potential for erosion by not disintegrating the soil and by maintaining vegetation at the surface, maintenance of moisture and water retention capacity by the soil, because of the non alteration of the structure and capillarity of the soil and maintenance of biological balance in the soil. For Blainsk et al. (2008), the soil use and management systems must maintain the capacity of the soil to perform the physical functions for the growth of the plants' roots, as well as favor the water supply. Soil losses due to erosion, reduction of organic matter, compaction, reduction of porosity, and permeability, are some of the consequences of poor use of the soil resource.

This investigation disagreed with the results found by other authors (Cunha et al. 2015; Kamimura et al. 2009; Pinheiro et al. 2009) when they studied the infiltration rates in different soil management systems (conventional, minimal and no-tillage), they concluded that minimal cultivation provided higher values of soil water infiltration rate. This difference can often be associated with different soil classes, contribution of organic matter, soil quality, different climate and the time of use in the areas. Veiga (2005) states that the continued use of soil management systems determines changes in soil properties, whose intensity depends on the time of use.

The conventional cultivation system obtained a basic infiltration rate of 42 mm h^{-1}, and at the beginning the infiltration rate was 180 mm h^{-1} and soon afterwards it suffered a sharp decrease from the first seven minutes. This decrease was basically due to the traffic of agricultural machinery as well as the use of disc plough and levelling harrow, implements used to mobilize and incorporate plant residues in soil preparation

(Figure 4). When preparing the soil, the permeability of the superficial layers tends to increase temporarily, due to the breaking of the structure of this strip fact that, Costa et al. (2015) in his study on water movement and soil porosity of a sub-basin in the northwest of São Paulo State, states that, normally, soil development promotes a temporary increase in porosity, and consequently of water movement in the soil. Soon after, there is a reduction that is motivated by the compaction at the bottom of the furrow, this compacted layer that develops just below the plowed or gridded strip, causes a sealing in the soil, making it difficult for the water to infiltrate these areas.

Bertol et al. (2004) state that conventional cultivation degrades physical properties, because the revolving breaks the aggregates, compacts the soil below the prepared layer and leaves it uncovered. According to Silva et al. (2014), the physical characteristics of the soil are directly linked to its water infiltration capacity and that, due to the mechanization process, it is necessary to analyze deeper layers that correspond to the whole profile explored by the roots in order to obtain greater certainty of water availability for the crops. The result of this research differs from that found by Viana et al. (2015), who found higher values of basic infiltration rate (234 mm h^{-1}) in areas with conventional cultivation system.

Santos et al. (2020) evaluating the use of different infiltrometers to assess environmental damage caused by different soil uses, they observed that different uses and soil cover influenced the rate of soil water infiltration obtained by different infiltrometers.

Figure 5 shows the water infiltration curve in the soil determined from the data collected with the double cylinder infiltrometer for the eucalyptus area. The basic infiltration of water into the soil in this area presented an infiltration rate of 50.01 mm h^{-1}. The areas with eucalyptus plantations allow improvements, due to higher concentrations of organic matter, as well as the large amounts of roots present that promote the approximation of particles, through the constant absorption of water in the soil profile. According to Prevedello (2012), eucalyptus forest systems contribute to the improvement of structural quality, as they favor the formation of continuous pores, important for adequate aeration, retention and water conduction.

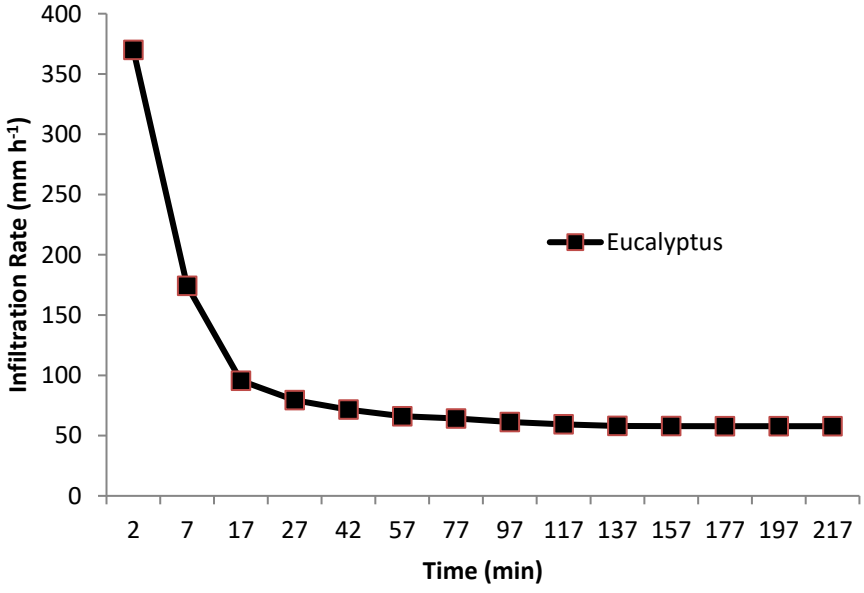

Figure 5. Soil water infiltration rate in the eucalyptus area.

There was a very sharp decrease in the first seven minutes of the infiltration test, reducing by half (Figure

5). This may be motivated by the intense passage of machinery in the eucalyptus area, which possibly caused a compaction in the soil layers, thus leading to low water infiltration capacity in this area, being possible to affirm that there is a high susceptibility to the occurrence of surface runoff.

Szymczak et al. (2014) warn that the weight and movement of the machines, combined with the improper soil moisture condition, are the main causes of structural soil degradation, verified mainly by changes in their physical properties. The same authors also concluded that harvest operations impact the soil up to a depth of 10 cm, causing compaction in the traffic lines of the machines. Morais et al. (2012) still point out that the excessive traffic of agricultural machinery causes soil compaction and thickening, which ultimately translates into high soil density values.

The soil water infiltration rate in the forest area (Figure 6) was classified as very high, reaching the value of 273 mm h^{-1}. This result disagrees with the findings of Marcatto and Silveira (2015) who obtained basic water infiltration rates in the soil ranging from 2100 to 1560 mm h^{-1} in the Pirapó River basin in the state of Paraná. These results may be associated with the variety of plant species present in forests, with different types of root systems, and the presence of macrofauna found in these soils, close to the surface.

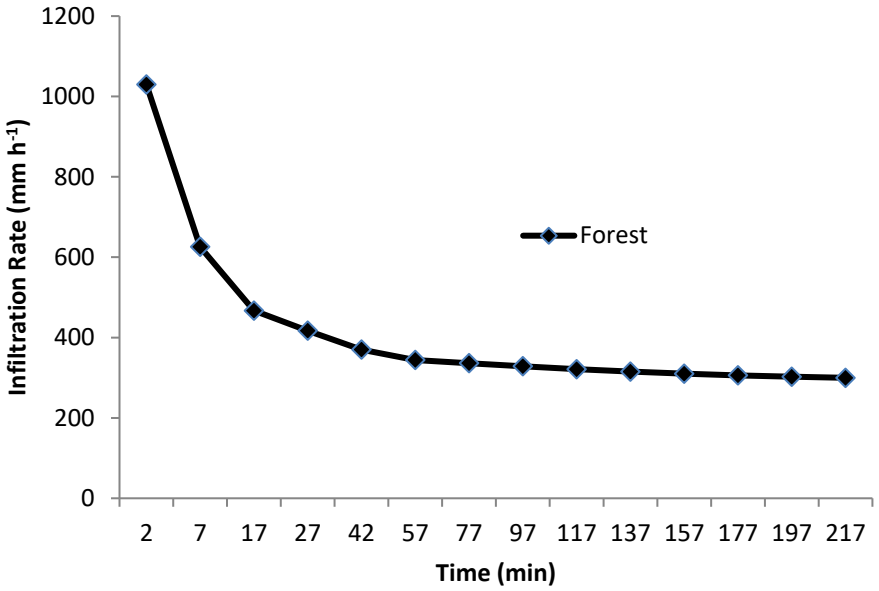

Figure 6. Soil water infiltration rate in the forest area.

According to Marcatto and Silva (2015), the good conditions of permeability in the forest, compared to other crop systems, are due to the maintenance of natural soil conditions, without direct interference from the use and management of any type of commercial crop. The forest has often been used as a comparison parameter, due to its greater conservation of physical and water properties of soils.

The empirical parameters for the mathematical models used to explain the water infiltrations in the studied soils, and the complete equations of Horton, Kostikov, Kostiakov-Lewis and Philip adjusted for each type and soil cover can be seen in Table 4.

Table 4. Results of the empirical parameters for the mathematical models used and the Horton, Kostikov, Kostiakov-Lewis and Philip equations.

Soil use	Models	EF	R^2	RMC	AC
No-Tillage	Horton	0.92	0.93	0.008	1.03
	Kostiakov	0.85	0.96	0.06	1.26
	Kostiakov-Lewis	0.70	0.97	0.07	3.60
	Philip	0.95	0.97	-0.20	1.04
Minimum cultivation	Horton	0.89	0.95	0.04	1.25
	Kostiakov	0.85	0.95	0.12	1.91
	Kostiakov-Lewis	0.57	0.98	0.19	4.84
	Philip	0.95	0.97	-0.13	1.05
Convencional cultivation	Horton	0.96	0.98	0.01	1.26
	Kostiakov	0.94	0.98	0.03	1.37
	Kostiakov-Lewis	0.50	0.98	0.16	4.37
	Philip	0.97	0.98	-0.16	1.02
Eucalyptus	Horton	0.86	0.95	0.03	1.80
	Kostiakov	0.62	0.93	0.13	3.99
	Kostiakov-Lewis	0.11	0.97	0.34	8.68
	Philip	0.85	0.92	-0.20	1.16
Forest	Horton	0.96	0.96	0.04	1.41
	Kostiakov	0.75	0.94	0.02	2.25
	Kostiakov-Lewis	0.46	0.96	0.12	6.72
	Philip	0.92	0.96	-0.18	1.07

RMC = Residual mass coefficient; AC = adjustment coefficient; EF = efficiency.

Regarding the values of efficiency (EF), the models obtained good overall performance, among them, Philip's model stands out, presenting the best results among the equations and areas, followed respectively by the models of Horton, Kostiakov and Kostiakov-Lewis (Table 4). The correlation coefficient values (R^2) were higher than 0.92, considered high, which means a good correlation of the regressions between the estimated and observed values (Table 4). This result corroborates with Souza Netto (2011), who also obtained values higher than 0.92, thus reinforcing the representativeness in the estimates of the models' parameter. The Phillip and Kostiakov-Lewis models showed the highest correlation coefficients for the no-till and forest area, while the Horton and Kostiakov models obtained the highest correlation coefficient for the conventional and minimum cultivation areas, respectively. According to Oliveira et al. (2015), the analysis of efficiency (EF) together with the correlation coefficient (R^2) represents a concise way of evaluating model performance. Fact not observed in the present research, since the EF and R^2 did not present values that could be correlated.

It was observed that by the value of the residual mass coefficient (RMC), when using the Horton, Kostiakov, Kostiakov-Lewis equations, the final infiltration rate may have been underestimated, a fact indicated by the positive values of the RMC index. For Philip's equation, overestimated values of the final infiltration

rate were observed in all treatments, which was indicated by the negative values of the CMR index (Table 4). This statistical index also confirms that the best adjustment of the equation was for Horton, as it presented deviations closer to zero in all areas. Tomasini et al. (2010), in the study of water infiltration into the soil in areas cultivated with sugarcane under different harvesting systems, stated that the best adjustment of the data was for the model of Philip's equation. It should be considered that the differences in forecasts can be attributed to several assumptions of the model and field conditions, especially the soil moisture background (Bamutaze et al. 2010). The best values of the adjustment coefficient (AC) came from Philip's mathematical equation, this can be proved by the value closest to 1.

There was significant interaction ($p<0.05$) between soil cover types and soil infiltration estimation models (Table 5).

Table 1. Summary of the analysis of variance for soil water infiltration depending on the types of soil cover and different estimate models.

Source of variation	Degree of freedom	Average square
Soil cover (SC)	4	162478.45**
error 1	10	359933.75
Models (MOD)	4	2028.76**
SC*MOD	16	254.93*
error 2		108.18
Total Adjusted	74	
CV 1 (%)	46.38	
CV 2 (%)	8.04	

* and ** significant by the F test at 5% and 1% probability, respectively.

There were significant differences between forest (F), No-Tillage (NT), Minimum Cultivation (MC), Eucalyptus (EU) and Conventional Cultivation (CC) areas, but both did not differ (Table 6).

Table 2. Average values of basic infiltration rate in forest (F), No-Tillage (NT), Minimum Cultivation (MC), Eucalyptus (EU) and Conventional Cultivation (CC) areas.

Models for estimation of soil water infiltration (mm h^{-1})	Types of use and ground cover				
	F	NT	MC	EU	CC
Kostiakov-Lewis	285.08aA	245.84aB	91.28aC	51.78aD	49.05aD
Infiltrometer cylinder	273.00aA	220.00bB	82.00aC	50.00aD	42.00aD
Horton	273.00aA	220.00bB	82.00aC	50.00aD	42.00aD
Kostiakov	238.54bA	208.21bB	70.16abC	39.75aD	39.00aD
Philip	231.45bA	219.63bA	57.72bB	30.69aBC	41.77aC

Averages followed by the same capital letter in the same line (unfolding of the crops within each infiltration model) and lower case in the same column (unfolding of the infiltration models within each coverage type) do not differ by Tukey's 5% probability

test.

The results of this research differed from those found by Cunha et al. (2015) who concluded that the no-tillage system was statistically similar to the conventional cultivation and both differed statistically from the minimum cultivation.

There was a significant effect at 5% probability for forest and eucalyptus, with a higher infiltration rate in the forest area. Romeiro et al. (2014) obtained a higher infiltration rate for the forest and a lower infiltration rate for eucalyptus, also statistically differentiated by Tukey's 5% probability test. Bonini (2012), studying degraded areas in recovery found that the forest area showed a higher soil water infiltration rate than in treatments that were modified by anthropic action. Soils with plant cover tend to have a higher infiltration rate, due to factors such as the presence of channels formed by roots, presence of organic matter and microbiological activity (Bonini and Alves 2012; Bonini 2012; Brandão et al. 2009).

The results obtained by the infiltrometer cylinder when compared to the Kostiakov-Lewis model, showed that the performance between curves were different at the beginning of the infiltration, presenting lower values than measured, but it was observed that the curves remained similar until the end of the test. These results are not in accordance with those of Pertussatti et al. (2011), studying water erosion and water infiltration under different types and soil cover, stated that the Kostiakov-Lewis model was the one that obtained the best fit for soils in studies.

Philip's model underestimated the basic soil water infiltration rate compared to the data obtained by the infiltrometer cylinder. Contrary to these results obtained for Philip's model, Gomes Filho et al. (2018) observed better results for the said model in the adequacy of the soil water infiltration rate in an area cultivated with corn and sunflower, guandu, millet and crotalaria as antecedents crops.

There was a significant effect ($p<0.05$) for no-tillage and conventional cultivation (Table 6).

The Kostiakov model underestimated the values found by the infiltrometer cylinder both at the beginning and at the end of the tests. There was a significant difference in the Kostiakov model compared to the infiltrometer cylinder test in all areas except the conventional cultivation system, this may be associated with the limitation of this model in determining the basic soil water infiltration rate in long term test. Cunha et al. (2015) when investigating the water infiltration rate in a Latosolo, concluded that the Kostiakov model was the one that best described the soil water infiltration rate.

The Horton model was the one that produced the infiltration rate of water into the soil that best fitted those obtained by the infiltrometer cylinder, since the curves became practically identical in all areas. There was no significant difference in all treatments at 5% probability when comparing the Horton model with the data obtained by the infiltrometer cylinder, thus it was possible to state that the Horton equation was perfectly adherent and best expressed the infiltration rate in all areas of this study, which was observed by other authors in a study of soil water infiltration described through mathematical models. (Santos 2014; Schreiner et al. 2010; Tomasini et al. 2010).

4. Conclusions

The different uses of the types of management and soil cover (forest, no-tillage, minimum cultivation,

conventional cultivation and eucalyptus) provided different infiltration rates, with the treatment of the forest providing the highest infiltration rate while the conventional planting provided the lowest water infiltration rate in the soil of the Poxim River basin.

No-till areas provided higher values of soil water infiltration rate compared to those of minimal and conventional cultivation, contributing to a greater recharge of the water table.

Horton's mathematical equation has better adapted to the edaphoclimatic conditions of the Poxim River basin.

5. Acknowledgements

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The Effect of Business Diversification on Financial Performance with Business Risk as an Intervening Variable in Manufacturing Companies for the 2014-2018 Period

Cesaria Saputri; Susi Sarumpaet; Sudrajat

Abstract

We can see that the significant economic development from time to time is from the number of companies that are increasing in number. Based on Schumpeter's theory of economic growth regarding innovation that causes the economy to develop, this study examines the effect of business diversification on financial performance mediated by business risk.

The sample used is manufacturing companies that carry out business diversification strategies during the 2014-2018 period on the IDX, amounting to 33 companies, with purposing sampling technique. The method of analysis in this study is experimental, which uses Size and Laverage as control variables. Data analysis in this study uses Path Analysis to see the direct or indirect effect of business diversification on financial performance mediated by business risk.

The results of the analysis prove that business diversification has a positive and significant effect on financial performance, and business diversification has a positive and significant effect on business risk. However, business risk is unable to mediate the effect of business diversification on financial performance.

Keywords: Business diversification, financial performance, and business risk

Introduction

In entering into increasingly rapid technological developments and the existence of free markets resulting in intense business competition between companies. With the current conditions, the company is required to be able to survive and further develop its business. A growing company must always strive to maintain the quality and excellence of its business to increase the value of the company concerned. Developing companies are also required to develop an appropriate strategy to maintain their existence and improve their performance. (Turiastini and Darmayanti, 2018)

When the 1998 economic crisis that hit Indonesia had a negative impact on domestic business economic activities, economic activity was paralyzed due to the number of companies that closed down and even suffered losses. (Sumendap, et.al., 2018).

Based on several studies regarding business diversification strategies that have an impact on financial performance, such as research by Turiastini and Darmayanti (2018) as well as research conducted by Vidyanata, et al., (2016) states that there is a positive effect of diversification on the company's financial performance. Contrary to the results of Ariani's research (2018) which explains that the diversification

strategy does not affect company performance. The differences in the results of these studies indicate different effects of business diversification on the company's financial performance, thus indicating that other factors influence this relationship. The current condition is where the government has begun to implement a lot of diversification strategies in certain regions in Indonesia,

The diversification strategy has several objectives, one of which is to minimize the overall risk by dividing it. Companies that diversify their business have less risk of bankruptcy because if one business experiences difficulties, other businesses can cover it with the returns they get. Research conducted by Sun and Govind (2017) found that the risk, in this case, is the investment risk that will be reduced if it diversifies when the market is in low volatility. On the other hand, if the market is in high turmoil, diversifying the business will increase the company's investment risk. In the portfolio theory, there is a proverb expressed by Harry Markowitz, namely "Don't put all your eggs in one basket", This means that if it is associated with a business diversification strategy, there are still other businesses that can cover the losses suffered. Research conducted by Wahyuni (2019) on the banking sector in Indonesia states that the diversification strategy has a positive effect on banking risk, which is marked by the more bank assets, better performance, and reducing risk. This is also in line with research conducted by Hendiono (2016) on manufacturing companies, where the results of this study indicate that diversification has a negative and significant effect on business risk, which means that the more diversified a company is, the lower the risk. This is because the losses incurred will be covered by the profits of other business segments so that the risk will decrease.

However, contrary to research conducted by Lucyanda and Wardhani (2016), it is stated that most diversified manufacturing companies in Indonesia have a very dominant sales value in one of their business segments, the results of this study also indicate that the more company segments are added, the lower the company's performance. Research conducted by Nuraini (2017) suggests that diversification can increase business risk, but if diversification works well, it will improve company performance. Due to the differences from previous research results, it is necessary to conduct further research on the role of diversification in risk, especially business risk.

This study focuses more on measuring the role of business diversification on financial performance with business risk as an intervening variable incorporated in the manufacturing industry on the Indonesia Stock Exchange, this reason is that this sector is a relatively large number of companies that diversify well by increasing the number of segments in the Indonesian Stock Exchange. companies or increasing the number of subsidiaries through acquisitions or mergers. This study adds a control variable using size and leverage.

Literature Review

Market Power Theory

Market power theory is the ability to influence market prices or even turn off competitors. Every company may have this capability but it is not necessarily used, this capability will be used when the company feels that a competitor has caused a loss (Dewi and Atiningsih, 2019)

Schumpeter's Theory of Economic Growth

Schumpeter's theory assumes that an economy is in a steady equilibrium. According to Schumpeter, the

process of economic development is the main factor that causes economic development to be the process of innovation and the perpetrators are innovators or entrepreneurs (entrepreneurs). The economic progress of a society can only be applied by the presence of innovation by entrepreneurs. These innovations include the introduction of new products, the introduction of new products, the opening of new markets, mastering new supply sources of raw materials or semi-manufactured goods, and the formation of new organizations in each industry such as the creation of a monopoly. In this theory, it emphasizes that innovation can pound and develop an economy. Diversification itself is part of innovation.

Business Diversification

According to Tjiptono (2008), diversification is an effort to seek and develop new products or markets, or fulfill the ambitions of managerial personnel.

both, to pursue growth, increase sales and profitability.

Harberd and Rieple also stated that diversification was carried out with several objectives, including:

a. Value-Added Growth
b. Even out the risks
c. Achieving Synergy
d. Control Suppliers And Distributors

Financial performance

Financial performance appraisal is one way that management can fulfill its obligations to funders and for the purposes set by the company (Rani, 2015).

Shareholders need information about the company's financial performance to avoid the risk of loss in the stock portfolio. Creditors need this information to assess whether or not a credit provider is appropriate based on company performance, while management makes various decisions by looking at the company's financial performance in the previous period (Vidyanata, et.al., 2016)

ROA is one of the profitability ratios that can be used to assess the company's performance in generating profits at certain levels of sales, assets and share capital. In analyzing the financial statements of the company's financial performance reports, ROA shows the company's ability and efficiency of the capital invested in all its assets to generate profits. ROA can be used as an indicator to determine how well a company is able to obtain optimal profit from its asset position (Turiastini and Darmayanti, 2018).

Business Risk

According to Horne and Wachowicz (2005) in the research of Valentina and Kuzikna (2017), business risk is the uncertainty that a company faces in running its business, can be measured by the variable operating profit (EBIT) generated by the company's asset portfolio and product market activities.

Effect of Business Diversification on Financial Performance

Several studies mention the effect of business diversification on financial performance including: researchTuriastini and Darmayanti (2018),Vidyanata, et.al. (2016), and Chen and Yu (2012) stated that the diversification strategy has an effect on the company's financial performance. And also research conducted

by Iskandar, et al., (2017) where the results of their research show that diversification strategies have a positive effect on the company's financial performance.

H1 = business diversification has an effect on financial performance.

The Effect of Business Diversification on Business Risk

Lestari and Sari (2014) stated that the diversification variable has an effect on total risk and systematic risk, but does not affect the company's unsystematic risk. Company diversification can reduce business risk by stayingprovide a sufficient potential level of profit, supported by research conducted by Wahyuni (2019), and Shabrina (2020).

H2 = Business Diversification has an effect on Business Risk

Effect of Business Diversification through Business Risk on Financial Performance

Hanafi (2014) explains that there is a positive relationship between risk and profitability. This means that the higher the risk, the higher the profit level expected by the company. This positive relationship shows that if the business risk is high, financial performance can improve. Turiastini and Darmayanti (2018) show that business risk has a significant and negative relationship to financial performance. The negative relationship shows that diversification only has a direct effect on financial performance.

H3 = Business Diversification has an indirect effect through Business Risk on Financial Performance.

Conclusion

This study discusses the effect of business diversification on financial performance mediated by business risk with the following conclusions: (1) Business diversification has a positive effect on financial performance, meaning that if the company is increasingly diversified, financial performance will increase. (2) Business Diversification has a negative effect on Business Risk, that if the company becomes more diversified, the business risk experienced by the company will be smaller. Because if in an unstable condition one segment of the company experiences a loss, it can be covered with other segments. (3) Business Diversification does not have an indirect effect through Business Risk on Financial Performance. The suggestions that can be given are for companies to improve the company's financial performance by choosing to implement a diversification strategy. The choice of this strategy also aims to increase the competitive advantage between other business competitors.

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Proposal for Modular Precast Bulk Warehouse for Brazilian Agricultural Frontier Farms

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Abstract

Brazil is one of the largest agribusiness producers in the world, however, Brazilian competitiveness is impaired when the agricultural product, at lower costs, reaches its destination at higher costs than global competitors due to the deficiency of the grain storage system and transport infrastructure. A viable alternative is the construction of a storage silo on the rural property, with low-cost prefabricated parts that can be transferred to other locations, with easy demobilization and assembly, if necessary. This paper has the objective to design a precast concrete silo with low weight, modular, structurally analyzed by the SAP 2000 V20 software, and presented the cost estimated at 15.6% of the cost of a conventional precast bulk silo, with the same storage capacity.

Keywords: Bulk grain storage; grain storage; precast panel.

1. Introduction

Brazil is one of the largest agribusiness producers in the world, being the second in the production of soybeans, breaking consecutive records of the crop to crop production. However, Brazilian competitiveness is decreased when the agricultural product, with has lower costs, reaches its destination at higher costs than global competitors, due to the inefficiency of logistical factors (Buss *et al* [1]).

According to Rosalen [2] today, the main logistical narrow in Brazil are precarious infrastructure, with delays in grain deliveries and enormous lines of trucks at entrances to ports, and virtually nonexistent rail

and waterway systems, poor quality roads, and outdated grain storage systems.

Each year the production grows up and the problems of the farmers remain the same, of all the grain that is harvested, about a quarter has nowhere to store. The static grain storage capacity in Brazil has not been sufficient to store the growth of crops over the years, with deficits in some regions, especially in those of recent incorporation into the production process such as the farms of the frontier agricultural (Vieira e Dalchiavon [3]).

With the expansion of agricultural borders in the cerrado region and northern Brazil (Figure 1), the distance to reach industrial centers and export ports have increased too much, making the problems related to the transportation of production got worsen.

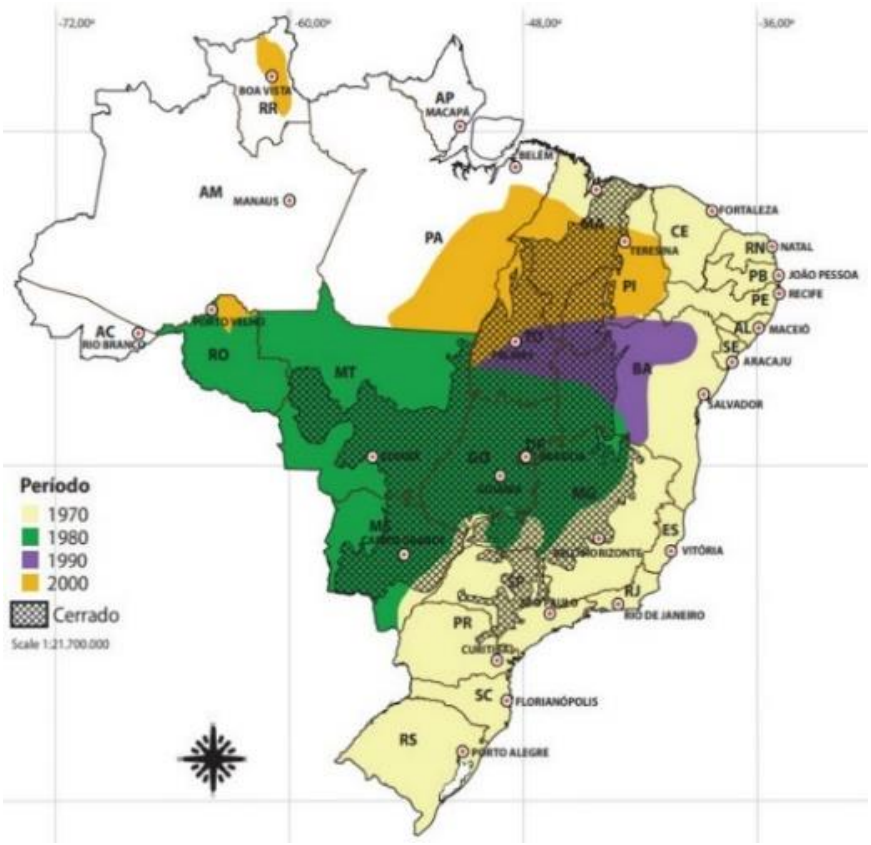

Figure 1 – Expansion of the agricultural frontier in Brazil

Easy access to storage facilities became extremely necessary due to increased distances and the unreliability of existing transport systems (Frederico [4]). Trading soybeans and corn at the final of the harvest in these regions of Brazil generate financial losses for the farmer because he is the price taker, just when the supply is high. Storing your harvest on the farm gives him the possibility to deal with his production when the price becomes more attractive. The storage units maintain the quality of grain and also prevent the loss, leaving the production system more efficient helping to reduce transport costs, and increases the markup of production (Resende, [5]).

The use of bulk grain handling and storage is a worldwide tendency and in developed countries, bulk handling is widespread and integrated since the harvest. In Brazil, as the farmer improves his technological and cultural level, there is a tendency to manipulate his bulk production, as is already the case in some regions of the South and Southeast, where warehouses for the storage of bulk grains are classified into

vertical elevated silos and horizontal silos according to the shape of the main storage structure (D'Arce [6]). It is normal to find justification for farmers not to invest in the construction of bulk silo storage on farms, on the reason that the cost prevents the operation. Most of them have a lack of knowledge about the real advantages of the bulk storage system on the farm, combined with the difficulties in getting the financial resources necessary for such an investment (CONAB [7]).

A viable alternative to the high-cost problem is building a storage silo on the farm, is use low-cost modular precast that can be transported to other locations, with easy demobilization and assembly, if necessary.

The objective of this paper is proposing a precast concrete horizontal bulk storage to be set up in farms in a period sufficient to wait for the mitigation of logistical narrows and the price of grains gets higher on the market with low cost of construction.

2. Bulk grain storage

Over time, grain storage systems have evolved greatly in technology, capacity, and form, from the most rudimentary and simple grain collectors to the most advanced systems, with high storage capacity and processing and handling speed (WEBER [8]).

A storage grain unit designed within technical parameters and conveniently located is one of the best options for making the production system more economical (SILVA [9]). According to Weber [8], storage units can be classified according to their location. The classification is described below and illustrated in Figure 2, below.

- Farm/Producer: Located within the rural property, they usually serve a single owner, being generally small or medium-sized.
- Collectors: Units that are at an average distance from rural properties and serve several producers.
- Subterminals: These units are located at strategic points in the logistics system, usually at transshipment points, rationalizing the flow of goods to minimize handling costs.
- Terminals: Located in consumer centers and ports, with high product turnover as the main characteristic.

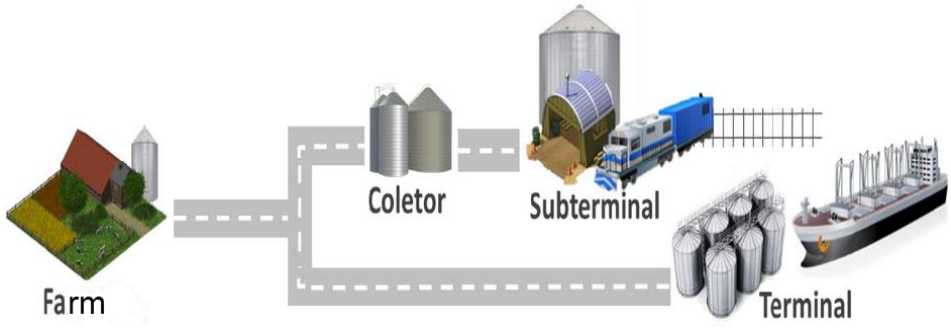

Figure 2 - Classification of storage grain units according to their location

The flowchart of a complete storage unit is shown in Figure 3. At the farm level, the structure of the storage unit is just the reception, storage, and shipping.

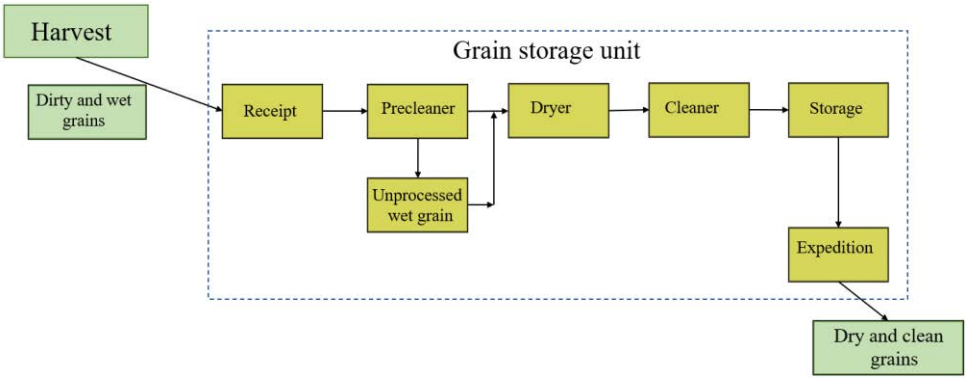

Figure 3 – Complete grain storage unit

The farm/producer storage units are located within the farm and are for the exclusive use of the owner, and should be designed, primarily, to receive wet and dirty grains (COGO [10]).

2.1 Bulk warehouse

For Silva et al [11], bulk warehouses are rural or industrial buildings whose basic purpose is to store bulk products, sheltering them from external environmental influence with the internal environment of the silo, to conserve the main characteristics of the product, during the storage time.

In Brazil, horizontal silos are known as bulk warehouses (Figure 4) whose base is greater than the height (RASI [12]).

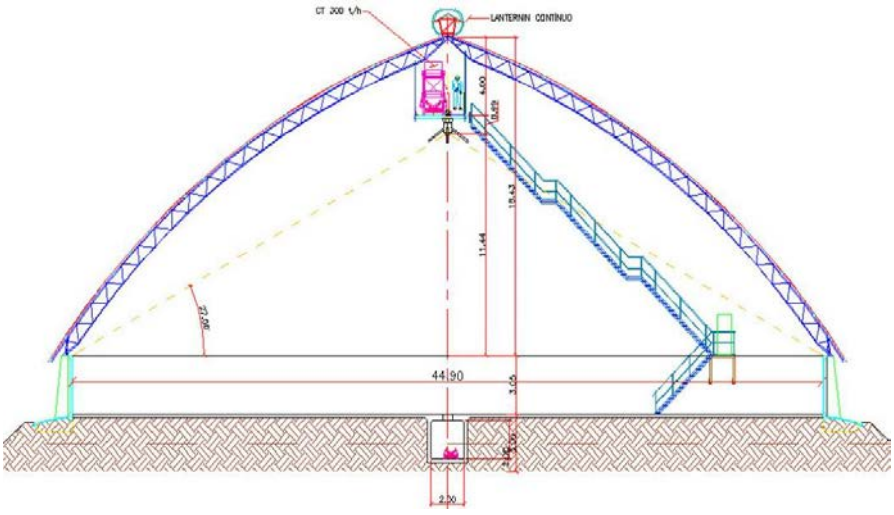

Figure 4 – Cross-section of a horizontal silo

Gomes [13] states that horizontal silos have the following advantages, in addition to the low cost:

- Simple structural system;
- The storage of grains is done in heaps, over the concrete floor that was executed directly on the ground.

In Brazil, concrete precast is the system most used in the construction of horizontal silos (RASI [12]). The side and front of vertical panels (walls) are supported and fixed on the pillars, which are also precast, constituting an articulated structure (Figure 5) and easy to assemble.

Figure 5 - Assembly of the precast wall of a horizontal silo

Precast is a process that allows several assembly fronts to be operated at the same time, reducing construction time and costs. This build process takes advantage of the following characteristics:

- Inline production allows the reuse of molds; use of prestressing with pre-tensioned reinforcement;
- use of sections with higher mechanical performance;
- higher labor productivity and better quality control;
- Demountability of the construction;
- Low use of materials;
- The construction of the precast is independent of climatic conditions.

2.2 Load and pressure on the walls

The grains stored make the pressure that acts on the vertical panels (walls) and the floor of the silo. Pressures perpendicular to the walls are known as horizontal pressures (P_h) and pressures parallel to the walls, which act on the floor, are known as vertical pressures (RASI et al [14]).

Gomes [13] recommends the use of the mathematical expression (Equation 1) to determine the horizontal pressures (P_h) on the walls of the horizontal silos.

$$P_h = \gamma \cdot h \cdot k \quad (1)$$

Where:

γ: grain specific weight; h: effective product height; K: lateral pressure coefficient - P_h / P_v ratio.

According to Calil [15], coefficient K (Lateral pressure coefficient) was defined as the relationship between horizontal and vertical pressures at any point in a granular mass. It is one of the necessary coefficients for determining the pressures exerted by the product on the walls and bottom of a silo. The limits of K, was indirectly determined by Gomes [13], are shown in table 1.

Table 1 - K limits as a function of the internal friction angle of the grain

K coefficient - MAIZE		
Φi (degree)	Inferior Limit	Superior Limit
32	0,307	0,560
35	0,271	0,505

The specific weight of the most common agricultural product to store, according to the main world storage

standards, can be found in Table 2.

Table 2 - Specific weight the most common agricultural product according to ISO, AS, DIN, and ABNT standards

AGRICULTURE	ISO		AS		DIN		NBR	
Product	γm kN/m²	γc kN/m²	γm kN/m²	γc kN/m²	γm kN/m²	γc kN/m²	γm kN/m²	γc kN/m²
Barley	7,5	8,5	7,0	8,5	8,0		7,0	
Flour	6,5	7,5	6,5	7,5	7,0		5,0	
Maize	7,5	8,5	7,0	8,5	8,0		7,5	
Sugar	9,0	10,0	8,0	10,0	9,5		7,5	
Wheat	7,5	8,5	7,5	9,0	9,0		7,8	

To determine the most unfavorable pressures, Calil [15] proposes, according to the Australian standard AS 3774: 1996 [16], for loading on the vertical panels of the silos, be determined using the lower and upper limits for each parameter. The appropriate limits for physical properties are shown in Table 3.

Table 3 - Appropriate limits for physical properties.

Property application		Peso especifico γ	Relação Pv/Ph Coefficient K
Flow type:	mass	inferior	superior
	hopper	inferior	inferior
horizontal pressure - Ph		superior	superior
vertical pressure - Pv		superior	inferior

According to ABNT NBR 6118: 2014 [17] – Brazilian Standard, the actions must be increased by the resistance factor of the actions. Calil and Cheung [18] presented in Table 4, a suggestion of values of the resistance factor of the actions, for designing of silos walls, according to NBR 6118: 2014 [17].

Table 4 – Resistance factor of the actions

ACTION		Ultimate limit states (ULS)	Serviceability limit states (SLS)
Permanent		1.4	1.0
grain pressure	static	1.4	1.0
	flow	1.4	1,0
	special	1.2	1.1
thermic		1.4	1,0
wind		1.4	1,0

2.3 Soil support

To determine the vertical reaction of the soil, under a base slab (footing), Milani [19] states that this tension can be determined through relations with the allowable tension of the soil, and there are two ways to achieve

the coefficient of the vertical reaction of the soil - K_s^v:

- Using the ratio with the SPT (Standard Penetration Test) results and the allowable stress of the soil;
- Using the ratio with the soil type and the allowable stress ratio.

Using the ratio with the SPT result, the allowable vertical pressure will be obtained through Equation 2, where the average SPT is the average of the SPT measured inside a pressure bulb when L = 1.5 B, where B the base of the footing (base slab).

$$\sigma_{alw} = 0{,}20 \cdot SPT_{average} \quad (2)$$

With the allowable vertical pressure (σ_{alw}) in kgf / cm², is possible to obtain the value of the vertical reaction coefficient of the soil - K_s^v through Table 5, shown below, where Morrison [20] relates the value of K_s^v with the allowable vertical pressure (σ_{alw}) estimated for the soil.

Table 5 - Values for the coefficient of vertical soil reactions - K_s^v

Allowable vertical pressure (kgf/cm²)	K_S^V (kgf/cm²)	Allowable vertical pressure (kgf/cm²)	K_S^V (kgf/cm²)	Allowable vertical pressure (kgf/cm²)	K_S^V (kgf/cm²)	Allowable vertical pressure (kgf/cm²)	K_S^V (kgf/cm²)	Allowable vertical pressure (kgf/cm²)	K_S^V (kgf/cm²)
0,25	0,65	0,90	2,02	1,55	3,19	2,20	4,40	2,85	5,70
0,30	0,78	0,95	2,11	1,60	3,28	2,25	4,50	2,90	5,80
0,35	0,91	1,00	2,20	1,65	3,37	2,30	4,60	2,95	5,90
0,40	1,04	1,05	2,29	1,70	3,48	2,35	4,70	3,00	6,00
0,45	1,17	1,10	2,38	1,75	3,55	2,40	4,80	3,05	6,10
0,50	1,30	1,15	2,47	1,80	3,64	2,45	4,90	3,10	6,20
0,55	1,39	1,20	2,56	1,85	3,93	2,50	5,00	3,15	6,30
0,60	1,48	1,25	2,65	1,90	3,82	2,55	5,10	3,20	6,40
0,65	1,57	1,30	2,74	1,95	3,91	2,60	5,20	3,25	6,65
0,70	1,66	1,35	2,83	2,00	4,00	2,65	5,30	3,30	6,60
0,75	1,75	1,40	2,92	2,05	4,10	2,70	5,40	3,35	6,70
0,80	1,84	1,45	3,01	2,10	4,20	2,75	5,50	3,40	6,80
0,85	1,93	1,50	3,10	2,15	4,30	2,80	5,60	3,45	6,90

3. Materials and method

A practical system was proposed to install a horizontal, modular and portable, whose walls are composed of modular precast pieces in the form of an inverted "T" (cantilever wall), with a height of 2,600 mm, a length of 1,500 mm, and a width of 1500 mm (Figures 6). The support of the precast would be made by the bottom (bottom of the inverted “T”), directly on the ground, like a footing. The materials used were concrete Fck 30 MPa and the rebar with the tensile strain of 500 Mpa (CA 50A).

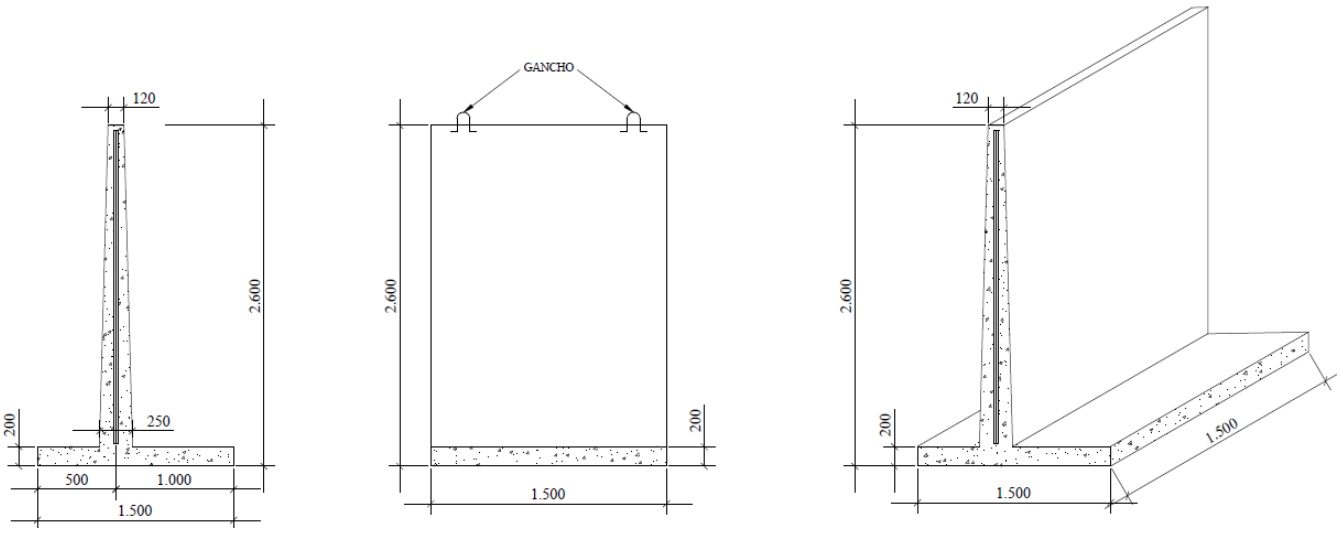

Figure 6 – Views of the precast walls of the horizontal silo.

To close the corners of the horizontal silo, a special precast piece will be used to match the walls in perpendicular directions (Figure 7), with the same technical characteristics as the precast panel of the silo wall.

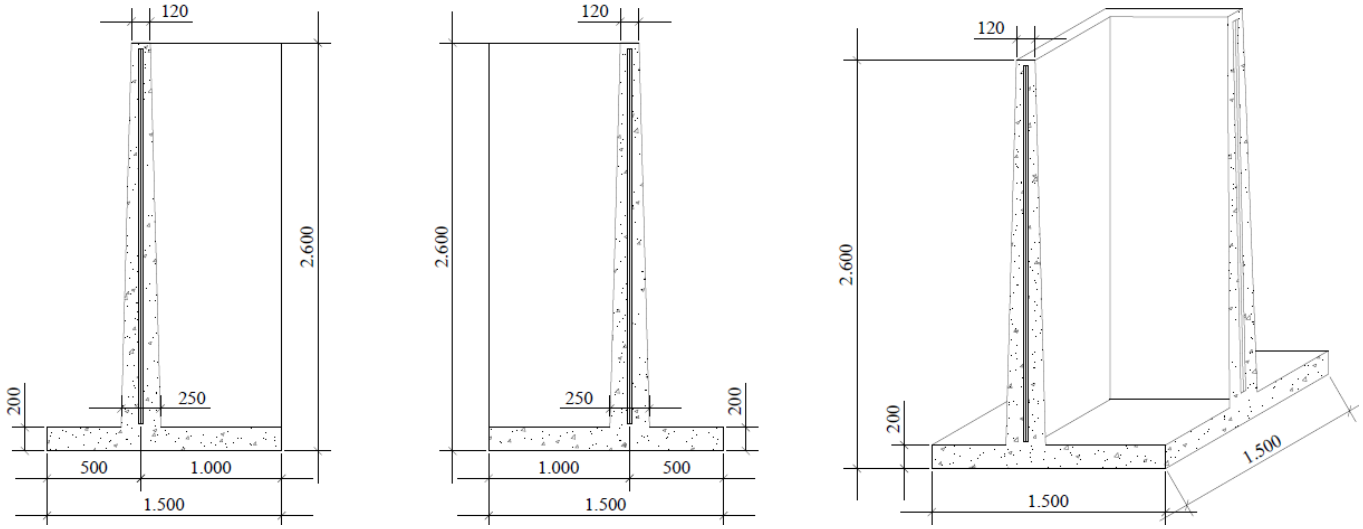

Figure 7 – Views of precast corner walls of the horizontal silo.

For sealing and interlocking the pre-molded parts, a type of groove designed by Ravent [21] was designed, whose parts had a protuberance in the semicircular shape at all ends, on the left side (internal view) and in reverse, on the right side (internal view), an undercut in the semicircular shape, acting as a male-female fitting, with a radius of 15 mm.

The precast pieces were dimensioned according to the standard ABNT NBR 6118: 2014 [18] - Reinforced concrete structures - Procedure, and a load of according to ABNT NBR 6123: 1988 [22] - Forces due to the wind in buildings and the product loads (actions due to grains) were considered according to the recommendations of Gomes [13] and Calil [15], as shown in Figure 8.

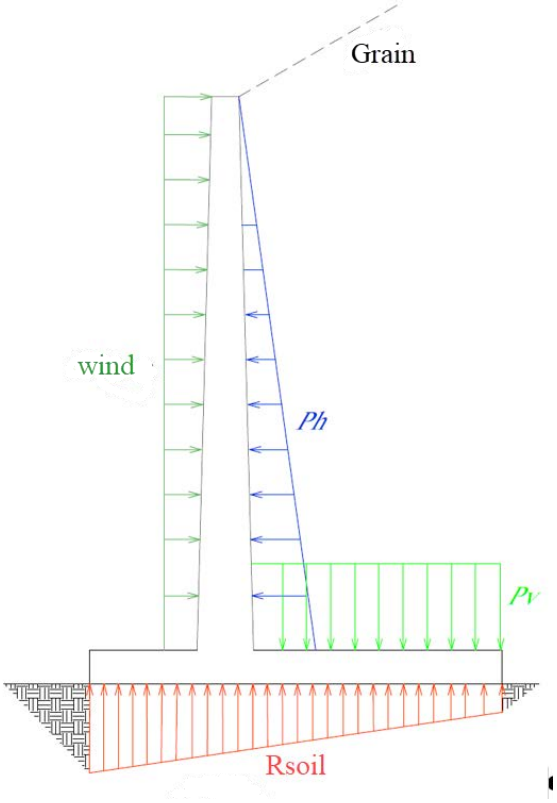

Figure 8 – Representation of external forces acting on precast cantilever wall

The determination of the maximum horizontal pressure (Ph), according to Equation 1, the Table 1 - K limits as a function of the internal friction angle, Table 2 - Specific weight the most common agricultural product, Table 3 - Appropriate limits for physical properties, and Table 4 - Resistance factor of the actions:

$\gamma = \gamma u = 8{,}50$ kN/m³ (Tabela 2 - maize)

h = 2,40 m (Figure 6)

K = 0,56 (Table 1)

From table 4, we will adopt the coefficient 1.00 for the Serviceability Limit States (SLS)

The maximum horizontal pressure value:

Ph max = 11.46 kN / m² (Loading at height 0.00 m)

For the determination of the vertical pressure (Pv) that affects the internal part of the base of the precast part, according to the same considerations for the calculation of the horizontal pressure, we have got the value:

$P_v = \gamma_u \cdot h = 8{,}50$ kN/m³ x 2,40 m ∴

$P_v = 20{,}40$ kN/m²

The wind pressure was not considered, because it is in the opposite direction to horizontal pressure.

To determine the vertical reaction of the soil, under the footing of the piece (inverted "T"), an allowable vertical pressure (σ_{alw}) = 1.00 Kgf / cm² which corresponds to the value of the vertical reaction coefficient of the vertical soil reactions K_s^v = 2.20 Kgf / cm² or 11,767, 98 kN / m², according to Table 5 of MORRISON [20].

The structural verification of the precast piece was done by linear static analysis processed in the SAP 2000

V20 software. Figure 9 shows the discretized three-dimensional (3D), performed by the SAP 2000.

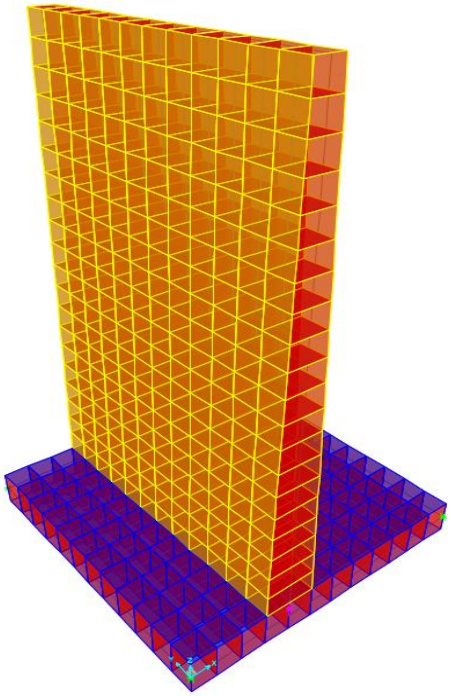

Figure 9 - Discretization of the precast cantilever wall

4. Results and Discussions

With loads of horizontal pressure on the inner wall (P_h), vertical pressure on the horizontal part of the base (P_v), and the vertical reaction coefficient of the soil - (K_s^v), the cantilever wall was analyzed by the SAP 2000 V20 software.

The values of the major bending moment were compatible with the strength of the piece (Figure 10) and the maximum horizontal displacement value was 5.2 mm (Figure 11).

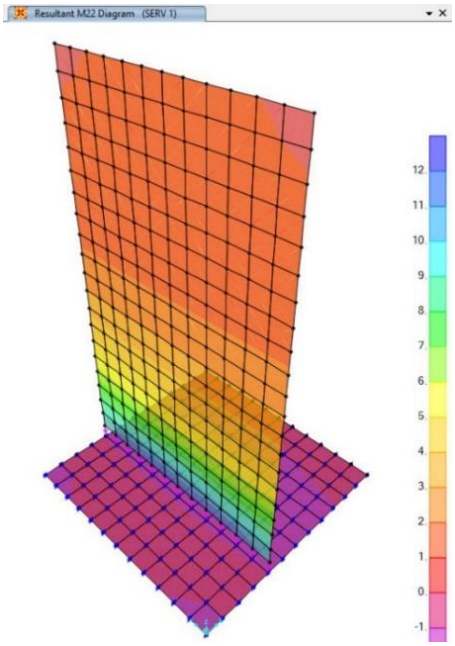

Figure 10 – M22 bending moment M22 [kN.cm.]

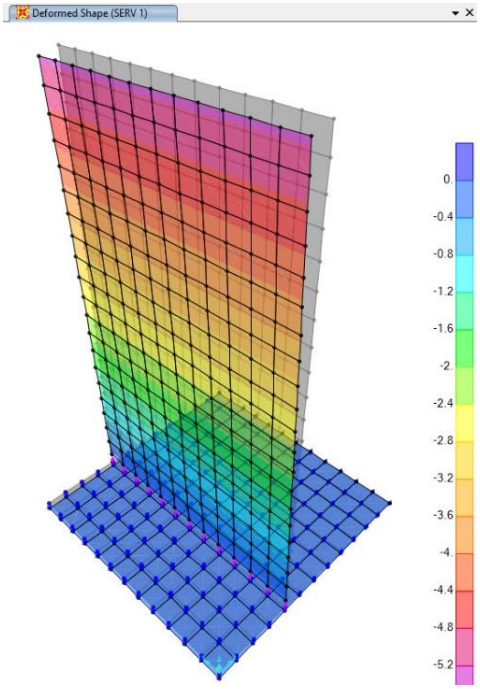

Figure 11 – Horizontal displacement on the X-axis [mm]

The maximum pressure applied to the soil by the footing of the cantilever wall was 52 kN / m², less than the allowable soil bearing pressure (Figure 12).

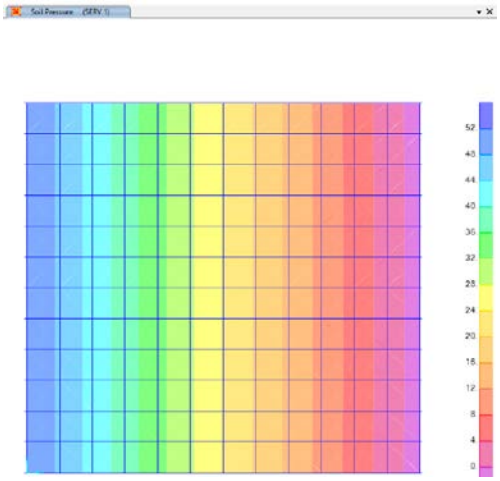

Figure 12 – Distribution of pressures in the soil at the footing of the cantilever wall [kN/m²].

The self-weight of the precast wall was estimated at 2,800.00 kg, with the volume of reinforced concrete, for all pieces (flat and corner pieces). The production cost of each piece, according to the cost standard spreadsheet for April 2020, from the Secretaria de Estado de Desenvolvimento Urbano e Obras Públicas – SEDOP – Governo do Estado do Pará / Brazil [23], for Fck 30 Mpa concrete, CA 50 rebar, and apparent mold is US$ 447.69 / m³, totalizing a cost per piece of US$ 501.41. The cost of the State of Pará was used because these precast pieces were destined for the agricultural frontier of Brazil. For the production of soybeans of 25,000.00 bags (1,500 tons) or 2,100.00 m³ of a medium-sized farm, respecting the proportions of the golden rectangle (1: 1,618), we have a silo with the dimensions of 17.00 m wide and 27.50 m long, with 54 precast pieces of the wall flat (Figures 6) and 04 precast pieces of the corner type (Figure 7), with

a total of 58 precast pieces (Figure 13).

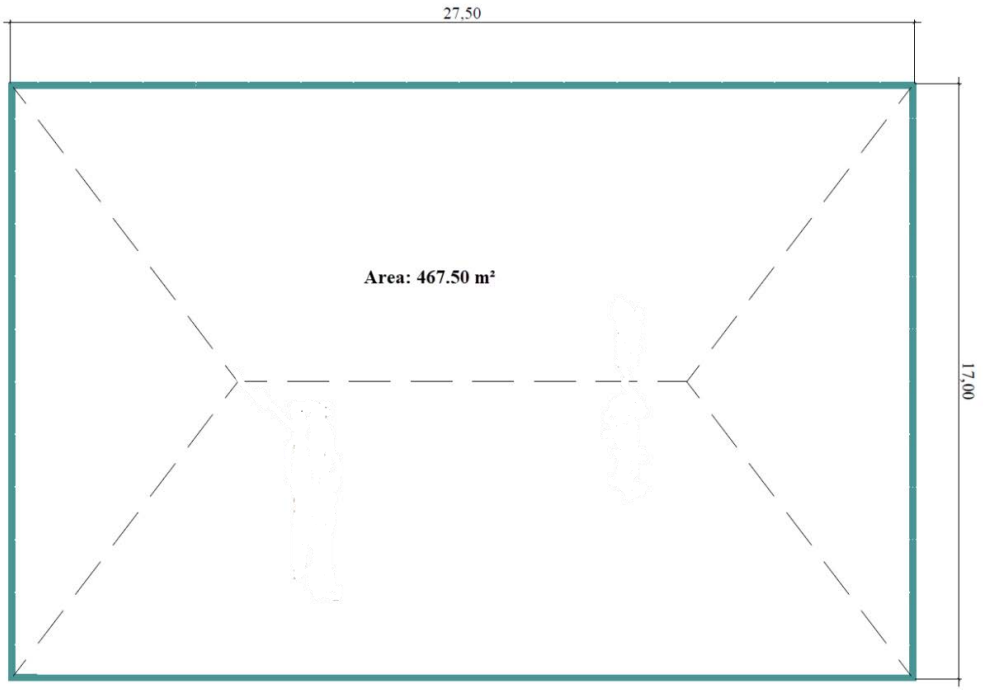

Figure 12 – Silo designed with a capacity of 25,000 bags of soybean (1,500 tons).

The side view of the silo is shown in Figure 13, where it shows that the total height of the grains, respecting the 27.5º angle of the rest of the soybean, reaches 7.03 m.

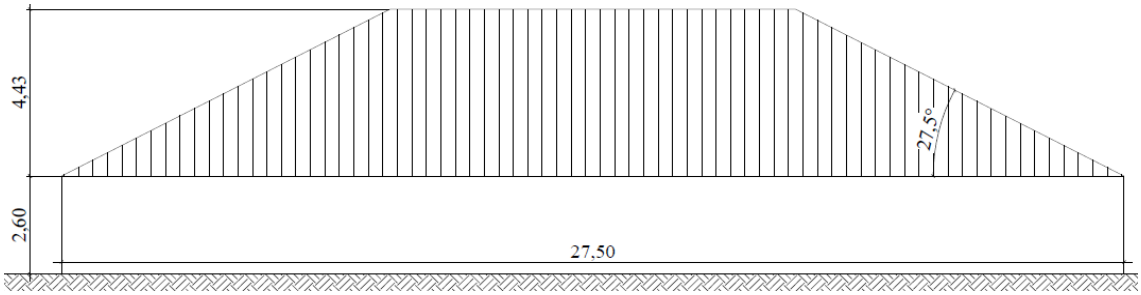

Figure 13 – Side view of the full-grain silo

The budget cost of all precast parts of this configuration would be in Brazilian currency US$ 29,081.81 and adding the plastic canvas costs of 220 μ, it would reach the total value around US$ 29,500.00 or about US$ 1.18 / per bag. According to Viera Filho [24], the cost of conventional storage of soy or corn on a 1,500-hectare farm in Mato Grosso Estate was US$ 7.42 / per bag, that is, storage in a conventional silo would cost about 6.29 times the cost of a proposed warehouse or just 15.90 % of that cost.

5. Conclusion

The budgeted cost of building a silo with a maximum storage capacity of 25,000 bags of soybeans was US$ 29,500.00, making this investment economically viable, meeting the needs of the agricultural producer regarding grain storage.

The precast parts can be built on the farm site, reducing the cost of transportation and logistics.

This precast bulk warehouse is modular and removable construction and can be expanded according to the

storage needs of the agricultural producer. In the event of changes in the grain production areas, the warehouse can be moved quickly.

This paper did not consider scenarios with variations in productivity and prices, which would make this study more credible for the analysis of economic viability. The study with variations in scenarios may be a potential future work.

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Perceived quality assessment of the health services offered to riverine communities in Brazilian Amazon

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Abstract

In line with the UN 2030 Agenda for Sustainable Development Goals, Public Health Policies follow in Brazil criteria of universality, completeness, and equity formulated to ensure access to health services in adequate quantity and quality for the entire population. To evaluate the quality of services provided in health units, it is essential, however, to make methodological considerations concerning the use of proper instruments and techniques to achieve accuracy and precision when evaluating effectiveness from users´ perspective. Mainly where health care is precarious or in need of adjustment, properly constructed indicators can become excellent management tools. This paper aims to analyze the specificities of the perception of the quality of health services offered to residents of the riverine communities of the Tupe Sustainable Development Reserve (SDR), Manaus, Amazonas, Brazil. The methodological approach follows a descriptive and ecological case study, based on field research with original data collection of fixed residents, aged over 18 years, by applying structured questionnaires and analyzing the results according to the SERVQUAL methodology. In the present study, the impact of previous experiences of attending on the quality of health service evaluation was taken into consideration. In the SDR of Tupe respondents positively rated all items. Nevertheless, when previous experience exists, a different pattern of perception was detected. Based on these results, we suggest that the quality perception of health has to do with

competitiveness, associated with the performance standard on the offer available to the customer.

Keywords: ServQual; Sustainability Indicators; Health Services Evaluation; Decision making

1. Introduction

Health is a multidimensional phenomenon, complex and of fundamental importance for the quality of human existence (Mujica-Mota et al., 2015). In particular, about the Amazon region, pandemic events, such as the covid19 (Castro et al., 2020; Daspett et al., 2020); epidemic, such as dengue (Fares et al., 2015; Pinto et al., 2016); and endemic, such as malaria (Ferreira & Castro, 2016), are expressions in the health area resulting from a systemic imbalance in the relationship between man, environment and society.

The pain, suffering and anguish that loss of health can cause to the other members of group, makes that the respective socio-cultural forms seeks to explain the occurrence of diseases, and considers their treatment and the inherent healing processes. In this way that, historically and collectively constructed, different sectors or levels of health care are installed, creating various social groups or sectors responsible for restoring the original state or before the moment of crisis. Helman (2007) lists the three main sectors with which societies linked to the pathological conditions they affect: the sectors of informal, popular and professional health care, which in deep regions, in pre-capitalist development stages or with full access to economic, technological and social resources indicates which one of the sectors is more present than the others.

In this study, we intend to analyze how the riverine residents evaluate the quality of health services, of the professional type, provided by the public authorities. This approach, of course, entails theoretical, methodological, and operational options that should be considered in heath management.

Initially, this happens because decision making in an organizational environment has a practical and immediate character. The managers use a set of indicators and instruments evaluative that allows getting the maximum efficiency the relationship between costs and benefits of the products and services; effectiveness in the best relation between the objectives set and the results achieved ; and effectiveness to resolves the problems identified sustainably and definitively (Jannuzzi, 2016; Tanaka and Tamaki, 2012).

Secondly, because health is not just the absence of disease, rather being much more the synthesis of a range of determinants that transcend the biological and reaches the ambiance economic, social, political and culture in which are inserted the subjects (Berkman, Kawachi, & Glymour, 2014). The importance of health is widely recognized in the various multilateral instances that discuss the fundamental rights of the human person and in international organizations that regulate and guide the actions of the Member States to ensure the implementation of practices leading to the achievement of a better, universal, equitably extensive and sustainable quality of life (United Nations, 2015). Among the Sustainable Development Goals of Agenda 2030 of the United Nations (2015) the number 3, that focuses on the theme of "Health and Wellness", claims to ensure a healthy life and promote well-being for all, at all ages. Among the specific objectives, in goal 3.8, the universal health care coverage is pursued, including the protection of the financial risk, access to essential quality health services and access to essential medicines and vaccines safe, effective, with quality and affordable for all (United Nations, 2015).

Thirdly, because in Brazil, since the promulgation of the Magna Carta in 1988, and anticipating the guidelines proposed by the United Nations in 2015 , the Public Health Policies follow criteria of universality, completeness, and equity formulated to ensure access to health services of adequate quantity and quality for the entire population. Surpassing any limits or despite any socio-spatial specific condition (Paim, Travassos, Almeida, Bahia, & Macinko, 2011). The legal guarantee of access is not, however, synonymous with its immediate enjoyment (Santos, Marques, & Duarte, 2011). In addition to the physical structure required to assist users, the logistics supporting activities involves specialized staff, support materials, appropriate equipment, as well as the existence of material, financial and human resource management processes. Whereas, in general, when it comes to public funds, this supporting is often scarce and heterogeneously distributed (Bovaird, 2015; Medeiros, Araújo-Souza, Albuquerque-Barbosa, & Clara-Costa, 2010).

Finally, it should be considered that monitoring and assessing quality in health services, to achieve the sustainable development goals proposed by Agenda 2030, requires, in turn, the use of appropriate instruments, techniques, and methodologies for this purpose. Quality assessment occurs under the epistemological complexity of qualitative evaluations and of how to establish the adequacy of relations between the object (health services) and its representation (the quality of services offered). In this challenge, it must be observed that the relationship between the "perceived quality" and "quality" is not given directly. "The qualitative measurement is a derived measure, which does not take place directly on the phenomenon of interest, but on the manifestations of this phenomenon" (Pereira, 2001, p. 67).

Thus, if on the one hand, any reference made to the quality of the services provided in the health area derives from the evaluation of the material, human resources and organizational structures available to the user; on the other, it requires considerations taken from the sociocultural universe that permeates the relationships between the "client-user" and the service provider unit, which impact differently on how clients perceive the quality of health services received. In order to analyze the main factors that interfere in the perception of the quality of health services, this study proposes to adapt and exploratory apply the SERVQUAL instrument, developed from 1985 by A. Parasuraman, Valarie Zeithaml, and Leonard Berry, in users of healthcare, located in an environmentally protected area near the city of Manaus, in Brazilian Amazon region.

For the accomplishment of this objective and presentation of the results, the article was divided into four parts. In the first part, we present the general lines of the theoretical framework adopted in the study. After, the methodological procedures used are detailed, describing how the field of study was delimited, the informants' choice and comprehensiveness and the data collection, treatment, and analysis techniques. Then search results are offered for analysis in the form of tables, figures, and graphs and systematized according to their statistical properties. Finally, the main findings of the research are discussed considering the bibliography selected and referenced in the paper. The article is concluded with the presentation of limits, contributions, and possibilities of expansion of the study.

2. Theoretical references for quality assessment in services

In management decision-making processes, and even before discussing the use and application of

mechanisms to evaluate the perception of health services, it is necessary to clarify what is meant by "quality" when it measures the perception of the client-usuary about the requirements and procedures to achieve the previously defined management objectives.

Quality may have different meanings, depending on the criteria used to define it (Mitra, 2016). Synthesizing a generalist proposal, Garvin (2002) considers quality as any coordinated activity to direct and control an organization with the goal of enabling the improvement of their products/services in order to ensure the complete satisfaction of customer needs related to what is being offered, or, overcoming their expectations. To make quality manageable the author (Garvin, 2002, p. 22–24) indicates and problematizes five forms of approach, defined as follows: 1) the transcendent, a quality that is only perceived by experience; 2) based on the quality related to the technical characteristics of the product; 3) the user-based, quality from the consumer's perspective is the what suits them best; 4) that is based on production, quality directly linked to the offer of the product or the package of services; and 5) the placed on the value, quality entirely based on cost and price relationship.

Fadel and Regis Filho (2009), in their turn, highlight the important managerial contribution brought using tools of perception of customer-user quality in public services. This may be the first step for the manager to design operational strategies that will lead to continuous improvement actions with better professionals who are oriented to meet the expectations of those looking for service. In the field study that subsidized the work, the authors observed that from the research carried out with the so-called "internal clients" - the employees of the researched service - the technical quality is the most relevant for the researched professionals, while for patients, aspects such as the way care is provided or the treatment they receive from professionals become more visible (Fadel & Regis Filho, 2009).

In fact, is complex to be measured objectively the perception that users and customers have about the quality in the service sector. And therefore, it demands innovative strategies and forms of the theoretical and methodological approach to the issue. One tool that enables this assessment is the SERVQUAL model proposed by Parasuraman, Zeithaml, and Berry. (Pena, Silva, Tronchin, & Melleiro, 2013).

The SERVQUAL instrument bases theoretically on the differential found between, first, the expectations of excellence of consumers and users of the service offered and, after, their perception of these services when delivered. As a management tool, it enables the assessment of quality improvements over time, assisting in identifying specific service elements that require development, as well as pointing out training opportunities for staff involved in the activity (Parasuraman, Zeithaml, & Berry, 1985).

In its original conception (Parasuraman, Zeithaml, & Berry, 1988) the SERVQUAL model examines five dimensions, considered by the authors as essential for assessing the quality of services provided:

a) **Tangibility**, which relates to infrastructure. Refers to the physical elements, equipment, and personnel, considered in their external presentation and appearance, such as furniture, office, forms, employee physical appearance, clothing and uniforms, material, and physical disposition.
b) **Reliability**, which is the certainty or confidence in the performance or functionality of the service offered. Ability to perform the service well, performing precisely what was promised, on the given date.

c) **Understanding**, Readiness, or Promptitude, that is, the ability to respond rapidly, to serve service users promptly. Ability to quickly understand the problems and difficulties of the users and respond it positively.
d) **Safety**, or the ability to inspire and convey credibility and trust. Warranty of providers to respond appropriately to user needs for the knowledge and courtesy on service.
e) **Empathy**, which is understood as care, the individualized attention that accompanies the service provider in their work.

In applying the model, SERVQUAL research is a process composed of three distinct and sequential moments. With questions related to the five dimensions of quality, the users are asked to offer their perception about the given industry, how they would imagine an ideal service unit or company. Then the same questionnaire is repeated, but now assessing how the actual performance of the company or service unit that is being analyzed. Finally, the results obtained at moment 1 (ideal) are compared with moment 2 (real).

The creators of the SERVQUAL instrument argue that service expectations are subjectively constructed by users from three sources: a) past experience in using the service or in units providing similar services; b) specific personal needs, which usually vary from user to user; and c) the world of word of mouth communication, where their perception is socially calibrated or adjusted with and from the impressions collectively shared by service users. (Parasuraman, Zeithaml, and Berry, 1985). Note that the referential universe of subjectivities, as it is exposed by the authors of SERVQUAL, it is socially built (Gonçalves & Sousa, 2015).

3. Methodological procedures for assessing the quality of health services in the SDR of Tupe

This is an exploratory, descriptive, and ecological study, based on field research (Fachin, 2006). The original data were collected with residents aged 18 and over who lived in the five riverine communities of the Sustainable Development Reserve of Tupe (SDR of TUPE), Manaus, Amazonas, and health service users provided at local units. Data were collected by applying structured questionnaires, systematic observations, and analysis of results according to the SERVQUAL methodology.

The area selected for study is in the Brazilian Amazon. Flanking the left bank of the Rio Negro, the SDR of TUPE is an area of environmental protection located in the rural zone of Manaus. Its 12,000 hectares, even though territorially spacious, house few fixed habitants within its limits. About 1800 people, distributed in six communities, five riverine ones (Tatulândia, São João do Tupe, Julião, Livramento, and Agrovila) and one rural settlement in the hinterland (Central). The present study only covers the riverine communities of the SDR of TUPE, a traditional population that receive this name because of the influence of the rhythm of the waters on their way of life. Thus, providing the conditions for the construction of a similar or with few collective variations in their social representations (Serra, 2002).

The object of study is the perception that community members point out regarding the quality of services provided by local health units. Throughout the SDR of TUPE area, care to the population is offered only

in the form of primary care, composed of the essential health units (BHU) and Primary Team Care, Family Health and Endemic Control. The SAMU 192 (Mobile Emergency Assistance Service) and Emergency Care Units (UPA) provide the intermediate care levels are provided. Finally, the medium and high complexity of care performed in hospitals, all located in the urban area of Manaus. In the Livramento community is located the UBS (Nossa Senhora do Livramento Rural Health Post), which is also responsible for attending the Agrovila and Julião communities. At UBS, it is possible to provide primary assistance in the programs of Pediatrics, Gynecology, General Practice, Nursing, Dentistry, and Social Assistance. The team of professionals consists of 02 doctors, 03 nursing technicians, 02 dentists, 02 oral health agents, 06 community health agents, and 03 endemic agents. They are responsible for providing services such as reception, social program monitoring, blood pressure, and blood glucose measurement, primary emergency care, medical and nursing consultation, dental consultation, dressing, malaria and leishmaniasis control, health education, vaccination, inhalation, reproductive planning, home visits, dermatological examination, collection of laboratory tests, referrals to specialties, and provision of primary medicines. In each community, there is a community health agent responsible for providing urgent care to the population, complemented by the team, from Monday to Friday in the Livramento community; on Wednesdays in the Agrovila community and on Thursdays in the Julião community. The health care services provided in the communities in the SDR of Tupe, like Tatulândia and São João do Tupe, happen by the Fluvial Health Post. A traveling unit of the Municipal Health Secretariat that serves the riverine population with equipment, services, and human resources also available at the Livramento health unit.

The sample universe of this study is the permanent residents on the riverine communities SDR of Tupe: Tatulândia, São João do Tupe, Nossa Senhora do Livramento, Julião and Agrovila, aged eighteen years or older. The selection of the informants was made at random and the recruitment developed as follows.

Initially, 620 buildings located in SDR of TUPE riverine communities were identified by their respective geographic coordinates and spatial distribution. Then, using Microsoft Excel software resources, 248 addresses were randomly selected, considering the minimum statistical confidence interval of 95%, sampling error of 5% and observing the proportionality of the spatial concentration of the residences. In the Agrovila community, 176 properties identified in the initial survey, 62 were selected; in the Julião community, from128, 55 were selected; In the Livramento community of 194, 64 were selected; in the São João do Tupe community, from 111, 52 were selected; and in the Tatulândia community, of the 15 properties found, all 15 were selected.

The questionnaire was built in a semi-structured form, containing in the first part questions about the individual characteristics of the informant, like gender, marital status, place of residence, education, occupation, own and family income; information about the health unit or units that frequently attended enters or knows; and in the second part specific issues involving the perception of health services in the local health units where they are usually accompanied, according to Table 1.

Table 1 - Questions and the perception dimensions of the Quality of Service Performance in Health Unit

Item	Dimension	Query	Perfomance Perception
1	**Tangibility**: Describe to infrastructure. These are the physical elements, equipment, and personnel, considered in their external presentation and appearance, such as furniture, office, forms, employees' physical appearance, clothing and uniforms, equipment and physical disposition.	Q5	Health unit staff look good (Clean and well dressed).
2		Q11	The health unit features modern equipment.
3		Q14	The facilities of the health unit are attractive, comfortable and organized.
4		Q20	User guides and health unit forms feature quality.
5	**Confiability**: Certainty or confidence in the performance or functionality of the service offered. Ability to perform the service well, executing with precision the promised, on the given date.	Q4	Services are provided in a way right the first time.
6		Q12	The health unit custody the attendance records and registration data of customers without errors.
7		Q17	Healthcare facility staff adopt a stance that inspires confidence in clients.
8		Q19	The health unit meets the agreed deadlines.
9	**Understanding**: Ability to respond immediately, to promptly serve service users. Ability to quickly understand users' problems and difficulties and respond positively.	Q6	There is the immediate care of the customers.
10		Q7	Health facility staff are always free to respond to customer requests.
11		Q10	Health unit staff correctly report the release and completion times of procedures.
12		Q13	Health facility staff always show a willingness to help customers.
13	**Safety**: Ability to inspire and convey credibility and trust. The assurance furnish by the knowledge and courtesy of service providers to respond appropriately to user needs.	Q3	Healthcare facility staff are well trained to serve clients.
14		Q8	Health facility staff are cordial with clients.
15		Q15	The health facility understands the specific needs of its clients.
16		Q18	Health facility staff have the knowledge to answer customer questions.
17	**Empathy**: It is the care, the individualized attention that accompanies the service provider in their work.	Q1	The health unit the client's interests are treated as a priority.
18		Q2	The opening hours are convenient for customers.
19		Q9	Health unit clients receive individual attention.
20		Q16	It is perceived an interest in solving customer problems.
(1)	(2) (3)	(4)	(5) (6) (7)
Disagree Strongly			**Agree Strongly**

Source: Adaptation of the SERVQUAL Model (Parasuraman et al., 1988)

Data collection occurred through interviews conducted by teams previously oriented and trained to contact informants, after the presentation, and signing of informed consent. The application of the questionnaires to the residents obeyed the criteria: a) exclusive to the selected houses; b) intended only for the permanent residents of the houses chosen in this way; c) excluding, therefore, temporary residents, vacationers or from other locations; d) interviewing only residents over the age of 18 found in the residences. The study found 103 respondents who, to each question read by the interviewer in the instrument, assigned a value from 01 (strongly disagree) to 07 (strongly agree). Eventually, given the answers “I don't know” or “I don't want to answer”, the respective fields were left blank and excluded from the analysis as “not informed”.

The original data were systematized through measures of centrality, means, and relative frequency and arranged in comparative tables for analysis of the results. Hair (2006) observe that on sample surveys, using the Likert scales, the number of respondents must be at least five times the number of questions. For the instrument applied, with 20 questions answered by 103 selected respondents, this criterion was met, allowing data analyzed according to the principal component factor analysis method. Using the SPSS 22 (Statistical Packet for Social Sciences) software, the Kaiser-Meyer-Olkin sampling adequacy tests (KMO test) and Bartlett's sphericity tests were applied to determine whether the factor analysis method could be used. And the internal reliability test of data (Cronbach's alpha), to verify that the data did not contain significant biases.

The data collected were interpreted according to the percentage variability relations of the answers given

to the questions of the Adapted Servqual Instrument. The criteria for selecting were the form of care, if by the fixed Health Post or if in a Floating Unit, and whether the respondent knows or not two or more care units.

4. Evaluation of the perception of quality of health services offered in the riverine communities from SDR of Tupe, Manaus, Amazonas

In the studied area, health care is provided to the local population by the basic health units (BHU Livramento), Primary Care Teams, Family Health, and Endemic Control, and the Basic River Health Unit (BSHU). The complexed cases receive care at the Manaus health units, by prior appointment or, in emergencies, by the SAMU speedboat since access between the communities of the Tupe and Manaus SDR is possible solely by the river. Residents at the communities of Livramento, Agrovila, and Julião receive assistance from the health clinic located in the Livramento. The residents of the São João and Tatulândia communities receive by local health agents and, sporadically, due to the not always favorable conditions of displacement, equipment, and material and human resources, by vessels or river health units that assist the riverine communities of the inland Amazon.

The questionnaire applied to residents collected individual information about the health unit or units they attend or know, with specific questions involving the perception of health services in the local health units where they usually attended.

The Kaiser-Meyer Olkin sampling adequacy test (KMO test) showed a value of 0.808. According to Pereira (2004), if this value is above 0.800 indicates a good fit for the factor analysis. The significance of Bartlett's Sphericity test showed less than 0.001, meaning that there is a probability level very suitable for the correlation between variables. We used Cronbach's alpha test to verify the degree of internal consistency of the scale. Considering that the value found was 0.761, which indicates an accuracy of 76.1%, we understood that the table is adequate for the proposed study. For more excellent reliability of the test, were evaluated all 20 instrument variables in their contribution to change the final value of Cronbach's Alpha, the results achieved were between 0.721 and 0.761, which once again demonstrates the internal consistency of the scale applied.

After tabulation, the values attributed by users of health services offered to residents of the Tupe Sustainable Development Reserve's riverine communities, on a LIKERT scale from 1 (totally dissatisfied) to 7 (fully satisfied) for the characteristics of Tangibility, Reliability, Understanding, Safety, and Empathy, predicted in the SERVQUAL methodology, reached numbers between 5.523 and 5.960, confirming average approval rates for the quality of services offered around 81.84%, according to Table 2.

Table 2 - Values and average response given by groups of residents of riverine communities to the questions that make up the SERVQUAL instrument adapted for measuring the perceived quality of health services in the SDR of Tupe

STATISTICAL PARAMETERS	TANGIBILITY				
	Q5	Q11	Q14	Q20	AVERAGE
N	103,00	101,00	103,00	99,00	**101,500**
Average	6,66	4,86	5,17	6,19	**5,720**
Standard deviation	1,12	2,42	2,28	1,50	**1,829**
STATISTICAL PARAMETERS	RELIABILITY				
	Q4	Q12	Q17	Q19	AVERAGE
N	102,00	100,00	102,00	99,00	**100,750**
Average	5,63	6,36	6,02	5,32	**5,833**
Standard deviation	1,82	1,53	1,74	2,25	**1,836**
STATISTICAL PARAMETERS	UNDERSTANDING				
	Q6	Q7	Q10	Q13	AVERAGE
N	103,00	99,00	101,00	103,00	**101,500**
Average	4,76	5,72	5,57	6,04	**5,523**
Standard deviation	2,35	1,84	1,99	1,67	**1,962**
STATISTICAL PARAMETERS	SAFETY				
	Q3	Q8	Q15	Q18	AVERAGE
N	102,00	102,00	101,00	101,00	**101,500**
Average	5,98	6,31	5,39	6,16	**5,960**
Standard deviation	1,84	1,46	2,09	1,61	**1,750**
STATISTICAL PARAMETERS	EMPATHY				
	Q1	Q2	Q9	Q16	AVERAGE
N	101,00	102,00	102,00	97,00	**100,500**
Average	5,16	5,20	6,28	5,79	**5,608**
Standard deviation	2,33	2,14	1,51	1,93	**1,978**

Source: Data collected from the SDR of TUPE riverine communities, Manaus, Amazonas, July 2015.

In another analysis, no significant differences were observed when collected data set were separated into two groups of clients-users of health services: those who received care only in the health units in the SDR of Tupe and, therefore, without comparison; and those who received care in 2 or more health units and, thus, with reference service for comparison.

As shown in Table 3, using the LIKERT scale from 1 (totally dissatisfied) to 7 (fully satisfied) for the characteristics of Tangibility, Reliability, Understanding, Safety, and Empathy, predicted in the SERVQUAL methodology, the final average values range from 5,899 for respondents who did not have previous comparison and 5,764 for those who had been seen at two or more health units.

Table 3 - Summary values and average response given by groups of residents of coastal communities with unparalleled service in another health facility and the experience of being treated at two or more health care units

QUALITY DIMENSION		TANGIBILITY	RELIABILITY	UNDERSTANDING	SAFETY	EMPATHY	TOTAL
WITHOUT COMPARISON	N	24.75	24.50	24.25	24.50	24.25	**24.45**
	Average	**5.72**	**5.89**	**5.67**	**6.13**	**6.07**	**5.89**
2 OR MORE UNITS	N	58.50	57.75	58.50	58.50	58.00	**58.25**
	Average	**5.65**	**5.91**	**5.61**	**6.03**	**5.60**	**5.76**

When we applied the Paired T-test to the data set collected, the results are not conclusive, according Figure 01. The means test for the answers given by the groups of residents at riverine communities compares the group that does not have a previous contact and a second group with the experience of being attended in 2 or more units. It cannot assume that there is a significant difference between the means of assessment given by the groups (1. which received attended in 1 single unit. 2. which received attended in 2 or more), as indicated by the test results: T = 1.419 and p-value = 0.172.

RESULTS	
T statistics	1.418862
Degrees of freedom	19
P-value	0.172136
Sample Average 1	5.8985
Sample Average 2	5.7635
Standard Deviation of Differences	0.425509
Size of Samples	20
Alternative Hypothesis Different from	0
Level of Confidence	95%
Inferior limit	(-) 0.064144
Upper limit	(-) 0.020788

Figure 1 - Paired t-test applied to the ratings of the quality of health services perceived by groups of residents at riverine communities that do not have a previous contact and a second group with the experience of being attended in 2 or more units. Source: Data collected from the SDR of Tupe riverine communities, Manaus, Amazonas, July 2015.

Finally, significant differences were found when we analyze the same set of data collected but separating the customers-users of health services among the two groups. 1) who attended the health facilities in Basic Health Units (BHU Livramento); 2) those who received care provided by the Fluvial Health Post, the Basic River Health Unit (BSHU), a traveling unit of the Municipal Health Secretariat. Applying the LIKERT scale from 1 (totally dissatisfied) to 7 (totally satisfied) for the Tangibility, Reliability, Understanding, Safety and Empathy characteristics, provided for in the SERVQUAL methodology, the final mean values of each of the quality dimensions ranged from 5.465 and 5.703 for respondents who were attended at BSHU and between 5.535 and 6.040 for those who had been attended at BHU Livramento, as shown in Table 4.

Table 4 - Values and means of answers given to questions of the SERVQUAL instrument by groups of residents of riverine communities with care at Basic River Health Unit (BSHU) and with the experience of being attended at Basic Health Unit (BHU) Livramento.

UNIT	STATISTICAL PARAMETERS	TANGIBILITY				
		Q5	Q11	Q14	Q20	AVERAGE
BSHU	N	25.00	24.00	25.00	25.00	**24.75**
	AVERAGE	6.56	6.08	5.36	4.75	**5.69**
BHU LIVRAMENTO	N	78.00	75.00	78.00	76.00	**76.75**
	AVERAGE	6.69	6.22	5.11	4.89	**5.73**
UNIT	STATISTICAL PARAMETERS	RELIABILITY				
		Q4	Q12	Q17	Q19	AVERAGE
BSHU	N	25.00	24.00	25.00	25.00	**24.75**
	AVERAGE	5.63	5.91	5.48	5.20	**5.55**
BHU LIVRAMENTO	N	77.00	76.00	77.00	74.00	**76.00**
	AVERAGE	5.62	6.49	6.19	5.36	**5.91**
UNIT	STATISTICAL PARAMETERS	UNDERSTANDING				
		Q6	Q7	Q10	Q13	AVERAGE
BSHU	N	25.00	25.00	25.00	25.00	**25.00**
	AVERAGE	5.11	5.71	5.20	5.85	**5.46**
BHU LIVRAMENTO	N	78.00	74.00	76.00	78.00	**76.50**
	AVERAGE	4.64	5.71	5.69	6.10	**5.53**
UNIT	STATISTICAL PARAMETERS	SAFETY				
		Q3	Q8	Q15	Q18	AVERAGE
BSHU	N	25.00	25.00	25.00	25.00	**25.00**
	AVERAGE	5.83	6.35	4.91	5.72	**5.70**
BHU LIVRAMENTO	N	77.00	77.00	76.00	76.00	**76.50**
	AVERAGE	6.02	6.29	5.54	6.31	**6.04**
UNIT	STATISTICAL PARAMETERS	EMPATHY				
		Q1	Q2	Q9	Q16	AVERAGE
BSHU	N	25.00	25.00	25.00	25.00	**25.00**
	AVERAGE	5.00	5.39	6.39	5.44	**5.55**
BHU LIVRAMENTO	N	76.00	77.00	77.00	72.00	**75.50**
	AVERAGE	5.21	5.12	6.24	5.91	**5.62**

Source: Data collected from the SDR of TUPE riverine communities, Manaus, Amazonas, July 2015.

The Paired T-test applied to the means of the answers given by the groups (1) who attended the health facilities in Basic Health Units (BHU Livramento) and 2) those who received care provided by the Basic River Health Unit (BSHU)) is shown in Figure 2. The test results (Statistics T = - 2.376, and p-value = 0.0282) indicate that there is a 97.18% chance that differences in the means of evaluations are not due to random.

RESULTS	
T statistics	(-) 2.376095
Degrees of freedom	19
P-value	0.02816911
Sample Average 1	5.593
Sample Average 2	57.675
Standard Deviation of Differences	0.3284329
Size of Samples	20
Alternative Hypothesis Different from	0
Level of Confidence	95%
Inferior limit	(-) 0.3282113
Upper limit	(-) 0.020788

Figure 2 - Paired t-test to the ratings of the quality of health services ratings perceived by both groups of users served on two Health Service Units in the SDR of Tupe, July 2015. Source: Data collected from the SDR of TUPE riverine communities, Manaus, Amazonas, July 2015.

Examining in a color map (figure 3), we can see how are spatially distributed the different mean assessments of the perception that residents of riverine communities have about the quality of health services in the SDR of Tupe, allowing to evaluate in each of the communities which dimension of the SERVQUAL model has the perception of high quality and where improvement is needed.

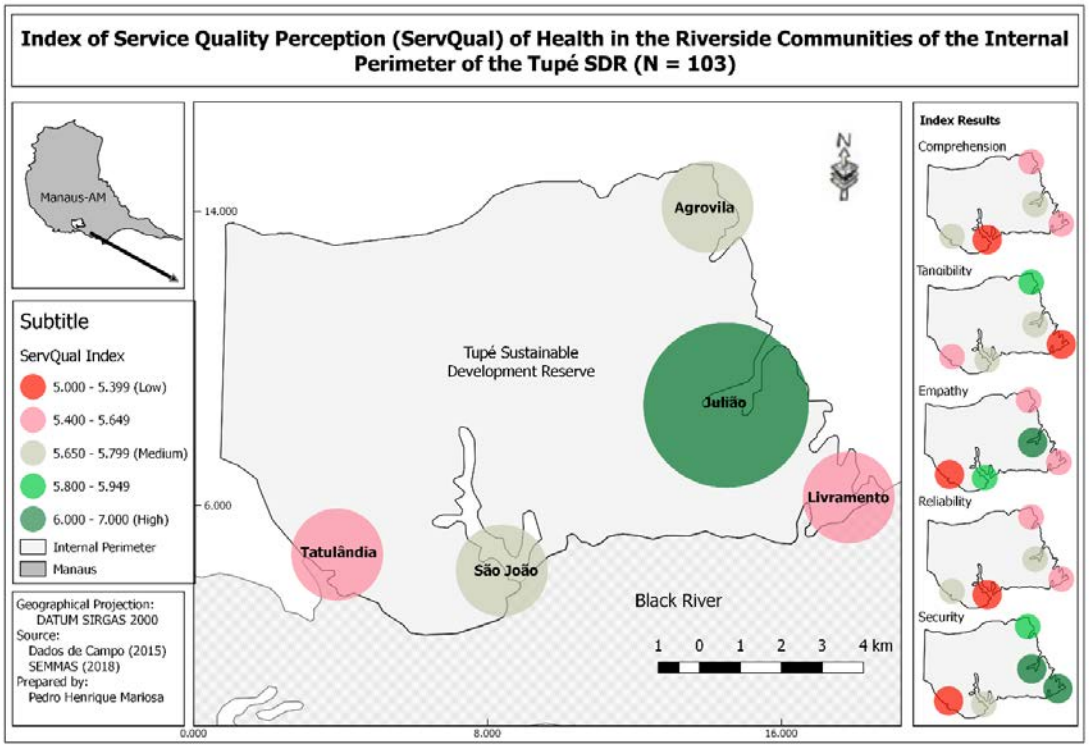

Figure 3 - Summary of indicators and outcomes by Quality of Service Perception (ServQual) indicator by Community. Source: Data collected from the SDR of TUPE riverine communities, Manaus, Amazonas, July 2015.

In the present study, it observed the impact of previous experiences of attending on regarding the quality of service. Especially in the Livramento, Tatulândia, Agrovila and São João do Tupe communities, the means of quality perception are lower than those obtained among the clients-users of the Julião communities health services. Analyzing each dimension, Julião has a perception quality index above 5.650 and Tatulândia below 5.799 in all dimensions of the SERVQUAL model.

As shown in Figure 3, when discussing the quality, we must also recognize the fact that service operations are always of even greater complexity and unexpected. The most diverse factors impact on the reference values used to evaluate the quality of services offered. They do not resume the physical elements, equipment, and personnel of the service unit. Much less the ability to perform the service well, delivering with precision what promised, on the given date. Or the ability to quickly understand users' problems and difficulties and respond positively, inspiring, and imparting credibility and trust. Or offering care, the individualized attention that accompanies the service provider in their work.

5. Conclusions

In the study, whose partial results here were presented, it was observed that measuring the quality offered in health services requires the use of instruments, techniques, and appropriate methodologies specially designed for this purpose. It occurs because we handle whit epistemological complexity of qualitative assessments, and in how to establish the relationships of adequacy between the object and its representation. In the case presented, the quality perception measurement was performed using a metric offered by the researcher to the client-user to learn their assessment, adapted from the SERVQUAL methodology. The investigation showed, by numerical indicators, how the comparative references impact the perception of the quality of health services offered by the Government in the Tupe SDR. If the study suggests that any reference to the quality of health care services should include the material, human, and organizational resources made available to the user, on the other side, it requires considerations taken from the sociocultural universe of relations between the “customer-user” and the service unit.

The methodological model, techniques, and instruments used in this work, as a management tool, allow subsidizing quality evaluations over time, helping to identify specific elements of the service that require improvement, as well as pointing training opportunities for the personnel involved in the project activity.

In fact, the discussion about quality puts the customer before what Karl Albrecht called the “moment of truth” (Freitas, 2005) or “service cycle” (Gianesi & Correa, 1994). That is, the service offered is not exclusively associated with the idea of what carries the customer to go to the service provider. But in finding a solution to your problem, he will go through a series of experiences that will directly influence your concept of attendance. Or if the conditions or manner of dislocation do not meet the arrival objectives, or when arriving the reception has problems of flow in the service, or yet troubles with the attendant, who for some reason is not attentive to the expectation of the client/user, will have a different experience from the purpose for which you went to the service desk.

Additionally, the strategy of the offered operation demands specific attention that often disregarded in public institutions. Especially in places where the quality parameters are perceived without previous experience, there is no reference or counterpart capable of providing the customer with the opportunity of

comparison. The quality as a strategy has to do with competitiveness. And this is associated with the performance standard of the offer available to the customer. If there is no competitiveness, the quality will be related to control in the supervisory sense, where it starts from a defined performance standard and seeks within the limits of available resources to meet the requirements of the protocols.

The main contribution of the study is to demonstrate that the relationship between the "perception of quality" and "quality" is not given directly. The qualitative measurement is a derived measure, which does not correspond directly to the phenomenon of interest but through the manifestations of this phenomenon. We must say, however, the conclusions are yet provisory, limited to the cases analyzed. Definitive affirmations require the continuity of studies in other service units and different similar territorial situations for purposes of consolidation and evaluation of the instruments and techniques indicated here.

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Computational Mathematical Model Based on Lyapunov Function for the Hormonal Storage Control

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Abstract

Computational mathematical models have shown promise in the biological mechanism's reproduction. This work presents a computational mathematical model of the hormonal storage control applied to an endocrine cell. The model is based on a system of differential equations representing the internal cell dynamics and governed by the Lyapunov control function. Among the stages of these dynamics, we analyze the storage and degradation, which occur within some endocrine cells. The model's evaluation considers, as an example, the synthesis–storage-release regulation of catecholamine in the adrenal medulla. Seven experiments, varying the input parameters, were performed to validate and evaluate the model. Different behaviors could be observed according to the numerical data used for future research and scientific contributions, besides confirming that Lyapunov control function is feasible to govern the cell dynamics.

Keywords: Lyapunov function; Computational mathematical model; Hormonal storage control;

1. Introduction

The complex physiological mechanisms that keep the organism in homeostatic balance stimulate the minds of scholars to seek an understanding of this dynamic of internal control. The nervous and endocrine systems are responsible for the regulation and coordination of most of these mechanisms [9, 7]. The endocrine system, with its set of glands and cells, participates in this control through the hormones it releases. They function as chemical messengers mediating endocrine coordination. The word endocrine means secretion inward, and hormones are substances synthesized by endocrine cells and released into the blood, through which they reach the target cell or tissue [22, 24].

The functional balance of endocrine cells depends on an optimum balance between the synthesis, storage, and secretion of the hormone it produces. It involves a complex control system, from synthesis to secretion. Anomalies in this control contribute to the development of diseases. Therefore, the study and modeling of this control system are of great relevance [37].

In the study of the endocrine cells has been advances. Researches in animals using cell cultures developed to mimic events occurring in their dynamics have help to understand some mechanisms [10, 30, 33, 40].

Undoubtedly, mathematical and computational modeling is a path that can help a lot in this understanding, providing answers to many questions generated by experimental research. Mathematical modeling is already an integral part of Biology and Medicine. Models and computer simulations, using real data, are capable to generate insights. They have the potential to predict normal and abnormal behaviors of a cell, organs, and other components of living systems [11, 13, 15, 39].

The work of Cortez et al. [13] used the Lotka-Volterra equations to verify the dynamics of storage-synthesis control in a cell. In this work, we proceed by associating these equations with the classical theory of enzymatic kinetics, the Lyapunov dynamics, and the Hamilton-Jacobi-Bellman optimization equations to simulate the synthesis-storage-degradation balance in the production of catecholamines in an adrenal cell [4]. The computational model was implemented in C language, to

simulate various situations and to show the existence of the storage-degradation balance, studying the influence of the parameters on this equilibrium phase.

The remainder of this paper is organized as follows. Section 2 describes the storage control model applied to an endocrine cell. Section 3 presents the algorithm structure and experimental environment. All experiments, validation, and evaluation are approached in Section 4. Finally, Section 5 shows our conclusions and directions for future works.

2. Control Model Applied to Endocrine Gland

2.1 Endocrinophysiological System

The secretory cells are, in their majority, cubic cells and with two faces: apical and basal, with different polarities of secretory flow. Substrates (S) enter through the basement membrane for the secretion product synthesis that the gland secretes. The product synthesis occurs along the path from the basement membrane to the apical membrane, where it is released into the extracellular medium, and it reaches the blood. The model uses, as an example, the endocrine cell. The adrenal or suprarenal gland cells secrete two well-known catecholamines: EP and NEP. They call adrenaline and noradrenaline, respectively [22, 24].

The suprarenal is a gland located on the kidneys. There are two glands each over a kidney. In a cut of the gland, two regions can be distinguished with the naked eye: the cortical (the cortex) and the medulla. The adrenal cortex secretes steroid-like hormones. The medulla constitutes less than 20% of the gland, and it contains the chromaffin cells, the producers of catecholamines. These cells are called chromaffin because of their high affinity for chromium dyes [28, 31].

The sympathetic nerve fibers, from the autonomic nervous system, richly innervate the adrenal medulla [28, 35]. The adrenal chromaffin cells are modified neurons derived from the sympathetic nervous system [29]. The sympathetic nerve discharges activate the EP secretion in the blood. They also stimulate the exocytosis of catecholamine granules [1].

The synthesis of catecholamines begins with the amino acid tyrosine, which is collected from the bloodstream through the basement membrane of the chromaffin cells. The sequence of reactions for EP synthesis begins with the transformation of tyrosine into dopa, mediated by the enzyme tyrosine hydroxylase. Subsequently, the dopa-decarboxylase enzyme converts dopa into dopamine, which is pick up into reservoir granules. Inside these granules are enzymes that end up converting dopamine into NEP and then into EP, but both have hormonal action. In a few chromaffin cells, the synthesis ends at NEP. But in most cells, the reaction continues with NEP being methylated and converted to EP, by the action of the enzyme N-methyltransferase phenylethanolamine [22].

Figure 1 shows the synthesis of catecholamine, with several reactions until we get the catecholamine.

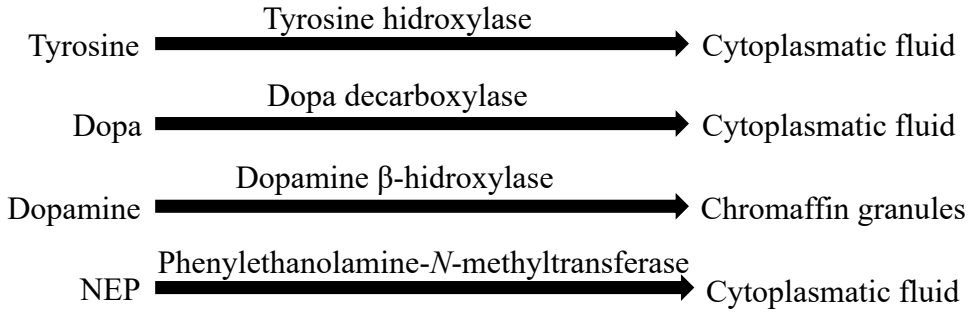

Figure 1. Enzymatic reaction sequences involved in the synthesis of catecholamine.

The regulation of adrenal catecholamine synthesis is a complex process. Nerve discharges activate the enzyme tyrosine hydroxylase and initiate synthesis [35]. However, plasma NEP inhibits this first step in synthesis through a negative feedback mechanism. When the synthesis exceeds the storage capacity, the EP is metabolized in its chromaffin cells. In the blood, catecholamines are short-lived (1-3 minutes) hormones as they are quickly removed from the plasma and metabolized [2, 42].

Catecholaminergic granules have approximately 0.3 μm of diameter. A chromaffin cell can contain approximately 30,000 granules [32]. In addition to EP and NEP, the chromaffin granules contain ATP, dopamine β-hydroxylase, lipids, β-endorphin, chromogranin and pro-opiomelanocortin peptides [32, 35].

Catecholamines are stored in large concentrations in the granules, about 0.5 μM [17]. The normal human adrenal contains 412-633μg of EP and 37-123μg of NEP [17]. EP synthesis is usually so rapid that it is only in rare circumstances that the adrenal medulla can run out of EP supply [12, 21, 8, 18]. Esler et al. [18] found that, at rest, in elderly persons, the secretion of EP is approximately 0.86 nmol/min of EP, while in young people, the secretion is around 0.17 nmol/min.

2.2 Mathematical Model

Figure 2 shows the adopted model to represent the hypothetic endocrine cell and its dynamic control of your endocrine function. The mathematical model has three distinct phases.

The first phase is the synthesis of *H*. The substrate *S* is transported from the blood to the intracellular medium with a V_T speed. The model considers continuous the plasmatic availability of *S*, being *H* produced with a V_H speed depending on the *S* concentration. The second phase is the storage of *H*. The hormone accumulates and is stored in granules at the cell through Via *S* and V_S speed. If not secreted (Via *R*), its excess goes to degradation (Via *D*). When the storage capacity exceeds the maximum limit, *H* proceeds Via *S* and V_D speed to the third phase. Degradation is activated dissociating the hormone molecule to control the hormone quantity in the cell. The recovered substrate *S* can return to the new synthesis phase.

We always consider a small amount of hormone secreted (H_R) by the cell into the plasma with a V_R speed, regardless of any massive discharge that may occur in response to some major organic need.

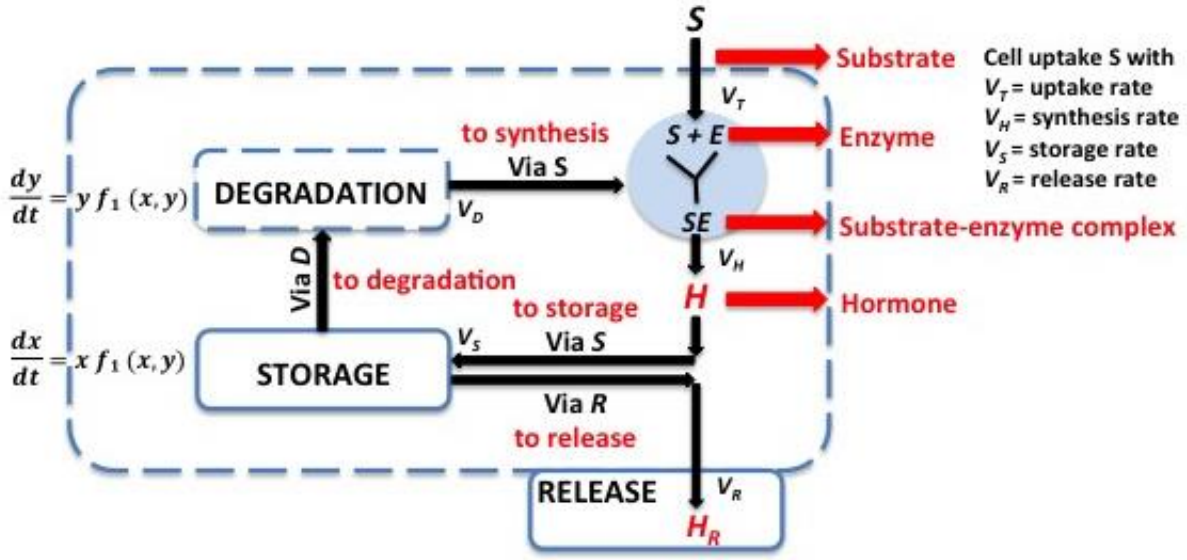

Figure 2. Model adopted for the dynamic control for the synthesis, storage, and release of hormone. S = substrate, E = enzyme, SE = substrate-enzyme complex, V_T = uptake rate from blood, H = hormone, V_H = synthesis rate. Via S = storage pathway, Via D = degradation pathway and Via R = release pathway from the storage, H_R = released hormone.

The hormone synthesis (H) is described by the following sequence of reactions:

$$\underbrace{E + S}_{1^a\ step} \underset{k_{-1}}{\overset{k_1}{\rightleftarrows}} \underbrace{ES}_{2^a\ step} \xrightarrow{k} \underbrace{E + H}_{3^a\ step} \xrightarrow{k} \underbrace{E + H} \qquad (1)$$

where S is the substrate, E the enzyme, whose concentrations in the cell are [S] and [E], respectively. The H synthesis process consists of three distinct stages:

(1^{st}) formation of a substrate-ES enzyme complex, by the interaction of S and E, described by the equation: [ES] = k_1 [E] [S];

(2^{nd}) reverse dissociation of ES in E and S, in which [ES] = k_{-1} [E] [S];

(3^{rd}) dissociation of ES giving formation to H, according to [H] = k [ES]. The speed of each step depends on the constants k_1, k_{-1}, and k.

Usually $k > k_{-1}$ [6]. At equilibrium, the rate of hormone formation (V_H) is given by the equation $V_H = k[ES] = k/k_m[E][S]$, where the Michaellis constant is k_m, which is related to the maximum speed V_{max} of the enzymatic reaction, $k_m = 1/V_{max}$, and is given by the equation $k_m = \frac{k+k_{-1}}{k_1} \approx \frac{[E][S]}{ES}$.

Through this method, we arrive at a linearization and consequently a first-degree function of the type $y = ab + b$, where a is the angular coefficient and b is the linear coefficient. In this case, $a = -1/k_m$ and $b = 1/V_{max}$. So $y = -1/k_m\, x + 1/V_{max}$ [38].

The specificity constant limit k is given by the frequency at which the substrate and enzyme find each other in the solution. This limit can reach $10^{10} M^{-1} s^{-1}$ [36].

$$k \leq 10^{10} M^{-1} s^{-1} \qquad (2)$$

We call this rate limit, regardless of the substrate or the enzyme dimension [14].

The ratio between the specificity constants for two substrates is a quantitative comparison of the

enzyme's efficiency in converting the substrates.

2.2.1 Storage-Degradation Model

The storage time (t_s) is the interval in which H remains stored, Q_E is the amount of hormone in the storage, and V_S (mol/min) is the speed with which H enters into storage. The Q_E quantity depends on V_S and t_s, being limited by an internal control system. The t_s period depends on the activation of the specific mechanism. The mechanism triggers the transport of H across the cell membrane, for its release into the bloodstream.

The mechanism that controls the quantity of storage (Q_E) is the degradation. Considering the synthesis continuous, between one and other hormonal discharge into the blood, occurs degradation. The excess of H is degraded, so the released substrate becomes available for new synthesis or returns to the plasma. Thus, the control system includes variables involved in the storage and the degradation system.

We represent the activation dynamics of the storage (X) and the degradation (Y) through a system with two interrelated differential equations. The first one relates to the storage process and involves the function $f_1(x, y)$. The second one refers to the degradation using $f_2(x, y)$. According to [5, 26], we have the following equations $dx/dt = xf_1(x, y)$ e $dy/dt = yf_2(x, y)$. In these equations, the x and y variables represent, respectively, the amount of stored hormone and the amount of degradation enzyme.

In our model, the storage-degradation dynamics follow the Lotka-Volterra model [16, 20, 23]:

$$\frac{dx}{dt} = x(a - ry - px), \tag{3}$$

$$\frac{dy}{dt} = y(-b + gx + C), \tag{4}$$

where a, b, r e s are positive constants, the term ax defines the rate of the stored hormone, $-by$ refers to degradation rate, $-rxy$ and gxy relate to the interdependence between storage (X) and degradation (Y), the first favoring the storage and the second one favoring the degradation.

The term C (Eq. (4)) ensures the maintenance of optimal control, and characterizes the number of antagonistic conditions present in the cell at time t, being described by the relationship:

$$C = \xi y + U, \tag{5}$$

being ξy represents any compensatory process that at any stage of the system conducts the system to the optimal equilibrium point, and U is the stability term.

2.2.2 Lyapunov Criteria to Define the Balance

We assume that the synthesis is continuous, so the balance is dependent on the degradation process, which has the function of preventing excess storage. We consider three possible hypotheses: (1) the endocrine cell is normofunctional and the three phases (synthesis, storage, and degradation) are balanced; (2) the cell is hypofunctional, the degradation being more intense than the synthesis; and (3) the cell is hyper-functioning because the degradation process is slow comparing to synthesis and storage.

We need a U control function (Eq. (5)) that stabilizes the system and to be a Lyapunov function. This

function must be positive and guarantee asymptotic stability, in other words $dU/dt < 0$ [25, 27, 41, 43].

Boundary conditions should be considered and are the following: (1) there is a value Y_D so that $Y_{min} \leq Y_D \leq Y_{max}$, for which the gland is normofunctional; (2) for balance to exist, the term C in equations 4 and 5 must be positive, $C > 0$, and when $t \to \infty$, $U \to 0$, and $C = \xi y$; (3) U is a positive function; (4) we have $dU/dt < 0$ for points out of balance and $dU/dt = 0$.

Suppose the existence of optimal equilibrium point (x*, y*) for storage-degradation dynamics, such as $df(x^*, y^*)/dt = 0$. In other words, at this point, Eq. (3) and Eq. (4) cancel each other. Thus, from Eq. (3) we can rewrite:

$$a - ry^* - px^* = 0, \tag{6}$$

$$y^* = \frac{a - p\,x^*}{r}, \tag{7}$$

Thus, $a - px^* > 0$. Using Eq. (4) and considering boundary condition 1 we obtain that:

$$-b + gx^* + \xi y_o = 0, \tag{8}$$

$$\xi = \frac{b - gx^*}{y}, \tag{9}$$

For boundary condition (1) to be fulfilled, $\xi > 0$ and x_0 must be such that $x < b/g$, so b/g is the balance-imbalance limit. For the optimal deterministic control over a period $(0, T)$, the control function can be determined from

$$U(y(0),0) = min_V \left\{ \int_0^T C(y(t), U(t))\, dt + D(y(T)) \right\}, \tag{10}$$

where $D(y(T))$ is the function that defines the system performance. For linear stochastic dynamics and a described performance by a quadratic function, the optimal control problem can be reduced to the Hamilton-Jacobi-Bellman partial differential equation [3, 27, 43]

$$min_V \left\{ \frac{dU\,(y(t),t)}{dt} + \omega \right\} = 0, \tag{11}$$

and ω function, by definition, is:

$$\omega = m_1\,(x - x^*) + m_2\,(y - y^*) + U^2 \tag{12}$$

and U function is by definition:

$$U(y(t), t) = min_V \left\{ \int_0^T [m_1(x - x^*)^2 + m_1(y - y^*)^2 + U^2]\, dt \right\} \tag{13}$$

being m_1 and m_2 positive constants.

The solution of Eq. (11) should be investigated among the Lyapunov functions, according to the Lotka-Volterra type models. For the nonlinear stochastic dynamics, to determine the solution U (x, t) in Eq. (12), we used the Lyapunov function in the following way [25, 34, 41, 43]

$$U\,(x, y) = v_1 \left(x - x^* - x^* ln\left(\frac{x}{x^*}\right) \right) + \left(y - x^* - y^* ln\left(\frac{x}{x^*}\right) \right) \tag{14}$$

where v_1 and v_2 are positive constants to be determined, whose values can be defined by the Hamilton-Jacobi-Bellman equation [3]. The derivative of Eq. (14), considering Eq. (3) and Eq. (4), gives:

$$\frac{dU(x,y)}{dt} = v_1(x - x^*)(a - px - ry) + v_2(y - y^*)(-b + gx + \xi y + U). \quad (15)$$

Using Eqs. (12), (14), (8) and Eq. (10) in Hamilton-Jacobi-Bellman, we obtain:

$$min_V\{v_1(x - x^*)(a - px - ry) + v_2(y - y^*)(-b + gx + \xi y + U) + m_1(x - x^*)^2 + m_2(y - y^*)^2 + U^2\} = 0 \quad (16)$$

The function $U(t)$ is not limited and can be found by $\partial / \partial U$ considering Eq. (15), being $U^* = \frac{-v_2}{2}(y - y^*)$, where U^* is the optimal value for control function. The value U^*y represents the ideal enzymatic activity of the system in each instant t. Replacing $U = U^*$ in Eq. (3) and assuming that $v_1 = m_1/p$ and $v_1 = -sv_2/r$, and for $v_2 > 0$, $v_2 = 2\left(\delta + \sqrt{\delta^2 + m_2}\right)$, finally, we have that:

$$\frac{dU}{dt} = -m_1(x - x^*)^2 - \left(\sqrt{\delta^2 + m_2}\right)(y - y^*)^2 < 0 \quad (17)$$

3. Algorithm and Experimental Environment

Based on the described formulae we develop an algorithm to reproduce the functioning of an endocrine cell considering the Lyapunov function to control the storage and degradation processes. Figure 3 shows the algorithm's simple structure.

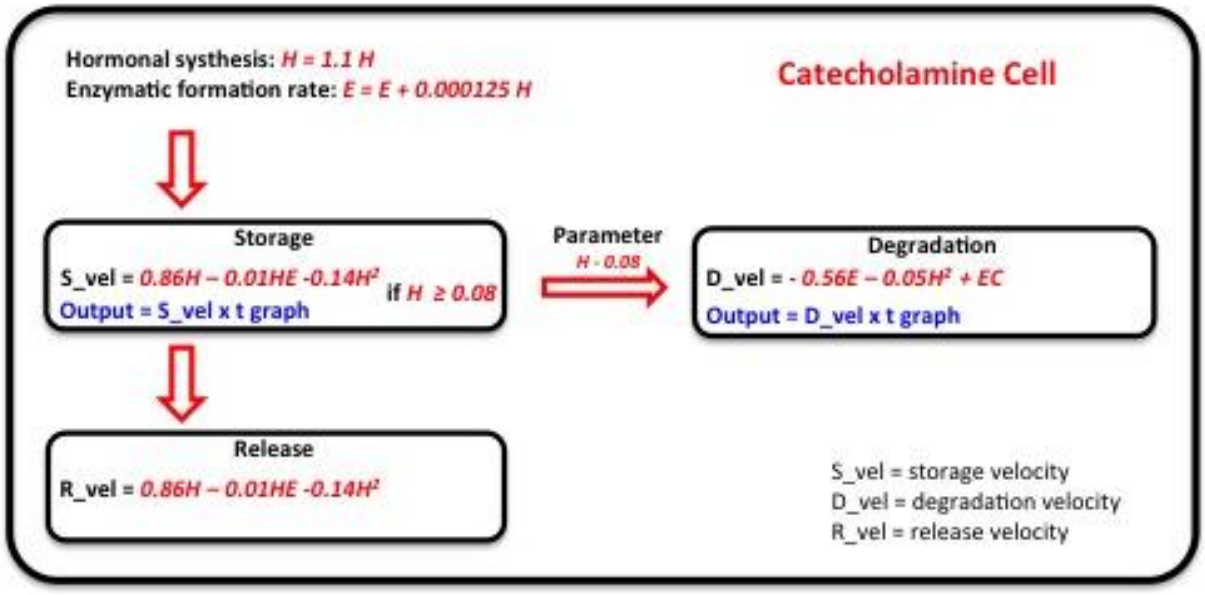

Figure 3. Algorithm's simple structure.

The algorithm simulates how the system works inside a cell using equations to represent the chemical reactions.

The algorithm has three main modules: storage, degradation, and release (Figure 4). The input parameters

are the hormone concentration (H) and enzyme concentration (E). The outputs are graphs related to the storage and degradation process speed as a function of time.

The parameters used in each formula are a the rate that enters the storage by time; r the rate that goes to degradation by time; p the rate that is secreted by time; b the rate of degradation by time, and s the rate of degradation possible by time.

Some parameters of the computational mathematical model's equations were obtained in the literature (a and p [2]). However, not all of them were found. We focused specifically on these parameters in the simulations, trying to know how they could influence the behavior of the adopted model. In this way, we test the model's ability to simulate the process control dynamics.

There are two main functions involved: storage and degradation. We analyzed the following functions used inside each one. Enzyme factor growth control E ($E = EH - H/100000$); Controlling the growth of the hormonal amount in the system H ($H = 1.1H$); Storage speed in function of time ($\frac{dx}{dt} = x(a - ry - px)$); Degradation speed as a function of time ($\frac{dy}{dt} = y(-b + gx + C)$); Balance between storage and degradation ($C = \xi y + U$) where $\xi = \frac{-bgx}{y}$.

The algorithm was executed in a computer with an Intel Core i5 of 1.70GHz with 2 cores, 6GB of RAM, and 8MB of cache memory, running the Windows 10 Pro operating system. It was implemented using Code::Blocks IDE, version 17.12, in C Language and compiled with GCC version 4.9.2.

4. Model Evaluating

We used the production of catecholamines, epinephrine (EPI) and norepinephrine (NEPI), as an example, to evaluate the proposed model. This is an endocrine gland consisting of a cortex (superficial layer) and a medulla (inner layer). In adrenal medulla, chromaffin cells store and secrete catecholamines [2]. Each cell has approximately 30,000 secretory granules [32] with about 0.3μm diameter containing about 0.5μM of catecholamines [17]. The EPI and NEPI concentrations in the normal human adrenal are 412□g to 633□g and 37μg to 123μg, respectively [17]. From all the NEPI formed, 15% remain in the granules, and 85% pass into the cytoplasm [32]. NEPI is methylated forming EPI, which is captured and stored in the granules of chromaffin cells [2, 28]. EPI is normally produced very fast so that the depletion of its EPI supply occurs only in unusual circumstances [12, 19].

The proposed model is composed of equations that have many parameters. Thus, it is necessary to know how each of them influences the model's behavior. Seven different experiments were carried out, varying the parameters, and observing the enzymatic activity in the storage and degradation processes.

Figures 4 (a) and 4 (b) show a first approximation to the storage and degradation velocities as a function of time, according to the model, for the following parametric values a = 0.86; r = 0.001; b = 0.56; s = 0.05; p = 0.14; E = 0.09; m_1 = 0.03; e H = 1.0, 2.0, 3.2, 3,9, 5.0, 5.7, 6.1 μM.

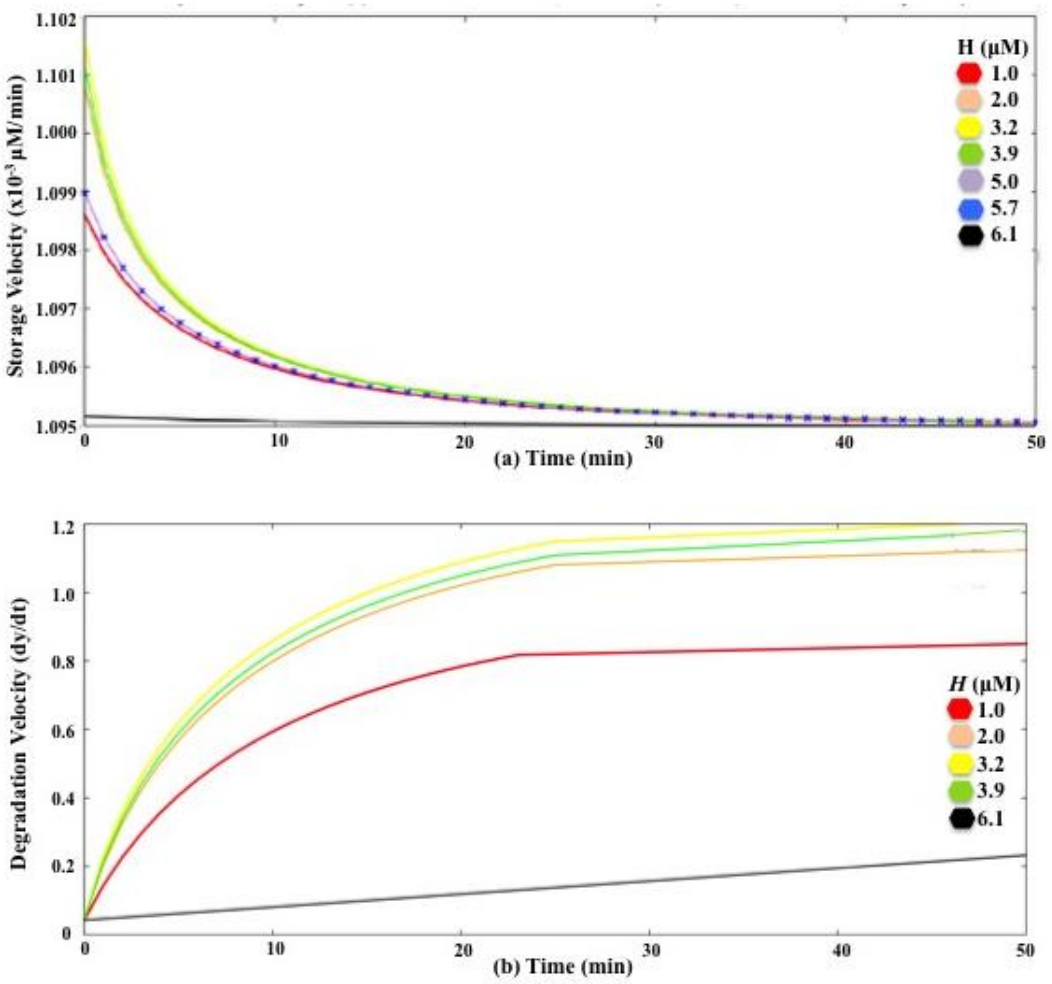

Figure 4. Storage (a) and Degradation (b) velocities as a function of time.

In Figure 4 (a), we observed that at this rate it decreases with time, for all tested hormone concentrations (from H = 1.0 to 6.1 µM), and tends to zero for t > 50 min. Figure 4 (b) shows that, unlike storage, the rate of degradation increases with time, from H = 1.0 to 3.9 µM), and reaches a plateau to t > 10 min. This plateau corresponds to the maximum degradation phase. But, while still growing, the chart for H = 6.1 µM is linear, showing that in this case the equilibrium would occur for a very long-time interval.

It is important to mention that a random variation of the input parameters (a, b, r, s, p, m_1, H, and E) did not produce valid results. It was not possible to find in the literature the variation of the enzymatic action over time. In this way, we looked for, through simulations, which function could represent the rate of growth of the enzymatic action that led us to a more realistic result. Thus, we adopted a linear function with a low angular index. In contrast, the behavior of the storage rate plot as a function of time did not increase and stabilize after a certain time. We looked for other functions that could represent enzymatic variation, such as exponential, quadratic, or logarithmic. But these were not adequate. At the end, we adopted the function

$$E = EH - 100000 \text{ or } y = xy - x/100000 \qquad (13)$$

with which we could observe the behavior of the storage speed as a function of time.

Figures 5 (a) and 5 (b) present the storage and degradation variations in time for the following parametric values a = 0.86; r = 0.001; b = 0.56; s = 0.05; p = 0.14; E = 0.09; m_1 = 0.03; e H = 1.0, 2.0, 3.2, 3,9, 5.0,

5.7, 6.1 µM, considering the equation of the variation of E (Eq.13).

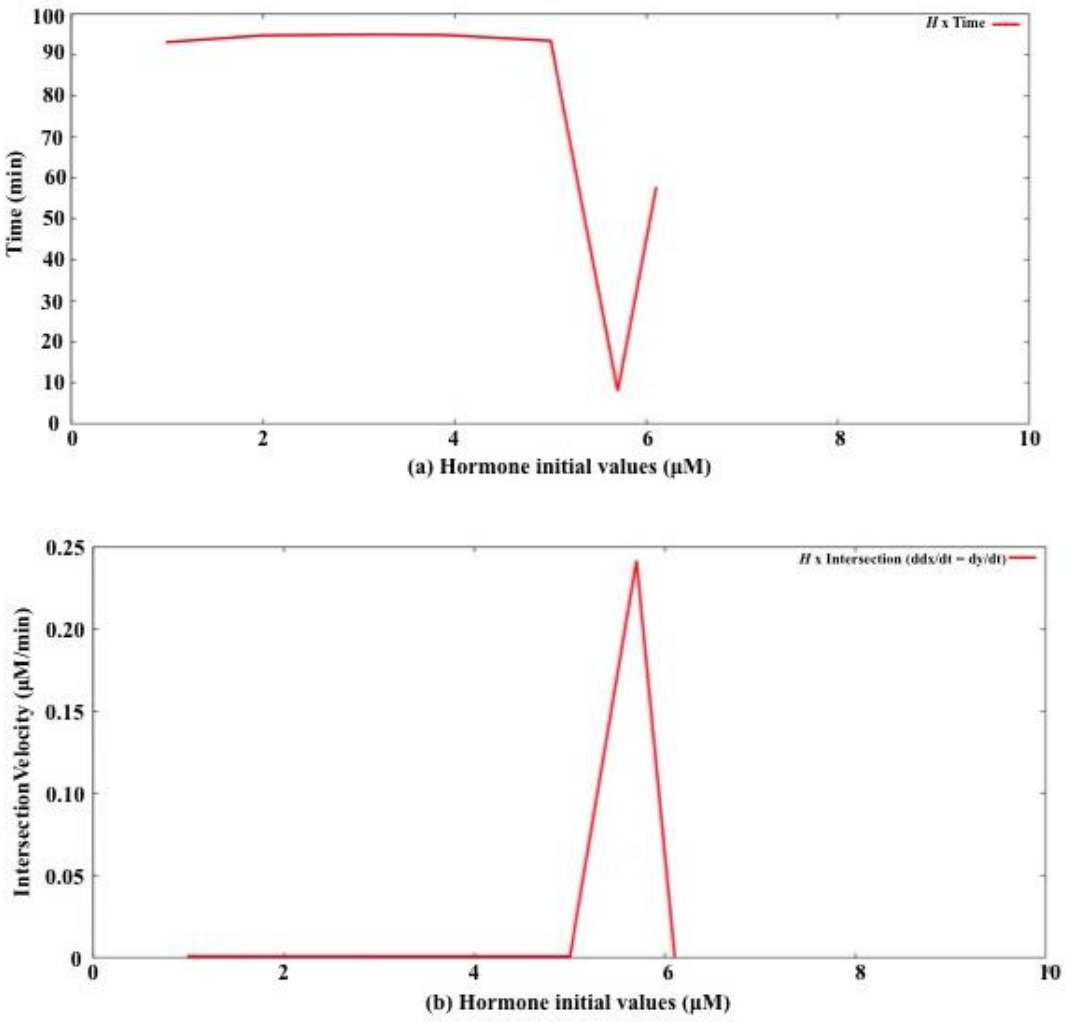

Figure 5. (a) Time versus values of the initial hormonal quantity at the intersection between storage and degradation speeds. (b) Relationship of the intersection between storage and degradation speeds with the initial hormonal amount.

In Figure 5 (a) we observe that about 9 minutes after the start of storage there is a condition of balance between this function and degradation, where H = 5,7 µM and the speed is equal to 0.24 µM/min. As one grows, the other decreases. These functions have a complementary character. They reflect each other, despite being in different sizes. These experiments were important to note that with the growth rate linear enzyme, even if the differential equations balance the system because we observed that the speed of degradation as a function of time behaves as expected, in the storage speed as a function of time there is no growth. That means that enzymatic growth using this type of function was not enough for the system to reach equilibrium within the time interval that was simulated. Following the validation of the model, we investigate the possible factors that would influence the model behavior.

Looking for more accurate results we vary the r parameter. Figures 6 (a) and 6(b) show the results for the variation of storage and time degradation for the following parametric values a = 0.86, r = 1.1, b = 4.56, s = 0.05, p = 0.14, E = 0.03, m_1 = 0.09 and H = 0.4, 0.5, 0.6, 1.5 µM. Both considering equation (13) of

the variation of E.

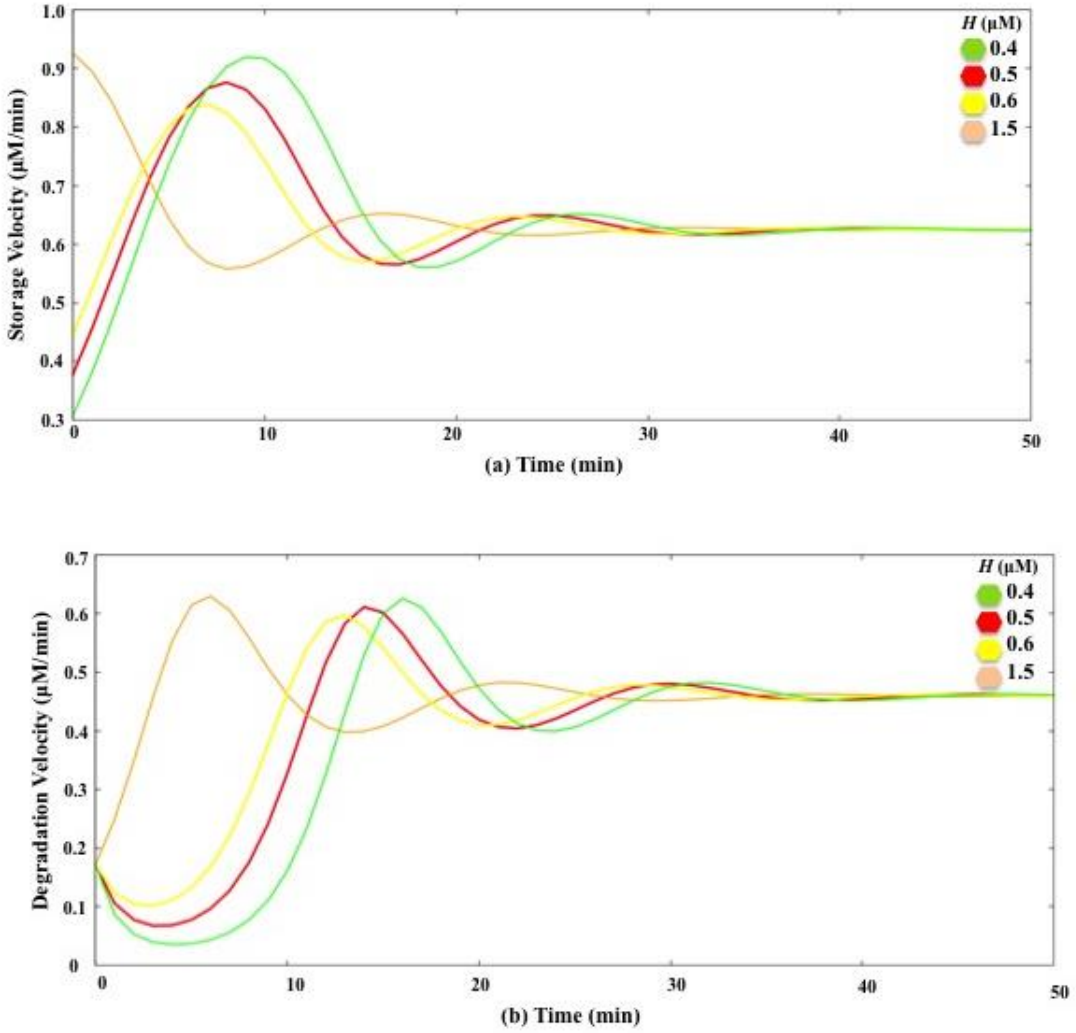

Figure 6. Storage (a) and Degradation (b) variations in time.

Cortez et al. [13] observed, using a simple mathematical model based on the classical Lotka-Volterra equations, the degradation process starting about 20 minutes after storage reaches its maximal capacity, and the degradation activity increased until $y = 0.103$ mg at $t = 35$ min, and then stabilized at $y = 0.0873$ mg. The storage and degradation velocities came into equilibrium for $V_S = V_D \approx 1.53$ µg/min (about 0.008 µmoles/min). This value is in the same magnitude order of that found in experimental studies [12].

Subsequently, we consider the intersection points between the storage and degradation speeds and the time when these intersections occur. We related these values to the initial hormonal amount. Figure 7 (a) shows the relationship between the initial hormonal amount and time. Figure 7 (b) presents the initial hormonal amount and the intersection points between the storage and degradation speeds.

Figure 7 shows more than peaks and valleys comparing to the first simulation, where we use the growth of a linear function for the enzyme rate in the system. Note that one is complement of the other, while one grows the other decreases and vice versa. We can consider that one is the reflection of the other, despite being in different scales. In Figure 7 (a) has a global maximum occurring at 18 minutes for an initial concentration of $H = 0.4$ µM. This time is spent to complete the capacity of storage. For the highest possible concentration ($H = 1.5$ µM) it is necessary a shorter time of about 8 minutes to reach this

capacity. These results have a biological sense, since the concentration is greater than the capacity, consequently this difference goes to the degradation faster. Considering that the values found in the storage speed are the same as the degradation, we noticed, in Figure 7 (b), that the highest speed occurs at highest concentration possible (H = 1.5 µM and 0.62 µM/min). The lowest speed occurs at the lowest initial hormone concentration (H = 0.4 µM and 0.56 µM/min). Therefore, the initial hormone concentration is directly proportional to the encounter speed of storage and degradation processes in the system.

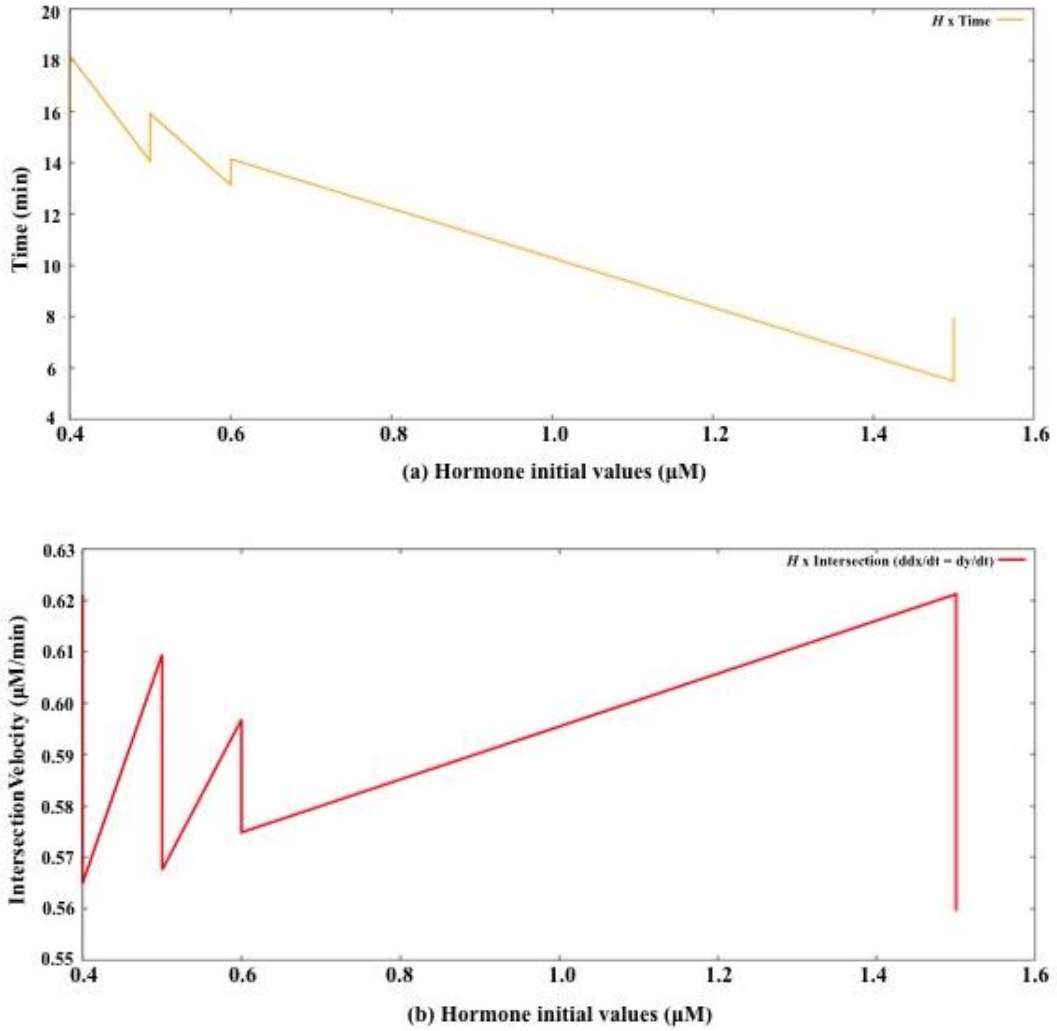

Figure 7. (a) Time versus values of the initial hormonal quantity at the intersection between storage and degradation speeds. (b) Relationship of the intersection between storage and degradation speeds at the initial hormonal amount.

In the subsequent experiments, we analyzed the variation of parameters m_1, r, s and b keeping the other parameters fixed. For all experiments we assume a = 0.86, p = 0.14, E = 0.03, H = 0.5µM.

With the parameters r = 1.1, b = 4.56, s = 0.05 fixed, we observed that the variation of m_1 (m_1 = 0.09, 0.5, 0.6, 0.7, 0.8, 0.9) does not influence the hormonal storage speed as a function of time. However, r greatly influences the rate of degradation as a function of time.

The variation of r (r = 0.95, 1.5, 2.1, 2.2) influences both the storage and degradation speeds, considering

b = 4.56, s = 0.05, m_1 = 0.09 fixed.

The variation of the parameter s behaved similarly to the variation m_1 within the tested values range (s = 0.05, 0.051, 0.052, 0.053). It does not influence the rate of hormonal storage as a function of time, but it does influence the rate of degradation. The other parameters were b = 4.56, r = 2.1, m_1 = 0.09.

Parameter b does not influence the behavior of the studied dynamics, within the range in which it was tested (b = 0.0001, 0.009, 0.9, 9.0, 99.0, 9999.0). The storage and degradation speed remained the same considering as fixed input parameters r = 2.1, s = 0.05, m_1 = 0.09.

Table 1 summarizes the intervals of the results obtained, allowing us to get a better sense of them. In this table we can observe that the intervals do not vary much. The range with the biggest difference is the one where the model was still being adjusted, using a linear function to represent growth in the enzymatic activity. The storage speed as a function of time varies in range from 0.35 μM/min to 0.85 μM/min ($0.35\ \mu M/min \leq dx/dt \leq 0.85\ \mu M/min$). For the speed of degradation as a function of time we notice a variation from 0.1 μM/min to 0.7 μM/min ($0.1\,\mu M/min \leq dy/dt \leq 0.7\,\mu M/min$). The time to reach equilibrium in the system is in the range between 30 minutes and 35 minutes ($30\,min \leq t \leq 35\,min$). The intersection speeds between storage and degradation vary between 0.57 μM/min and 0.61 μM/min ($0.57\,\mu M/min \leq dx/dt = dy/dt \leq 0.61\,\mu M/min$). The time it takes for the storage and degradation speeds are the same occurs between 13 and 16 minutes.

Table 1. Obtained results.

Test	**1°**	**2°**	**3°**	**4°**	**5°**	**6°**	**7°**
Constant	***H***	***H***	***E***	m_1	***r***	***s***	***b***
Interval (μM)	**[1, 6.1]**	**[0.5, 1.5]**	**[0.0009, 0.1]**	**[0.09, 0.9]**	**[0.95, 2.2]**	**[0.05, 0.053]**	**[0.0001, 9999]**
$\frac{dx}{dt}$ **(μM/min)**	**[1, 1.4]**	**[0.3, 1]**	**[0.3, 1.1]**	**[0.35, 0.9]**	**[0.3, 0.9]**	**[0.35, 0.85]**	**[0.35, 0.85]**
$\frac{dy}{dt}$ **(μM/min)**	**[0.00109,0.0110]**	**[0, 0.7]**	**[0, 0.7]**	**[0, 7]**	**[0, 0.7]**	**[0, 0.7]**	**[0.1, 0.7]**
***t* (min)** $\frac{dx}{dt}$ $\frac{dy}{dt}$	**[0, 50]**	**[0, 50]**	**[0, 50]**	**[0, 50]**	**[0, 50]**	**[0, 50]**	**[0, 50]**
$\frac{dx}{dt} = \frac{dy}{dt}$ **(μM/min)**	**[0, 0.25]**	**[0.55, 0.63]**	**[0.35, 0.61]**	**[0.5, 0.9]**	**[0.56, 0.64]**	**[0.57, 0.63]**	**[0.57, 0.64]**
***t* (min)** $\frac{dx}{dt} = \frac{dy}{dt}$	**[10, 90]**	**[4, 20]**	**[0, 25]**	**[0, 8]**	**[13, 16.5]**	**[13, 16.5]**	**[13, 16.5]**

5. Conclusion

In this work, we propose a computational mathematical model for the synthesis-storage-degradation control in an endocrine gland. We used catecholamine synthesis in the adrenal medulla to validate and

evaluate the model.

Several simulations were carried out to study the model's behavior, verify the parameter influence involved in the equations, and adapt the construction of the algorithm.

The study of the input parameter variations allowed us to realize the importance of the enzymatic activity variation in the behavior of the storage and degradation processes. Initially, when we used a very high input value for the hormone concentration, the storage speed as a function of time assumed a behavior consistent with the expected, but no hormone was degraded. Then, we performed experiments varying the hormone concentration, the enzyme concentration, and the degradation rates.

The results obtained are favorable to the proposal that the model associating the Lyapunov equations to those of Lokta-Volterra can be used to represent the control dynamics of the synthesis-storage and degradation of the catecholamines in the medulla of the adrenal gland. The parametric values pointed to the equilibrium condition of the equation system of the computational mathematical model are in the magnitude order of values found in the literature, and the simulations used realistic values [2] for (a = 0.86) and p (p = 0.14), which were obtained in the literature, resulting from experimental measurements. For future works, we intend to refine the model by implementing the enzyme synthesis procedure that directly influences the storage-degradation-synthesis processes of the endocrine gland, and to focus on the release function to make the model more accurate.

6. Acknowledgement

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Mapping of technologies using thermal images to control epidemics

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Abstract

The quest to combat the spread of the new Corona Virus Pandemic is a battle experienced worldwide, more specifically in the year 2020 when it caused a tragedy in the lives of a large part of the world population. The current numbers of contaminated people and deaths are alarming. Transmitted through droplets expelled through the nose or mouth, it leads to fever, which is the most common symptom of COVID-19. A technique that uses thermal images to check dispersed heat is a thermography. These images are captured by thermal cameras or devices with temperature sensors. Thus, the purpose of this work was to map the deposits of patent applications in order to seek technologies related to the use of thermal images to control the pandemic. The search base chosen for this research characterized as exploratory quantitative was Espacenet, which returned a final result of 119 published patent documents. Of these 93 documents were worked on in this article which gave us a more discussed result, since the others were repeated. The research revealed that patent applications in this area were stable until the current year when a Corona Virus pandemic spread, forcing researchers to develop research in order to combat it. The increase in the number of patents in 2020 shows the tendency to increase to 2021 when new research should appear and, consequently, new patented documents may be exposed in the future.

Keywords: pandemic; corona virus; patents; thermal images;

1. Introduction

It is visible worldwide that countries are looking for ways to prevent the spread of the new Corona Virus Pandemic. (ALJAZEERA, 2020). According to the World Health Organization - WHO (2020), until September 14, 2020, the global panorama is 28,918,900 confirmed cases and 922,252 deaths. The highest incidence of confirmed cases is registered in the American continent, representing 51.23% with 14,815,178 of the total of these cases. The American continent also outperforms the others in terms of the number of deaths, representing 55.45% with 511,427 deaths. Brazil records 4,315,687 confirmed cases (14.92%), occupying the third place and classified, as for transmission as community. Regarding the number of deaths, Brazil ranks second with 131,210 deaths, representing 14.23% of the total deaths.

COVID-19 is a virus, as are Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). Fever is one of the most common symptoms of COVID-19. The disease is transmitted to people through the droplets that are expelled through the nose or mouth, when speaking, coughing or sneezing. Another form of contagion is by touching a surface that contains these particles and then touching your eyes, nose or mouth (WORLD HEALTH ORGANIZATION, 2003).

According to ANSER et al. (2020), communicable diseases affect poor and rich nations, requiring the adoption of preventive measures. The lack of basic services in certain regions of poor countries increases the transmission of these diseases, as well as the lack of information about security measures to combat contagion.

Thermography is a technique that uses thermal images captured by thermal cameras or devices with temperature sensors, allowing to verify the dispersed heat (SHARMA; YADAV, 2017).

There are several ways to perform the measurement in order to result in different results. The most common clinical investigation is the measurement of temperature. An ideal thermometer should perform the measurement accurately, making it possible to obtain the result quickly, ensuring safety and absence of potential risks (KOCOGLU et al., 2002).

According to LIU; CHANG; CHANG (2004), several countries used techniques to identify people who had fever as a way to contain the spread of severe acute respiratory syndrome (SARS), which occurred in 2003. In Taiwan, some safety measures were applied, such as measuring the temperature of all people entering or leaving the country. At strategic points such as airports, hospitals, schools, government facilities, and large confined spaces, screening was put in place to measure people's temperature and allow them to enter these places.

Due to the high number of people to measure the temperature, the method that was chosen in Taiwan was the use of the infrared thermometer that measures the temperature by the body surface of the forehead, but that is not the most reliable way. The most efficient way of measuring is through the ear canal. According to SIMÕES; MARTINO (2007), to measure the auditory canal, tympanic thermometers are used whose working principle is based on the measurement of the amount of infrared energy emitted by the tympanic membrane and nearby tissues. According to LIU; CHANG; CHANG (2004), the external environmental factors alter the temperature in the body, decreasing the precision of the values obtained from the forehead temperature.

According to ZHANG et al. (2020), the temperature measurement technology with the use of thermal images developed quickly because it has some advantages, such as the possibility of carrying out the measurement at a long distance without the need for contact and allowing the accomplishment of several measurements at the same time with precision. Some factors such as ambient temperature, lens temperature, detector temperature and other factors interfere with the accuracy of the temperature measurement, but the most important factor is the high precision calibration performed on the equipment.

According to KUMAR et al., (2018), the Internet of things (IOT) allowed devices through the use of sensors "devices or things" to detect data that will be processed by other devices or things, being connected via the internet. These devices can be used to detect health changes. Learning algorithms are used to process the large amount of data and to make the decision.

The use of thermal imaging technology to monitor body temperature has the advantage of reducing the risk of infection for operators and eliminating the inefficiency of manual measurement (YOUXI; GUOKUN, 2020).

According to JIANBO et al. (2020), the temperature screening carried out in places where there is a large flow of people is carried out by a measurement mode that, although it is non-contact, the efficiency is low due to having to measure one person at a time. This method comprises a measuring gun with an infrared

measuring system.

The temperature measurement based on facial recognition allows the control of authorized persons access and the control of epidemics by issuing a warning in cases of high temperature detection. In this way, it is possible to allow only people with the temperature at the acceptable limit. This system can be applied in public places where there is a large flow of people such as transport stations, parks, schools etc. This measure prevents the spread of the virus (GUANGBIN, 2020).

Therefore, this study aims to investigate the technological production related to the use of thermal images to control the pandemic through the use of the mapping technique based on patent searches using the Espacenet platform and then carry out an analysis of the temporal behavior regarding the number of publications in the period chosen for analysis, which was since 2002 when the first patent on the topic was published.

2. Theoretical Foundation

The use of thermal images is an efficient way to identify cases of Covid-19 in environments that require a large flow of people. The traditional method of individual verification with the non-contact thermometer puts the operator at risk and takes a long time to verify a crowd of people (P RANE, 2020). According to MAGESH et al. (2020), thermal cameras detect radiation producing thermal images, being able to detect the temperature of several people in a few seconds.

In 2003 the first case of Severe Acute Respiratory Syndrome (SARS) was reported in China, which is a disease caused by the SARS-CoV corona virus. Spreading rapidly to other countries before the outbreak was contained (CENTER FOR DISEASE CONTROL, 2013). According to NEGISHI et al. (2020), in December 2019 in the city of Wuhan in China the first case of Covid-19 occurred and spread to more than 110 countries in March 2020. It is necessary to implement systems for measuring multiple vital signs in places where there is a concentration of people.

A sorting system can have one or more sorting stations. At airports, these systems use a combination of questionnaires, trained observers and screening devices in order to detect travelers who carry an infectious agent. If there is any suspicion, travelers are subjected to laboratory tests to prove it. Once the suspicion is confirmed, they are referred for treatment. To choose the screening system to be adopted, one must know the clinical manifestations of the infectious disease to prevent the spread of infectious agents (GOLD et al., 2019).

According to GOLD et al. (2019), the most efficient way to identify infected people is to search for the most frequent symptoms of the disease. According to NEGISHI et al. (2020), most infectious diseases have temperature, heart rate and high respiratory rate.

If resources for screening at airports are limited, you must first install screening at departure terminals at airports located in affected countries. But to increase the detection rate, sorting systems must be installed at the Arrivals terminals (GOLD et al., 2019).

According to NGUYEN et al. (2010), some infrared thermal detection systems have automatic calibration adjusting to environmental conditions. But there are thermal detection systems that need to be manually calibrated for the environmental conditions of the site, which influence the measurement results of both

thermal measurement systems and oral measurement systems.

The success in avoiding transmissibility is related to the identification of cases quickly. (FERGUSON et al., 2005) According to VILKE et al. (2020), many companies are using temperature measurement screening to allow customers and employees to enter.

According to JIANG; HU; ZHAI (2020), the first symptom presented by a person infected with Covid-19 may not be fever. Thus, devices that use only the measurement of body temperature as a parameter would not be effective because it disregards the other initial symptoms. It is necessary to evaluate multiple symptoms by the device to improve the effectiveness of the screening. Another parameter that can be increased in the analysis by thermal cameras is the respiratory state simultaneously with body temperature, which is more used in the screenings than the assessment of the respiratory state. Breathing is the most important parameter for the analysis of vital signs and it is possible to use thermal images to perform the analysis of the breathing pattern and frequency. The use of thermal cameras allows facial recognition if the person is wearing a mask and with the use of algorithms it is possible to analyze the information regarding temperature and breathing status. According to BUOITE STELLA et al. (2020), due to the large number of asymptomatic people and people who do not have a fever even though they are infected with Covid-19, temperature measurement cannot be considered as the only safety protocol. Needing to measure other physiological parameters using different devices and creating algorithms capable of performing the analyzes.

According to technology developed by SOMBOONKAEW et al. (2020), the use of internal temperature compensation and external temperature was able to provide promising precision results for technologies that use thermal cameras. Efficiency is another point that favors technology for application in high-flow site screening, this technology being able to detect the temperature of 9 people at a speed of 8 frames per second, with an accuracy of 92.7%.

According to BUOITE STELLA et al. (2020), the use of the infrared thermometer is not necessary as it may have measurement variations due to the distance from the thermometer in relation to the body location, the location of the face chosen to make the measurement is another point that influences the accuracy, as depending from the location chosen to perform the measurement, different values can be obtained. The temperature measured on the forehead does not represent the best measurement location because it does not represent the central body temperature. To improve the accuracy for these types of thermometer it is of utmost importance that those responsible for measuring the temperature receive training from the manufacturer.

Using only fever as the only parameter in the screening is not feasible, as a false negative can be presented due to the use of antipyretic drugs to control fever. Thus, the use of thermal cameras is not sufficient to detect cases of febrile influenza (NISHIURA; KAMIYA, 2011).

According to SILAWAN et al. (2018), to perform mass temperature monitoring the most viable technology is the use of thermal cameras that have the possibility of measuring the temperature of several people in a large area, but the performance still needs to be improved. To improve the accuracy, it is possible to perform a measurement of several points on the face using thermal image capture and perform an estimate by correcting these different temperatures. Thermal cameras prevent people from having to stop at test stations. The capture of the temperature of multiple facial areas does not lead to a substantial increase in processing

time that compromises the advantage of the speed of temperature measurement performed by thermal cameras in relation to other methods of measurement.

Since 2003, after the SARS outbreak, many airports have used thermography to measure the temperature of many people. The same method remained for more than a decade, but according to the system proposed by NAKAYAMA et al., (2015), thermography can also be used to monitor respiratory and cardiac alternations generated by infection.

3. Methodology

The methodological scope of the research was restricted to selecting and investigating technological production related to the use of thermal images to control the pandemic. The ESPACENET patent search base was used as an information source, which is a free online service for searching for patents and patent applications developed by the European Patent Office (EPO) in conjunction with the member states of the European Patent Organization.

The survey of technological production on the ESPACENET base was carried out in September 2020, selecting the field Patent search, and using as keywords the following combinations shown in Table 1:

Table 1: Combinations of keywords for patent search

(ctxt = "thermographic" OR ctxt = "thermal") AND (ctxt = "human" OR ctxt = "person") AND (ftxt any "Epidemic" OR ftxt any "SARS" OR ftxt any "coronavirus") AND (ctxt any "temperature" OR ctxt any "fever") AND (ctxt any "imaging" OR ctxt any "camera")

Source: Prepared by the authors based on the Espacenet search database (2020)

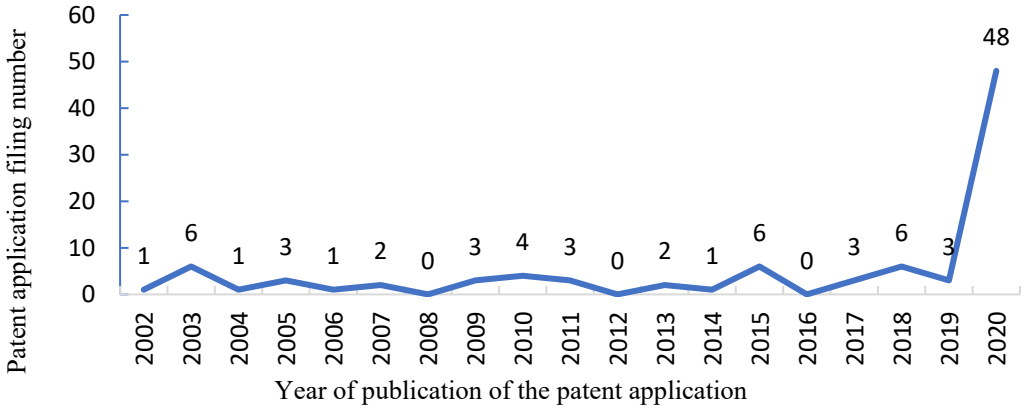
The search resulted in 119 patent documents published from 2002 to 2020. Subsequently, an analysis of each patent was carried out and 25 of them were discarded because they were not related to the purpose of this study. Then, the data were grouped and processed in order to obtain the following information: number of publications per year, patent applications by country of origin of the technology, IPC classifications with higher occurrence in the applications and number of patents published by the inventor.

4. Analysis and discussion of results

After data collection, the first analysis to be carried out was the distribution of patents related to the use of thermal images to control the pandemic per year, as shown in Figure 1. Next, patent applications by country of analysis were analyzed. origin of the technology (Figure 2) in order to be able to verify which country obtained the highest number of requests on the topic. The search ends with the IPC classifications with the highest number of occurrences in the applications (Figure 3) and the number of patents published by the inventor on the study under analysis (Figure 4).

It is worth mentioning that both results show a series of quantitative variables. Thus, we chose to work with the most expressive, with the exception of Figure 1, which is the presentation of the series of patent distribution data related to the theme per year during the period under analysis.

Figure 1 - Distribution of patents by year

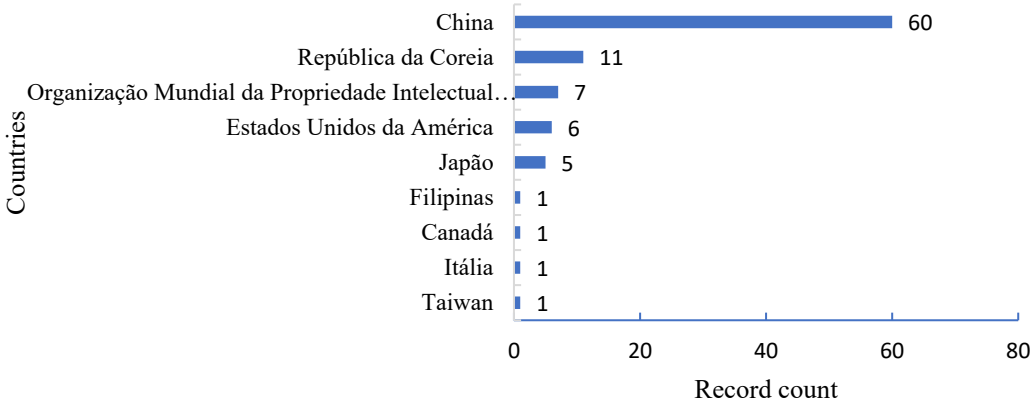


Source: Prepared by the authors, using data collected in Espacenet (2020)

Figure 1 shows the annual evolution of patents on technologies related to the use of thermal images to control the pandemic based on the Espacenet platform. The research took the period from 2002 to 2020. The evolution shows a stability in the number of patents until the year 2019. It is visible that in 2020 the number had a sharp growth, going from 3 patents in the previous year to 48 patents (2020) related to the technologies of using thermal images to control the pandemic. This fact can be justified by the scenario that the world is experiencing in relation to the pandemic of the new Corona Virus - COVID19.

It is important to state that the year is still in progress, that is, new patents may be registered or even those that are under confidentiality may be disclosed in the following months. Thus, the stability seen until the year 2019, which was with values ranging from one to six patents, will probably no longer occur in later years.

Figure 2- Patent applications by country of origin of the technology

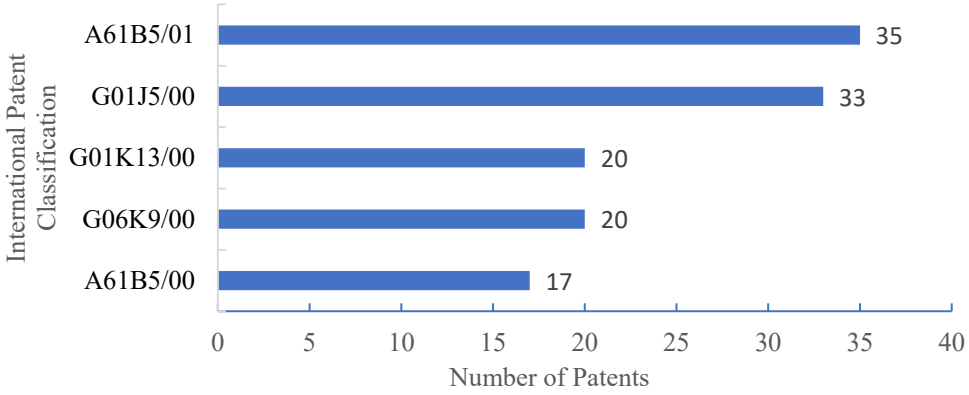


Source: Prepared by the authors, using data collected in Espacenet (2020)

Figure 2 highlights that there is a concentration of patent applications in China followed by the Republic of Korea. We noticed, through the graphical visualization, that the difference between these two countries, in relation to the number of patent applications, is quite significant, that is, China is far ahead in the requests based on the researched theme.

In four countries (Philippines, Canada, Italy and Taiwan) the numbers are equivalent, that is, only one patent application on technologies related to the use of thermal images to control the pandemic was registered in the search base.

Figure 3 - IPC classifications with higher occurrence in orders

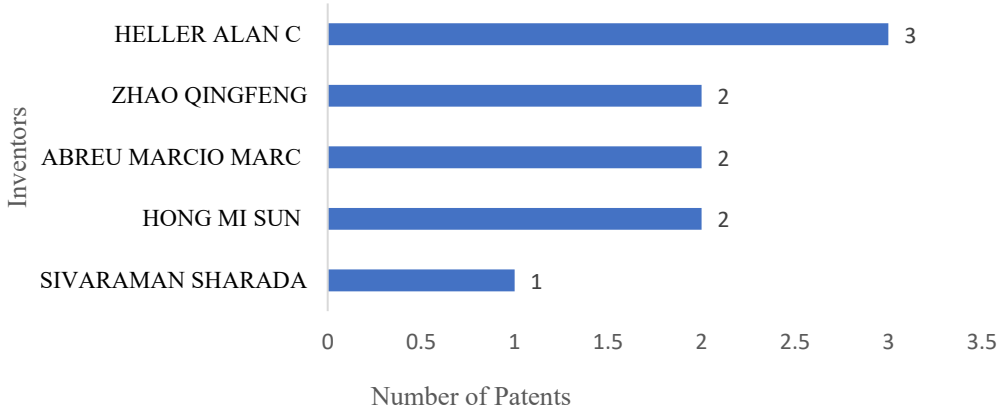


Source: Prepared by the authors, using data collected in Espacenet (2020)

Figure 3 shows the codes of the International Patent Classification (CIP), which aims to organize patent documents, in order to facilitate access to the technological and legal information contained in these documents (INPI, 2020). The five classifications that presented the largest number of documents were separated.

The deposits found are mostly allocated to classification A61B5 / 01 with 35 patents, followed by classification G01J5 / 00 with 33 patents. Analyzing all classifications, it is noted that section G (Physics) presented the highest number of patents (58.4%) followed by section A (Human Needs) representing the complement of the number of patents (41.6%).

Figure 4 - Number of patents published per inventor



Source: Prepared by the authors, using data collected in Espacenet (2020)

Figure 4 shows the inventors who have the highest number of patent filings on the subject under analysis. The inventor Heller Alan C. was the one who filed more patents among the five most researchers with a

total of three patents. The rest had two and one deposits, respectively.

It is appropriate to justify that the other inventors have the same amount of patent filings as the inventor Sivaraman Sharada and so it was decided to work with the first five, since from the sixth inventor onwards, the number of patents filed was only one patent.

5. Conclusion

In the research addressed, a patent search was carried out on the Espacenet platform with the purpose of verifying the number of patents on technologies related to the use of thermal images to control the pandemic. This fact made it possible to note that technological studies were being carried out in an unstable manner based on the results found, that is, the number of patent applications was not higher than six annual deposits. With this search, it was possible to notice the need for research related to the theme, since there was a need to control the number of deaths before the new COVID19 as a result of the high number of infected people that this pandemic moment caused worldwide. This fact was confirmed by the significant increase in patent filings on the subject when it went from three patents in 2019 to 48 patents in 2020.

Therefore, the mapping technique is of fundamental importance to check how is the technological production scenario around a certain theme that you want to study. With this, it was possible to prove that research on technologies related to the use of thermal images to control the pandemic tends to increase in later years, given the circumstances experienced worldwide, especially from the end of 2019 with the new pandemic Corona Virus.

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Phytochemical Analysis of *Turnera Diffusa* Willd

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Abstract

Turnera diffusa WILLD is a plant used in folk medicine as a natural stimulant, and the objective of this research is to perform the phytochemical analysis of the secondary metabolites of the damiana of occurrence in the Juazeiro region, northern Bahia - Brazil. A phytochemical screening was performed from three Crude Ethanol Extracts (BSE), EEB1: leaves and flowers; EEB2: stems and EEB3: root. A thin analytical layer chromatography was performed using specific developers to detect each chemical class. Alkaloids, coumarins, anthranic derivatives, phenolic compounds, mono, sequi and diterpenes, naphthoquinones, triterpenes and steroids, saponins, hydrolyzed tannins and xanthines were identified in the three extracts. Only in the BSE of leaves and flowers observed the presence of antroquinones and aglycones. The secondary metabolites identified in the study evidence the pharmacological potential of Turnera diffusa. Phytochemical screening concluded the presence of fourteen classes of secondary metabolites in damiana, indicating important medicinal potential with pharmacological effects reported in the literature.

Keywords: Chromatography. Damiana. Secondary metabolites. Sorting.

I. INTRODUCTION

Medicinal plants have been used since antiquity, through empirical knowledge of their healing properties and have always represented a therapeutic option of great value. Thus, phytochemical analyses are important to scientifically prove the medicinal species of popular interest, aiming to identify, quantify and evaluate the secondary metabolites present in them (BESSA et al., 2013).

Phytochemical tests seek to understand the functions of these substances for bioecological interactions and the identification of pharmacologically active molecules (ARAÚJO et al., 2015). Highlighting that environmental, seasonal and soil factors can influence the concentrations of metabolites present in the plant, altering plant metabolism. In this sense, since the 4th century BC there have been

reports of norms for the collection of medicinal plants (GOBBO-NETO; LOPES, 2007).

The coordination and alteration of plant metabolites occur through seasonal, daily factors; intraplant, interplant and intraspecific independent of a genetic control, the expression may undergo modification due to the interactions between biochemical, physiological, ecological and evolutionary processes (LINDROTH; HSIA; SCRIBER, 1987; HARTMANN, 1996). Secondary metabolites represent a conjunction between plants and the surrounding environment and are often affected by environmental changes (KUTCHAN, 2001).

The time at which a plant is collected is the most important factor, since the active constituents are not constant all year round, and the composition of secondary metabolites of a plant can vary appreciably during the day/night cycle (GOBBO-NETO; LOPES, 2007). The age and development of the plant, the different plant organs, which are also important and can influence the total amount of metabolites and the relative proportions of the components of the mixture (BOWERS, 1993; HENDRICKS et al., 1997).

The genus *Turnera* is known in science for the presence of important secondary metabolites (SZEWCZYK; ZIDORN, 2014), especially in traditional Mexican medicine damiana, used as an aphrodisiac, for liver diseases, depression, anxiety, neurosis and as expectorant, stimulant (ALCARAZ; DELGADO, SLENDER; REAL, 2004; BARBOSA et al., 2017).

The incentive and appreciation of the economic potential of the plant can be real and effective, in the latter of all drugs used in Western medicine only 25% come from plants, some used as a drug or as a derivative of a product of natural synthesis, resulting in a model of development of new drugs through the biodiversity of nature (DE REZENDE et al., 2016).

It is also used to improve the flavor of desserts, ice cream, sweets and beverages (GARZA-JUÁREZ et al., 2011), in addition, *T. diffusa* has antioxidant activity similar to quercetin (SALAZAR, 2008). A phytochemical investigation identified 35 compounds in *Turnera diffusa,* among these: flavonoids, terpenoids, saccharides, phenolics and cyanogenic derivatives (ZHAO et al., 2007) and 24 isolated structures to investigate the anti-aromatase activity of *Turnera diffusa* (ZHAO et al., 2008).

Thus, the objective of this research was to perform the phytochemical analysis of the secondary metabolites of Damiana occurring in Juazeiro Bahia, submedia region of São Francisco northeast of Brazil.

II. METHODOLOGICAL PROCEDURES

1. Collection and identification of plant material

This research was developed through registration in the National System of Management of Genetic Heritage and Associated Traditional Knowledge - SisGen, under the number of Registration no. A652F54. "Damiana" (*Turnera diffusa*) were collected at 8:00 a.m. on September 24, 2019 in the Department of Technology and Social Sciences (DTCS) of the State University of Bahia (UNEB), Campus III, Juazeiro (BA) located at geographic coordinates 9º25'10" of south latitude and 40º29'16" of west longitude and altitude of 367 m.

According to the Köeppen classification, the climate of the region is classified as Bswh, which corresponds to the semiarid region. The average minimum temperature ranges from 18.4 to 22.2°C and the maximum from 29.6 to 33.9°C. The driest period of the year and the highest heatstroke occurs from August

to November. The average annual rainfall is 529 mm, with the rainy season concentrated between November and April (TEIXEIRA, 2010).

The collection site of the plants was georeferenced with GPS and the plants photographed, then recorded in a field booklet information related to the vegetable, such as growth habit, height, color and flower odor; Fertile branches of "Damiana" were standardized with 40cm of stems, placed on planks and stored in greenhouses at 700 C for 72h. After drying, the plant material was placed in cardboard with a previously established size with the herbarium plug. To identify the plant species, the exsiccate was compared with others already identified in the Herbarium of State University of Bahia - UNEB, Juazeiro - BA.

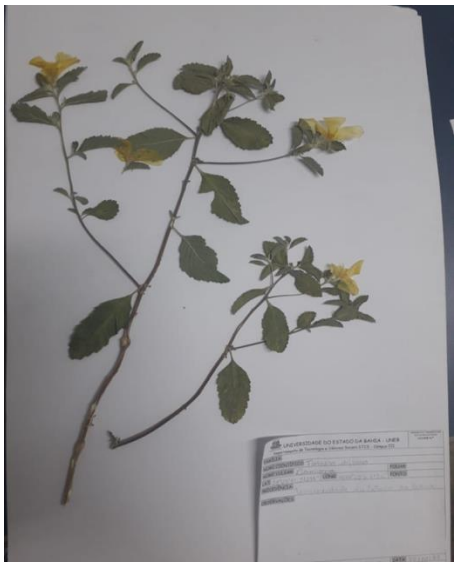

Figura 1. Exsicata da espécie *Turnera diffusa* WILLD depositada no Herbário da Universidade do Estado da Bahia. **Source:** Own Authorship.

The plant material was sanitized with running water and dried on paper towel by evaporation. The procedure of preparation and fractionation of crude ethanol extract (BSE) was developed in the laboratory of Pharmacognosy and Phytotherapy of UNIVASF.

The leaves and flowers, roots and stems of *Turnera diffusa* were dried in an oven at 40ºC for approximately 72 hours. Then, the leaves and flowers, stems and roots of the plant specimen were individually sprayed in a knife mill, generating three samples of plant drug, which were weighed and packed in exhaustive maceration systems with renewal of the extractor liquid (ethanol 99.5%) for seven days.

Crude ethanol extracts - BSE, being EEB1: leaves and flowers; EEB2: stems and EEB3: roots were obtained by evaporation of each extractive solution in a rotary evaporator at approximately 50ºC with reduced pressure (POSER; MENTZ, 2004).

EEB1, EEB2 and EEB3 were individually submitted to liquid vacuum chromatography using silica gel as a stationary phase and the solvents of increasing polarities hexane, chloroform, ethyl acetate and methanol as mobile phase, aiming at a pre-fractionation of the substances through their polarities.

2. Phytochemical screening of extracts

Based on the procedure of collection and selection of plant material, samples referring to different organs were investigated for phytochemical aspects. In this test the set of techniques used to track the compounds is based on staining reagents or precipitate formation that reveal the presence of secondary metabolites in an extract.

The analysis was performed in obtaining the crude ethanol extract (BSE) of *Turnera diffusa* by Analytical Thin Layer Chromatography (CCDA) with silica gel, in aluminum support (MachereyNagel®) using eluent and revealing system specific to each class of compounds.

For specific classes of chemical constituents, such as: alkaloids, coumarins, anthracene derivatives, phenolic compounds, mono, sequi and diterpenes, naphthoquinones, triterpenes and steroids, saponins, anthocyanins, lignans, antroquinones and aglycones, condensed tannins, hydrolyzed tannins and xanthines, tests were performed to identify the presence of these metabolites in the BSE according to wagner & bladt's adapted methodology (1996) (adapted).

III. RESULTS AND DISCUSSIONS

Phytochemical screening Through preliminary phytochemical screening by slender analytical layer chromatography (CCDA) was found the presence of classes of secondary metabolites in different organs of *Turnera diffusa* described in Table 1.

Table 1. Identification of the main classes of constituents of crude ethanol extract (BSE) in different organs of *Turnera diffusa* WILLD.

Chemical Class	Leaf and Flowers	Stalk	Root
Alkaloids	++	+	+
Coumarins (coumarin derivatives)	++	+	++
Anthracene derivatives	+	+	+
Phenolic compounds (flavonoids and phenylpropanoglycosides)	+	+	+
Mono, sequi and diterpenes	++	++	+
Naphthoquinones	++	+	+
Triterpenes and steroids	+++	+	+
Saponins	+	+	+
Anthocyanins	+	+	-
Lignans	+	+	++
Anthroquinones and aglyclones	+	-	-
Condensed tannins	-	+	+
Hydrolyzed tannins	++	+	+
Xanthines	+	+	++

(-); absence of the constituent, (+) presence of the constituent, (++); moderate presence of the constituent, (+++); high presence of the constituent. **Source:** Own Authorship.

The results show that the phytochemical extraction of "Damiana" was positive for the 14 classes of secondary metabolites tested. The presence of different chemical substances is linked to some medicinal uses, coupling several therapeutic purposes, it is also linked to the adaptation of the plant species to the environment (ROCKENBACH et al., 2018).

The crude ethanol extract (BSE) of leaves and flowers presented a higher incidence of secondary metabolites, highlighting a high level of concentration of triterpenes and steroids (Figure 2), which are part of a group of hormones and enzymes that interact for life maintenance. A similar study developed by Barbosa & colaboradores (2017) showed the presence of these constituents, highlighting the higher concentration of triterpenes and steroids in BSE of stalks and bark of medicinal plants.

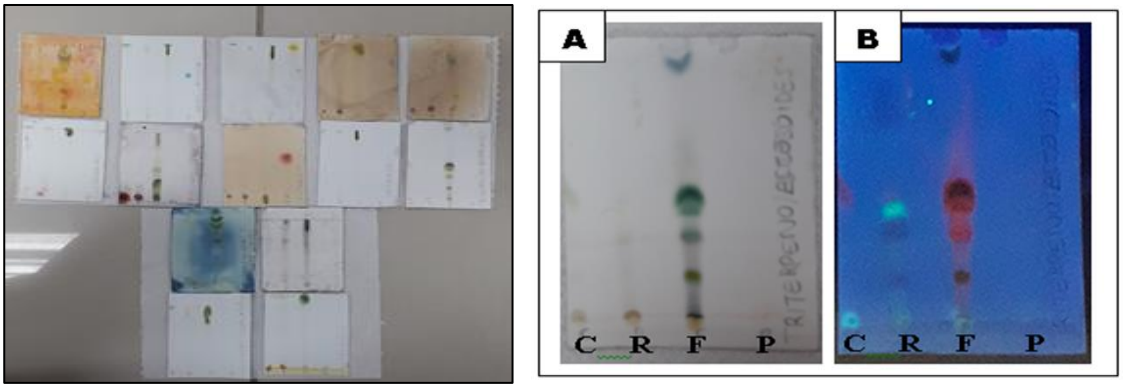

Figure 2: Phytochemical screening of *turnera diffusa* WILLD crude ethanol extract EEB. Identification of triterpenes and steroids (A) and UV 365 (B) of different plant organs (stem = C; root = R; leaf and flower = F and pattern = P). **Source:** Own Authorship.

The weak presence of anthracene derivatives, phenolic compounds and saponins in the three extracts evaluated was evidenced. And absence of condensed tannins in leaf and flower extract, antroquinones and aglycones in stem extract and absence of anthocyanins and antroquinones and aglycones in root extract. The other chemical classes evaluated had moderate presence in the evaluated extracts. Studies already reported in the literature show that arbutin and apigenin flavonoids are the main chemical constituents of *Turnera diffusa* with cytotoxic activity, present in methanolextract (AVELINO-FLORES et al., 2015).

Another study revealed that aceon extract also showed positive cytotoxic potential for MM cancer cells (WILLER et al., 2019). Apigenin-7-O-β-D-p-coumaroil flavonoids (1→6) glucopiranoside and p-arbutin have also been identified in 96% EtOH extract and infusion (CAMARGO; VILEGAS, 2010).

Study developed by Szewczyk & Zidorn (2014), composing the presence of 22 flavonoids, maltol glycolide, 7 cyanogenic glycosides, monoterpenoids, sesquiterpenoids, triterpenoids, polyterpene, fatty acids and caffeine in the genus Turnera. Flavonoids are capable of inhibiting cytochrome P 450 enzymes, which interferes with antiretroviral therapy (PIACENTE et al., 2002; Lee, Lee; ANDRADE, MR. ANDRADE; FLEXNER, 2006).

According to Zhao et al., (2007) "Damiana" contains many flavonoids, some with relatively high concentrations. The importance of these compounds consists of several beneficial biological functions, such as antioxidant, anti-inflammatory and anticancer effects (MIDDLETON et al., 2000; NARAYANAN, 2006), most of these flavonoids inhibit the aromatase enzyme, with flavonon pinocembrina with the

strongest inhibitory activity (ZHAO et al., 2008).

The hydroethanolic extract of T. diffusa identified flavonoids, specifically a mixture of flavones with aromatic acids and flavonols 3-O-diglucosides with high concentrations, in addition, presented cytotoxic activity in astrocytes cells (BEZERRA et al., 2016). However, the data obtained in the present study do not quantify the substances, it only proves the presence of chemical constituents in the BSE of different parts of the plant.

Studies confirm that plants containing coumarins (RESCHKE et al., 2007), tannins (MENDES et al., 2011), flavonols and flavanonas (DE PINHO et al., 2012), steroids and alkaloids (BESSA et al., 2013), in addition to phenolic compounds (FIRMO et al. 2014), can confer antimicrobial activity to an extract, thus *Turnera diffusa* presents these metabolites in their composition corroborating popular use and literature data.

Some secondary metabolites increase their concentration due to water stress, such as cyanogenic glycosides, glucosinolates, some terpenoids, alkaloids and anthocyanins (GOBBO-NETO; LOPES, 2007). In this sense, anthocyanins were found only in the BSE of leaves and flowers and in stem, absent at the root, which explains the positive correlation with the intensity of solar radiation and the presence of this class (JEONG et al., 2004).

Factors such as seasonality interfere practically in all classes of secondary metabolites since, in medicinal plants this concentration can change up to 80% (GOBBO-NETO; LOPES, 2007). The biosynthesis of secondary metabolites in medicinal plants has a direct relationship with genetic, environmental and agronomic factors. *Turnera diffusa* has pharmacotherapeutic potential and its metabolites may represent the opportunity for further research and development of effective and low-cost treatments from its molecules (SOUZA et al., 2017).

IV. CONCLUSIONS

The presence of secondary metabolites in *Turnera diffusa* WILLD identified from phytochemical analysis proves its pharmacological potential and reinforces traditional knowledge about its uses.

Turnera diffusa present in the sub-middle region of São Francisco has chemical properties relevant to the development of other research, both pharmacology and agronomic aspects.

This study suggests the isolation of these phytochemicals and in vitro tests for the safe use of the plant and its herbal medicines, as well as the study of seasonality and its primary metabolites.

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Tribological test of compressor used in the refrigeration industry

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Abstract

The article describes the analytical procedures and acceptance criteria for analysis of compressor and components with a focus to tribological aspects. In the introduction, the article deals with tribology as a scientific discipline. Subsequently, the article describes different kinds of wear, which may occur during the operation of compressor at different levels. Subsequently, the article mentions the equipment used in the test. At the end the results of the test are summarized with complete photo-documentation.

Keywords: Tribology, wear, compressor

1. Introduction

The Tribology belongs to scientific department with more than 60 year history in the Slovak republic and still has a place in the field of equipment care. The function of Tribology is guaranteed reliability and safety of operation the machinery and equipment. It deals with the processes of friction, wear and lubrication [1].

Tribology technology affects all phases of the production process, such as development, construction,

production technology, operation, maintenance, but also the repair of machinery and equipment. This is applied to all industries, such as automotive, aerial, cosmic, chemical or electro-technical industry. We also encounter the need to analyze tribological tests for refrigeration compressors in an effort to optimize production and material technologies in order to minimize friction and wear losses. [2].

The wear is in technical practice undesirable. It arises for various reasons, such as the interaction of moving surfaces or the action of the media on the surface of the device, respectively. components. The occurrence of wear is classified into several types.

Adhesive wear is the loss of material from one or both surfaces of a friction pair, which may or may not be lubricated. The necessary conditions for this type of wear are direct contact between the two parts (usually due to the breakdown of the lubricating film) and high chemical affinity between the two materials, which allows the formation of metal-metal bonds. Adhesive wear is the most common type of wear on materials and components. It manifests itself as seizure.

Scratch wear or abrasive wear is caused by the friction of two surfaces, one of which may have a rougher surface. This penetrates scratches and scratches. This unwanted the wear can also be caused by sharp edges, fillings, but also dirt between the moving parts of the system. Scratches or nicks are usually straight, continuous and spaced in rows, allowing them to be visually distinguished from other types of wear. In Figure 1. schematically shows adhesive and abrasive wear [3].

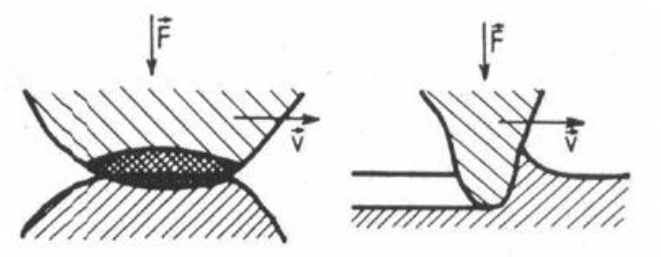

Figure 1. Scheme of Adhesive (a) and Abrasive (b) wear [3]

Polishing is a wear process characterized by uniform consumption of material, which tends to gradually transform the original surface treatment into a light (polished) surface. It usually occurs between surfaces with low adhesion to each other; this property is preferred by surface treatments which, inter alia, produce anti-adhesion behavior, such as cooling and tempering, nitriding, phosphating or steam treatment.

Vibration wear (Figure 2) is defined as abrasive wear of two components due to a combination of micro-movement and high contact pressure; respectively it is a mutual oscillating movement of functional surfaces of the bodies. The occurrence of vibration wear is analyzed by profile measurement of the affected areas and comparison between components that are tested with different durations. The wear should stabilize or decrease over time. [3].

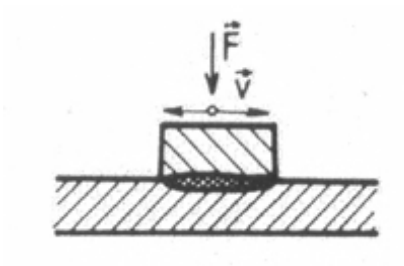

Figure 2. Vibration wear scheme [3]

Pitting is a form of wear that occurs with rolling bearings. During this wear, the surface layers break, move relative to each other and be microscopically welded. Subsequently, the welded layers are torn off and the surface between the inner ring of the bearing and the rolling element is damaged. [3].

Severity levels are divided into mild, moderate and severe, see Table 1.

Table 1. Codification of results, respectively the level of severity of wear

Occurrence	Type of occurrence	Severity levels
Wear	Adhesion	Medium Moderate Hard
	Scratch	
	Polishing	
	Friction	
	Pitting	

2. Tribological test

Equipment required for the tribological test:

- Prepare lighting
- Magnifying glass,
- Photo camera,
- Stereoscopes,
- Meter of torque meter,
- Air gap gauges.

The compressor that has been tested belongs to the latest generation with Full Motion Inverter technology (variable speed) for ice cream refrigerators with extremely high built-in energy efficiency. Provides better food preservation, low noise and a wide range of voltages. It is compact, benefits when deploying applications with limited interior space, and is designed to use R600a natural refrigerant (isobutane). This solution sets accurate and consistent temperatures to protect treated products, such as medical devices (Figure 3).

Figure 3. Compressor tested

Duration of the test: 5 months
Note: Temperature - approx 45 °C
In some cases, a power failure
Voltage start (min. 130 V)

The tested compressor was connected to an artificial circuit in conditions simulating a normal environment. It was exposed to the load as in normal operation. At the end of the test, the compressor was removed from the system and then gradually disassembled and visually examined.

3. Test evaluation

The evaluation of tribological tests is summarized in Table 2. The wear of the individual components is evaluated numerically, where 1 represents no or negligible wear of the surface of the component, 2 determines slight surface damage and 3 serious and unacceptable damage to the component. The compressor is suitable for use if all its evaluated components are marked with the number 1. When rated with the number by 2, it is advisable to examine the compressor in more depth and determine the cause of wear and its consequences. If the wear is stable and does not deteriorate further, the compressor is suitable for further use. When evaluating component number 3, it is necessary to examine the source and extent of wear as well as the manufacturing process and ensure remediation. The compressor is not suitable for further use until the source of wear has been removed.

Table 2 Evaluation of components according to the internal standard:

Component	**Evaluation**
Crancase, Bearing for crankshaft	1
Cylinder	1
Piston	1
Conrod big eye	1
Conrod small eye	1
Piston pin	1
Crankshaft, short leg	1

Crankshaft, bearing for crankcase	1
Crankshaft, long leg	1
Gasket	1
Valve plate	1
Suction valve	1
Discharge valve	1
Overall assessment	1

1 - No or negligible wear
2 - Superficial or slight damage
3 - Serious and unacceptable damage

Review
Final rating
= <3 ..... Positive
> 3… .... Negative

4. Conclusions

The analysis was performed according to internal standards, where the bearing surfaces were examined and evaluated. Compressor bearings have new properties, but they do not wear out. Chemical analysis of the oil volume confirmed good results. The compressor is suitable for further use. In figure 4. to 19. The compressor components under investigation are shown.

Photographic documentation

Figure 4. Crancase, Bearing for crankshaft

Figure 5. Crancase, bearing for long leg of crankshaft

Figure 6. Crankshaft, short leg

Figure 7. Crankshaft, bearing for crankcase

Figure 8. Crankshaft, long leg

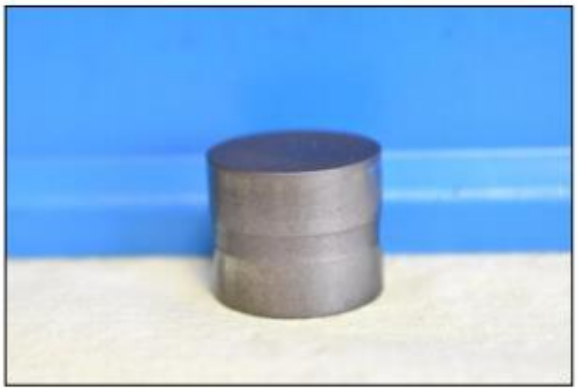

Figure 9. Piston

Figure 10. Piston pin

Figure 11. Conrod small eye

Figure 12. Conrod big eye

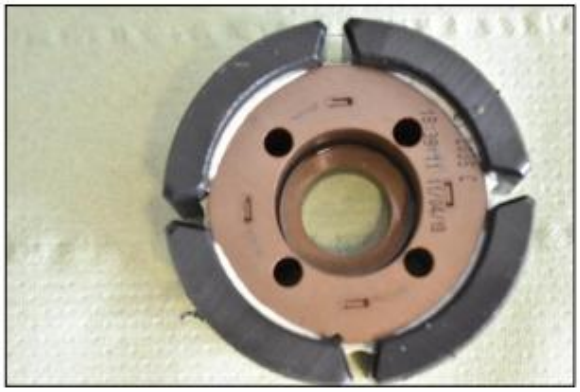

Figure 13. Rotor

Figure 14. Valve plate, suction valve, discharge valve

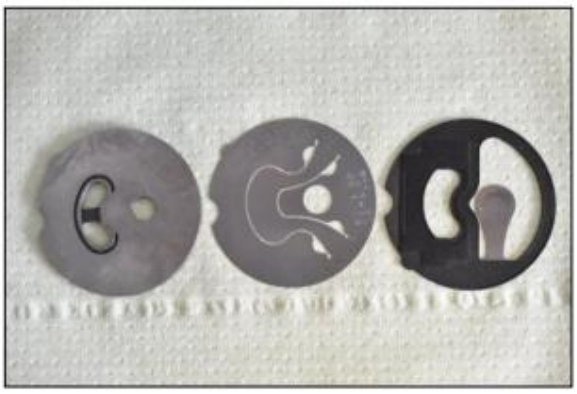

Figure 15. Valve plate, suction valve, discharge valve + gasket

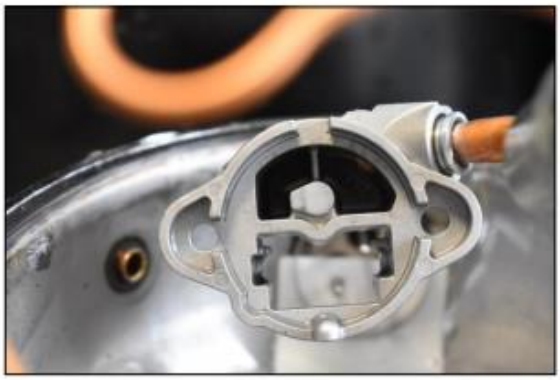

Figure 16. Aluminium cylinder head

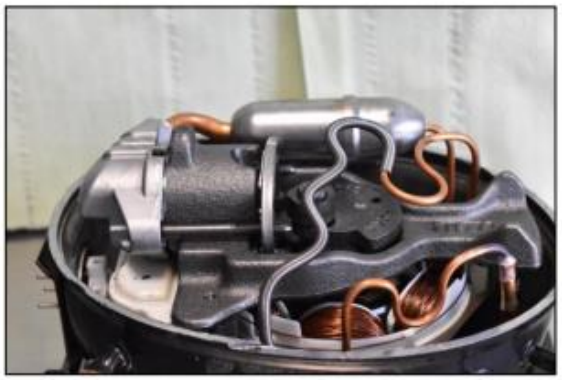

Figure 17. View of body kit compressor

Figure 18. Stator + springs

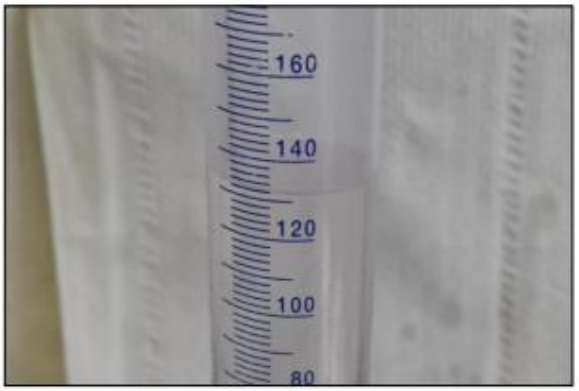

Figure 19. Volume of oil

5. Acknowledgement

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The Assessment of the Environmental Impact of Selected Plastics

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Abstract

The present article deals with a method of the environmental Life Cycle Assessment (LCA) as a tool for the evaluation of environmental burden of selected products. The assessment of the life cycle of individual products should be carried out while considering emissions released during production, use and disposal of products and during processes of raw material extraction, production of materials and energy, auxiliary processes or sub-processes.

Keywords: LCA; plastics; environment; recycling;

1. Introduction

In modern times, an increasing emphasis has been put on the development of environment-friendly technologies which are not only more energy-efficient, but they also eliminate the undesired environmental impact of active equipment or production and use of products [4].

A population growth constantly endangers reserves of fossil materials, and rapidly growing environmental pollution caused that scientists began to deal with ecological balance.

The most important point of view in assessing the environmental impact is energy consumption which is associated with a limited amount of energy sources. Energy consumption is also accompanied by negative effects, such as atmospheric emissions that contribute to the formation of acid rains, smog and greenhouse effect.

2. Life Cycle Assessment

An analytical method of environmental management referred to as the Life Cycle Assessment (LCA) has been increasingly applied all over the world. This approach analyses the environmental impact of products and services during their life cycles. The environmental impact of processes of raw material extraction, production, implementation and disposal of production waste are also taken into account. LCA may be defined as the collection and assessment of input and output data and potential effects of products on the environment during their entire life cycles.

The output of the method is the environmental assessment of the impact of a given product on the environment (environmental certification or environmental labelling of products). The main purpose of these outputs is to prevent environmental pollution, support the development of production and consumption of products with less negative effects during their entire service lives, provide true information on their environmental impact, all with the aim to influence not only producers but also consumers.

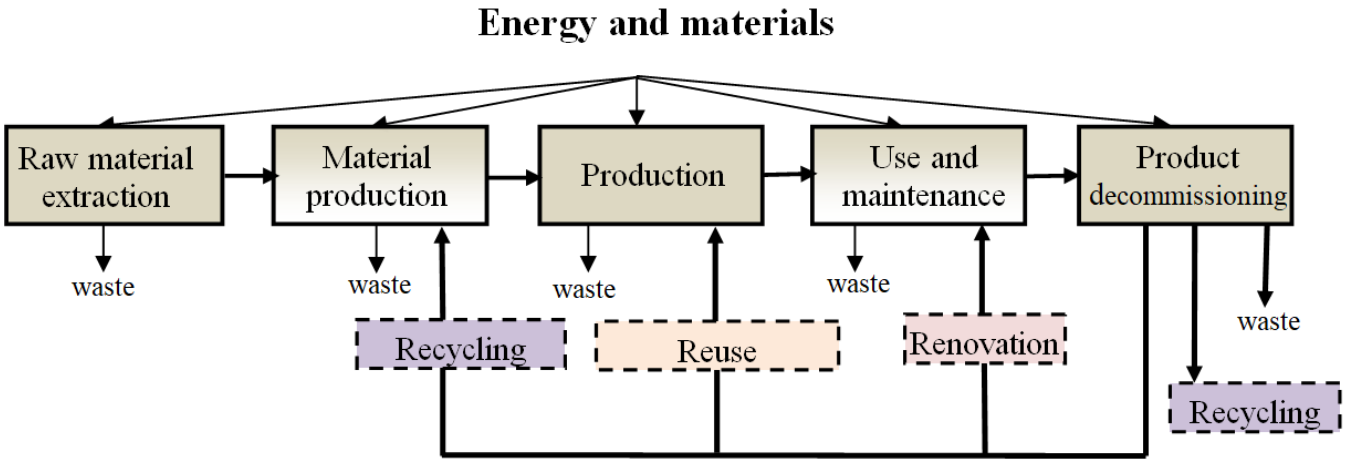

Figure 1. Product life cycle.

A life cycle assessment study consists of four phases: *goal and scope definition, inventory analysis, impact assessment and interpretation of a life cycle.*

The first stage includes defining the size of the product life cycle which will be subjected to the assessment and the purpose of the assessment. The inventory analysis includes drawing all input and output streams associated with the product, while the inputs represent water, energy and materials taken out of the environment and the outputs represent emissions and waste put into the air, soil and water. The third phase represents the calculated results of indicators of all impact categories and the evaluation of their mutual significance by normalisation or weighting. The result of the impact assessment is usually a table listing all the impacts. The last phase comprises of a systematic procedure aimed at identification, quantification, control and evaluation of information from the results of the life cycle inventory analysis and the assessment of the life cycle impact. The result of the interpretation phase is a set of conclusions and recommendations for the study.

At present, plastic materials have been increasingly used because plastics have proved to offer many applications and they meet the requirement of high quality for a relatively low price. Therefore, it is necessary to understand the essence of these materials, primarily their advantages and disadvantages, as well as their negative environmental impact.

2.1 Beginning of the life cycle of plastics

Plastics intervene with the environment in all stages of their life cycle, including the extraction of crude oil and gas, production, transport and final waste disposal. It is very difficult to assess categorically which one of the plastic materials is more environmental-friendly. However, it is absolutely certain that chlorine-containing plastics very often have a negative environmental impact.

The life cycle of a plastic material begins as early as the excavation of raw materials and consumption of energy required for the production of a plastic material.

Plastics are produced from crude oil which belongs to non-renewable sources of energy; moreover, oil treatment processes run in refineries which are not very ecological. The energy used for crude oil refining is taken from non-renewable sources. Production of plastics as such may be accompanied by the environmental pollution, in particular through leakage of harmful materials to air, soil and water.

Production of fluorinated polymers has been widely criticised due to the associated use of perfluorooctanoic acid which is toxic and even suspected of carcinogenicity. PTEE may degrade, at high temperatures, into toxic products which are very hard to decompose and accumulate in the food chain.

Another most frequently used plastic material is polyvinylchloride (PVC). Unfortunately, it is one of the worst plastic materials for the environment. It has been widely used in the food industry (various types of packaging, bottles etc.), building industry (window frames, cables, pipes etc.), automotive industry, as well as medicine, power industry and telecommunications.

Not only the production of this plastic materials is hazardous because it is accompanied with the formation of one of the most hazardous substances - dioxin, but also harmful additives escape to the environment during the use and disposal of PVC.

As PVC is very difficult to recycle, majority of this material ends at waste dumps or in incineration plants. Dioxins are produced during the PVC production and combustion, and these processes not only pollute the environment but also endanger human health.

One of the hazardous chemicals contained in PVC is phthalate, a plasticiser which is the main component

of this plastic material. Other hazardous components include heavy-metal-based colorants, flame retardants and bound chlorine which is very dangerous when these plastics burn.

Polystyrene is also a plastic material, production of which is very unfriendly to the environment, but its use is being increasingly popular. This material is very hazardous because it contains toxic substances - styrene and benzene - neurotoxins and probably also carcinogens. When polystyrene is in contact with a hot food or beverage, styrene is released and then it enters a human organism and causes serious health problems.

2.2 Recycling of plastics

Recycling is a reuse of previously used materials and products. This process reduces the consumption of natural materials, reduces the quantity of dumped waste and consumed energy, and thus contributes to the reduction of greenhouse gases.

Prior to the recycling process, it is necessary to thoroughly sort plastic wastes.

Recycling of plastics has a positive effect on the reduction of environmental burden and leads to reduction of the amount of dumped waste (decomposition of plastic materials at dumps lasts several decades). However, it also has a positive impact on crude oil extraction and leads to savings in purchase cost of this material.

Nevertheless, this process of recovery of plastics is not very ecological because it requires a lot of energy, water, transport etc. Plastics may only be recycled into lower-quality products. Despite such negative aspects, recycling is currently one of the most optimal methods of the disposal of plastic materials.

3. Thermal processing of waste

With regard to the fact that not all plastic materials may be recycled, it is necessary to deal with their storage or processing. Dumping larger quantities of waste, however, has a negative environmental impact in areas where such dumps are established, and in the case of uncontrolled or older dumps, the soil and underground water become seriously polluted. One of the potential methods of the disposal of such waste is thermal processing in which syngas is the resultant product. Such processing is usually carried out in incineration plants or plasma reactors where heat facilitates the decomposition of more complex hydrocarbons into basic compounds. The process output is synthetic gas, mostly consisting of hydrogen, methane, carbon dioxide and carbon monoxide.

As a majority of non-recyclable plastics end in combined communal waste, such waste is processed without sorting organic residues from plastics, whereas these plastics represent a significant part of the waste. Table 1 shows the percentages of individual components of syngas produced by processing various types of communal waste, while non-recyclable plastics in a plasma reactor reprersent a significantly high percentage.

Table 1. Compositions of various syngas components

Folder	Composition of synthetic gas samples			
	RDF (obj. %)	Municipal waste 1 (obj. %)	Municipal waste 2 (obj. %)	Municipal waste 3 (obj. %)
Methane (CH_4)	0,26	8,59	4,77	2,54
Hydrogen (H_2)	50,9	44,5	48,9	30,3
Oxygen (O_2)	0,03	0,16	0,11	0,74
Nitrogen (N_2)	4,25	6,03	6,61	15,9
Carbon dioxide (CO_2)	1,1	6,6	1,66	2,42
Carbon monoxide (CO)	43,5	32,5	37,1	47,3
Ethene (C_2H_4)	0,006	0,97	0,49	0,52
Ethane (C_2H_6)	0,001	0,055	0,031	0,023
Ethin (C_2H_2)	0,003	0,42	0,24	0,15
Σ C_3 hydrocarbons	0,005	0,011	0,004	0,004
Σ C_4 hydrocarbons	0,001	0,0099	0,004	0,005
Σ C_{5-8} hydrocarbons	0,001	0,17	0,12	0,09
Calorific value ($MJ \cdot m^{-3}$)	11,1	13,12	12,31	10,71
Expected volume production ($m^3 \cdot kg^{-1}$)	1,843	1,069	0,973	0,404

Results of measurements in a plasma reactor indicate a high percentage primarily of hydrogen and carbon monoxide. These gases belong to materials with a great potential of energy recovery. Following the processing of carbon monoxide, as described by Equation (1), it is possible to extract a higher percentage of hydrogen which is projected to represent an important energy carrier in future, not only for the automotive industry but also for other industries.

$$CO+H_2O \Longleftrightarrow CO_2+H_2 \quad (1)$$

A described reaction runs in a WGS reactor in the presence of iron-oxide-based catalysers at higher temperatures (370–420 °C) or lower temperatures (200–250 °C) using $Cu/ZnO/Al_2O_3$-based catalysers.

3. Conclusion

The evaluation of issues regarding environmental-friendly use and production of plastics while applying the LCA method is a rather complicated and time-consuming process. This is caused by the complexity of the whole process in which it takes a lot of time to proceed from the extraction of raw materials, through subsequent processing, production and use, up to the environmental-friendly disposal of products after their service life terminates.

However, it is currently one of the tools facilitating evaluation and assessment of how much energy and materials a particular plastic material consumes during its life cycle, how much it pollutes the environment and how much waste is produced in the process.

4. Acknowledgement

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The Competency Based Approach and Biology Students' Higher Order Thinking Skills in Secondary Technical Schools in The Buea Sub Division of The South West Region of Cameroon.

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ABSTRACT

This study investigated the extent to which the Competency Based Approach affects higher order thinking skills in Biology in Secondary Technical School Students' in the Buea subdivision of the South West Region of Cameroon. Three research hypotheses were formulated to test the effect of the competency-based approach on students' ability to analyze, synthesize and predict. The quasi experimental design was used and 120 Form five students were selected purposively. The experimental group was taught using student-centred methods with remediation (Competency Based Approach) while the control group was taught using the traditional lecture method only. An Achievement Test (AT) with items to measure competences in the fourth, fifth and sixth levels of the Cognitive domain of Bloom's Taxonomy of Educational Objectives, formulated by the researcher and validated by experts in the field of Biology was used to measure Higher Order Thinking Skills. Data were analyzed using mean scores, standard deviation and t-test to test the hypotheses stated at $p \leq 0.05$ level of significance. The results revealed that the experimental group significantly acquired HOTs more than the control group. Recommendations were made.

Keywords: Competency-based, higher order thinking, Biology, Secondary school, Cameroon

Introduction

Secondary education has increasingly become a central policy concern of developing countries (UNESCO,2000). Secondary education creates a pool of qualified people with the knowledge and skills to

contribute significantly to economic development and allows individuals to expand their choice and improves personal and work-related skills amongst other benefits. One of the abilities able to support secondary school leavers in facing the present times is high level thinking skills also referred to as higher order thinking skills (HOTS) (Anggraini, Budiyono and Pratiwi,2019).

Technical and Vocational Education is mainly concerned with the development of employability skills. In order for graduates of technical and vocational education to remain relevant, they ought to be able to develop capacities to learn continuously through thinking and reasoning, problem solving, decision making and interpersonal competence (King, Goodson, & Rohani, 2011). Thomas (1992) argues that vocational education in particular must enhance HOTS because occupations are becoming more reliant on cognitive capacities. The changing work environment requires flexibility and adaptability to changing conditions; and vocational education provides a real-world context for cognitive development. The preparation to cultivate the students' ability to think at a higher level has been an important theme for redesigning and reforming learning systems (Kim, 2005). Teaching approaches that permit the learners construct and apply knowledge are important in enhancing HOTS. This paper attempts to find out the extent to which the Competency Based Approach enhances the HOTs of Secondary Technical School students of Biology in the Buea sub-division of the Southwest region of Cameroon.

Review of Literature

Theoretically**,** there are several approaches to constructivist theory with major branches, those built on philosophical theories of learning and those focusing on psychological theories (Olsen,1999). The constructivist theory of learning is reflected in the developmental theories of Piaget and Vygotsky. In Cognitive constructivism from the work of Piaget, a student's reactions to experience leads to learning. From the work of Vygotsky, social constructivism plays an important role in the construction of meaning from experience. The basic idea behind competence based education is to help learners to develop and construct their own knowledge and seek ways to make optimal use of other people's competence in their learning journey. This is what social constructivism is about. For learning outcomes aimed at developing individual and personal competences, the approach must take the diversity of learner needs into consideration to meet the learners' goals and objectives. This requires an open approach or student-centred teaching which includes dialogues between learners and educators (O'Sullivan and Bruce, 2014). Constructivism theory underpins a variety of teaching methods such as problem-based learning, inquiry–based learning, project-based learning, case-based teaching, and discovery based learning which promote active participation in the classroom (Makgato,2012). Teachers must have an understanding of constructivist theory, principles and pedagogy in order to enhance HOTS in teaching and learning in the classroom.

Higher Order Thinking Skills in Biology

The ultimate goal of education is to help students develop their higher order thinking skills to enable them to face the challenges of daily life, through experiences that encourage students to use higher order thinking skills such as critical, reasoning, reflective and science process skills (Aktamis & Yenice, 2010). All human

beings are capable of thinking, however, most of them need to be encouraged, taught and assisted to the thinking processes. These thinking skills are teachable and learnable. Students who are trained to think demonstrate a positive impact on the development of their education. Higher Order Thinking skills (HOTs) is a thinking process, which is made up of complicated procedures and based on different skills such as analysis, synthesis, comparison, inference, interpretation, assessment, and inductive and deductive reasoning to be employed to solve unfamiliar problems (Zohar and Dori, 2003; Simon, 2013). The characteristics of students with HOTS are open-mindedness for risk-taking, curiosity, planning, having a systems thinking process, thinking carefully, using evidence to think rationally and frequent self-monitoring (Shari in Budsankom, et al. 2015). The students with HOTS are able to create new knowledge and make appropriate and logical decisions. .

The concept of higher order thinking (HOT) is derived from the of cognitive domain Bloom's taxonomy of Educational Objectives introduced in 1956 (Forehand, 2010). Human thinking skills can be classified into two major groups; low-order thinking skills (LOTS), and higher order thinking skills (HOTS). LOTS are the first three levels of Bloom's taxonomy, which are remembering, understanding, and applying. HOTS are the last three aspects of Bloom's taxonomy namely analyzing, evaluating, and creating (Moore & Stanley, 2010). Analytical thinking is the ability of individuals to classify objects logically, assessing the relationships of certain elements, how they contribute, how they relate to each other, how they work, and what the most important parts are (Marzano, 2001). Analytical thinking skills are critical in today's advanced technology work place. It is necessary for every country to develop its future human resource to be able to think analytically, critically, know how to solve problems, develop creative thinking skills, know how to acquire knowledge from multiple sources, learn and construct bodies of knowledge by themselves, adapt themselves in time for the ever-changing situations and be prepared to confront various challenges (Tang, 2017). Earl and Timperley (2015) assert that evaluative thinking provides the tools for systematically gathering and interpreting evidence that can be used to provide information about progress and provide feedback loops for refinement, adjustment, abandonment, extension and new learning. Creative thinking is a type of effort toward solving a problem based on the capacity of the individuals to suggest an authentic and new design, generate different hypotheses, solve the problem with the help of discovering and finding new applications (Glass, 2004; Young & Balli, 2014).

The aim of teaching Biology is to provide biology-related learning experiences for students to develop scientific literacy, so that they can participate actively in our rapidly changing knowledge-based society, prepare for further studies or careers in the fields related to life science and become life-long learners in science and technology (Conrad, 2001). In Biology, higher order thinking skills are needed to solve many questions in real life (Cimer, Timucin & Kokoc, in Sabu, 2018) and also help students to solve new problems (Janssen & Waarlo, 2010) not only in the examination but also in their daily lives. The emergence of a highly competitive and integrated economy, rapid scientific and technological innovations, and a growing knowledge-base will continue to have a profound impact on lives. In order to meet these challenges, Biology, like other science subjects, will provide a platform for developing scientific literacy and building up essential scientific knowledge through decision making, problem solving, experimentation, conducting investigations, classifying organisms and comparing different organisms (Marzano, 2007).

The Competency Based Approach (CBA)

Competence is defined as the developmental capacity to interactively mobilize and ethically use information, data, knowledge, skills, values, attitudes, and technology to engage effectively and act across diverse situations. Carracio et al (2002) asserted that there was no single definition of Competency-Based Instruction, however it can be identified by the following characteristics: Spell out exactly what it is that trainees should learn, provide high quality of instruction, help students learn one thing well before going on to the next and require each trainee to demonstrate competency. Thus competency-based approach focuses on measurable and useable knowledge, skills and abilities (Richards and Rodgers, 2001). It consists of teachers basing their instructions on concepts expecting to foster deeper and broader understanding. CBA curricula fostering learner-friendly teaching and learning strategies, could engender a shift from sheer memorization to the development of higher order intellectual skills and life skills, including communication, social and emotional and other relevant skills. Scwhab (2016) states that at least 10 competencies are needed by workers in 2020. Those competencies are complex problem solving, critical thinking, creativity, people management, coordinating others, emotional intelligence, judgment decision making, service orientation, negotiation, and cognitive flexibility. According to Bloom's taxonomy of Educational Objectives, those competencies are categorized as high order thinking skills. This includes to analyze, to evaluate, and to create. It focuses on learning and pupils' activities (learner-centered) rather than on the teacher's role (Jeager,2003).

The advantages of the competency Based Approach include the fact that participants will: achieve competencies required in the performance of their jobs; build confidence as they succeed in mastering specific competencies; receive a transcript or a list of the competencies they have achieved; use training time more efficiently and effectively as the trainer is a facilitator of learning as opposed to a provider of information; devote training time to working with participants individually or in small groups as opposed to presenting lectures and devote more training time to evaluating each participant's ability to perform essential job skills (Rojewski and Hill, 2014 and Sullivan, 1995).

HOTS can be taught and learned. Thus the issue lies with how best to teach this highly needed skill (Chinedu and Kamin, 2015). The CBA uses approaches that integrate differentiating, organizing, attributing (to break into constituent parts) and determine how these parts relate to one another and also to an overall structure and purpose (Yunos et al., 2010; Zohar & Dori, 2003). Teaching students to learn to develop evaluation techniques should comprise of activities that includes: coordinating, detecting, monitoring, testing, critiquing and judging. They further explained that exposing students to these kinds of activities would provoke their minds into recognizing patterns, distinguishing patterns and exposing the ideal problem (Anderson, et al. 2012)

Mkonongwa (2018) asserts that philosophically, competency-based teaching and learning has its roots in the social constructivism. Therefore, learners engage in a process of constructing their own knowledge by interaction with their environment, rather than as a process of absorbing the knowledge that the traditional teacher might try to transfer to them and so proposes the following teaching methods for competency-based teaching: Cooperative, interactive learning, Discovery learning, Reflective learning and Personal learning. A multidisciplinary approach is also important (O'Sullivan and Burce, 2014).

Statement of the Problem

The performance of Biology students in secondary school end-of -course exams for a period of eight years has not gone beyond 59%. Furthermore, biology students are for the most part unable to apply the knowledge acquired in the study of Biology in solving real life problems upon graduation. They are unable to apply the knowledge gained to improve and maintain the health of the individual, demonstrate resourcefulness, relevant technical skills and scientific thinking, relate and apply relevant biological knowledge and understanding to various situations in their communities and more. In Biology, higher order thinking skills are needed to solve many questions in real life and also help students to solve new problems. This indicates that the students do not possess higher order thinking skills. Higher order thinking skills are teachable and learnable. The teaching strategy is of prime importance is enhancing HOTs. CBA enhances a shift from mere memorization to HOTs and life skills. Thus this study aims at finding out the extent to which the use of CBA can enhance HOTs in secondary school Biology student. Findings will provide a basis for teacher professional development.

Hypotheses

Three hypotheses guided the study as follows:

- The CBA has no significant effect on secondary school students' ability to analyze
- The CBA has no significant effect on secondary school students' ability to synthesize
- The CBA has no significant effect on secondary school students' ability to predict

Methodology

The study made use of a quasi-experimental design. Participants consisted of 120 purposively selected form five students who study Biology. Intact classes were used. Form 5A had 70 students and Form FB had 50 students who took biology as a subject. Form 5A was the experimental group while Form 5B was the control group. A pre-test was administered to both the control and experimental groups before the introduction of the treatment to the experimental group. A combination of student-centred methods including discussion, cooperative learning, project method and experimentation method coupled with remedial teaching were used to teach eight lessons for the experimental group while only the traditional lecture method with no remedial teaching was used to teach the same lessons to the control group. Achievement was measured using a test bearing competences drawn from the cognitive domain of Bloom's Taxonomy of Educational Objectives namely: analysis, synthesis and prediction (evaluation). Thirteen items constituted the assessment instruments: five of them on analysis, five on synthesis and three on prediction. The results of both groups were compared using means and a student t-test to find out the extent of the difference in performance of both groups.

Results

The statistical analysis technique used to compare the performance on ability to analyse, synthesize and predict for both groups to see if they differ in performance significantly before the treatment with CBA was the independent t-test. The results of the analyses are presented in Table 1:

Table 1: Independent t-test analysis of pre-test scores for analysis, synthesis and prediction (120)

Analysis	N	Mean	SD	t-value
Control Group	50	3.34	1.59	-0.273
Experimental Group	70	3.44	1.62	
Total	120			
Synthesis				
Control Group	50	4.02	1.720	-0.780
Experimental Group	70	4.26	1.595	
Total	120			
Prediction				
Control Group	50	1.828	.805	-0.682
Experimental Group	70	1.929	.791	
Total	120			

*p<0.05, df=118; critical t = 1.98

The result of the analysis in Table 1 reveals that at a 0.05 level of significance with 118 degrees of freedom. The calculated absolute t-values of 0.273 is lower than the critical t-value of 1.98. This result implies that there is no significant difference in performance between the control group and the experimental group. So, there is no significant difference in the ability to **analyse** between the control group and the experimental group before the introduction of the treatment.

The calculated absolute t-values of 0.780 is lower than the critical t-value of 1.98. This result implies that there is no significant difference in performance between the control group and the experimental group. So, there is no significant difference in the ability to **synthesize** between the control group and the experimental group before the introduction of the treatment.

The calculated absolute t-values of 0. 682 is lower than the critical t-value of 1.98 which implies that there is no significant difference in performance between the control group and the experimental group. So, there is no significant difference in the ability to **predict** between the control group and the experimental group before the introduction of the treatment.

Three hypotheses guided the study as follows:

- The CBA has no significant effect on secondary school students' ability to analyse.
- The CBA has no significant effect on secondary school students' ability to synthesize.
- The CBA has no significant effect on secondary school students' ability to predict.

A post-test was administered to both the control and experimental groups after the introduction of the treatment to the experimental group. The statistical analysis technique used to compare the performance on the ability to analyse, synthesize and predict for both groups to see if they differ in performance significantly was the independent t-test. The results of the analyses are presented hypothesis by hypothesis

Hypothesis One: The CBA has no significant effect on secondary school students' ability to analyse.
The independent variable in this hypothesis was the CBA, while the dependent variable was students' ability to analyse. The scores of the dependent variable were got from the scores recorded from the test administered to the two groups after the introduction of the treatment (CBA) to the control group. The statistical analysis technique used to test this hypothesis was the independent t-test. The result of the analysis is presented in Table 2.

Table 2: Independent t-test analysis of post-test scores for analysis (120)

Analysis	N	Mean	SD	t-value
Control Group	50	4.30	1.930	-2.33*
Experimental Group	70	4.99	1.440	
Total	120			

*p<0.05, df=118; Critical t = 1.98

The result of the analysis in Table 2 reveals that, the calculated absolute t-value of 2.23 is higher than the critical t-value of 1.98 at a 0.05 level of significance with 118 degrees of freedom. With this result the null hypothesis was rejected and the alternative accepted. This means that the CBA has a significant impact on students' ability to analyse.
Since there is a significant influence of CBA on students' ability to analyse, a further examination of the influence reveals that the mean value of CBA on students' ability to analyse (mean = 4.99) is higher than the mean value of non-treatment of CBA on students' ability to analyse (mean = 4.30). Therefore, the use of CBA proves to be a more effective tool in students' ability to analyse.
Hypothesis Two: The CBA has no significant effect on secondary school students' ability to synthesize.
The independent variable in this hypothesis was the CBA, while the dependent variable was students' ability to synthesize. The scores of the dependent variable were got from the scores recorded from the test administered to the two groups after the introduction of the treatment (CBA) to the control group. The statistical analysis technique used to test this hypothesis was the independent t-test. The result of the analysis is presented in Table 3:

Table 3: Independent t-test analysis of pre-test scores for analysis, synthesis and prediction (120)

CBA	N	Mean	SD	t-value
Control Group	50	3.92	1.226	-5.343*
Experimental Group	70	5.14	1.243	
Total	120			

*p<0.05, df=118; critical t = 1.97

The result of the analysis in Table 3 reveals that the calculated absolute t-value of 5.343 is higher than the critical t-value of 1.96 at 0.05 level of significance with 118 degrees of freedom. With this result the null hypothesis was rejected and the alternative accepted. This means that there is a significant influence of CBA on students' ability to synthesize.

Since there is a significant influence of CBA on students' ability to synthesize, a further examination of the influence reveals that the mean value of CBA on students' ability to synthesize (mean = 5.14) is higher than the mean value of non-treatment of CBA on students' ability to synthesize (mean = 3.92). Therefore, the use of CBA proves to be a more effective tool in students' ability to synthesize.

Hypothesis Three: The CBA has no significant effect on secondary school students' ability to predict.

The independent variable in this hypothesis was the CBA, while the dependent variable was students' ability to predict. The scores of the dependent variable were got from the scores recorded from the test administered to the two groups after the introduction of the treatment (CBA) to the control group. The statistical analysis technique used to test this hypothesis was the independent t-test. The result of the analysis is presented in Table …

Table 4: Independent t-test analysis of students' ability to predict (120)

CBA	N	Mean	SD	t-value
Control Group	50	1.86	1.030	-6.05
Experimental Group	70	2.97	0.963	
Total	120			

*p<0.05, df=118; critical t = 1.97

The result of the analysis in Table 4 reveals that the calculated absolute t-value of 6.05 is higher than the critical t-value of 1.96 at 0.05 level of significance with 118 degrees of freedom. With this result the null hypothesis was rejected and the alternative accepted. This means that there is a significant influence of CBA on students' ability to predict. Since there is a significant influence of CBA on students' ability to predict. A further examination of the influence reveals that the mean value of CBA on students' ability to predict (mean = 2.97) is higher than the mean value of non-treatment of CBA on students' ability to predict (mean = 1.86). Therefore, the use of CBA proves to be a more effective tool in students' ability to predict.

Using an alpha level of 0.05, a dependent-samples t-test was conducted to evaluate if there were any significant differences in the pre-test/post-test performance for the control group and the experimental groups.

Control Group

The result of the analyses to see if the pre-test scores differ significantly from the post-test scores in students' ability to analyse, synthesize and predict for the control group are presented in Table …

Table 5: Results of dependent t-test and descriptive statistics for the control group on students' ability to analyse, synthesize and predict (50)

	Pre-Test		Post-Test		Γ_{xy}	t-value
	$\bar{X}$	SD	$\bar{X}$	SD		
Analyse	3.36	1.588	4.30	1.930	0.095	-1.705
Synthesize	3.66	1.610	3.92	1.226	0.366	-0.912
Predict	1.83	0.805	1.86	1.030	0.866	-0.170

*p < .05, df=69, Critical t = 2.01

The result of the analysis on Table 5 reveals that the calculated absolute t-value of 1.705 is lower than the critical t-value of 2.01 at 0.05 level of significance with 49 degrees of freedom. This result implies that there is no significant difference in the mean scores for the pre-test post-test scores of students' ability to analyse for the control group.

The calculated absolute t-values of 0.912 is lower than the critical t-value of 2.01 at 0.05 level of significance with 49 degrees of freedom. This result implies that there is no significant difference in the mean scores for the pre-test post-test scores of students' ability to synthesize for the control group.

The calculated absolute t-values of 0.170 is lower than the critical t-value of 2.01 at 0.05 level of significance with 49 degrees of freedom. This result implies that there is no significant difference in the mean scores for the pre-test, post-test scores of students' ability to predict for the control group.

Experimental Group

The result of the analyses to see if the pre-test scores differ significantly from the post-test scores in students' ability to analyse, synthesize and predict for the experimental group are presented in Table 6:

Table 6: Results of dependent t-test and descriptive statistics for the experimental group on students' ability to analyse, synthesize and predict (70)

	Pre-Test		Post-Test		Γ_{xy}	t-value
	$\bar{X}$	SD	$\bar{X}$	SD		
Analyse	3.90	1.621	4.99	1.440	0.000	-4.017
Synthesize	3.86	1.585	5.14	1. 243	0.000	-5.600
Predict	1.93	0.791	2. 97	0.963	0.000	-6. 893

*p < .05, df=49, Critical t =1.99

The result of the analysis in Table 6 reveals that the calculated absolute t-value of 4.017 is higher than the critical t-value of 1.99 at 0.05 level of significance with 69 degrees of freedom. This result implies that there is a significant difference in the mean scores for the pre-test post-test scores of students' ability to analyse for the experimental group.

Since there is a significant influence of CBA on students' ability to analyse. A further examination of the influence reveals that the mean value of CBA on students' ability to analyse (mean=4.99) is higher than the mean value of pre-treatment of CBA on students' ability to analyse (mean = 3.90). Therefore, the use of CBA proves to be a more effective tool in students' ability to analyse for the experimental group.
The calculated absolute t-values of 5.600 is higher than the critical t-value of 1.99 at 0.05 level of significance with 69 degrees of freedom. This result implies that there is a significant difference in the mean scores for the pre-test, post-test scores of students' ability to synthesize for the group of students exposed to the CBA.

Since there is a significant influence of CBA on students' ability to synthesize. A further examination of the influence reveals that the mean value of CBA on students' ability to synthesize (mean=5.14) is higher than the mean value of pre-treatment of CBA on students' ability to analyse (mean = 3.86). Therefore, the use of CBA proves to be a more effective tool in students' ability to synthesize for the experimental group.
The calculated absolute t-values of 6. 893 is higher than the critical t-value of 1.99 at 0.05 level of significance with 69 degrees of freedom, which implies that there is a significant difference in the mean scores for the pre-test, post-test scores of students' ability to predict for the group of students exposed to the CBA.
Since there is a significant influence of CBA on students' ability to predict, a further examination of the influence reveals that the mean value of CBA on students' ability to analyse (mean=2. 97) is higher than the mean value of pre-treatment of CBA on students' ability to predict (mean = 1.93). Therefore, the use of CBA proves to be a more effective tool in students' ability to predict for the experimental group.

Discussion and Conclusion

The result obtained from the data analysis revealed that there was a significant improvement in students' achievement in the experimental group from the pre-test to post-test scores after the use of student-centered method of teaching as compared to the control group who were taught by traditional method. Therefore, applying CBA is effective in improving the achievement of secondary school students' HOTS. HOTS can be taught and learned. Thus the issue lies with how best to teach this highly needed skill (Chinedu and Kamin, 2015). The findings of the present study support the assertion that CBA is a strategy that leads to higher achievement of students. This finding is well supported by the studies of Chelli, (2015), which found out that there were statistically significant differences on first year students' writing achievement in the Department of Foreign Languages at Biskra secondary school, due to the Competency Based Approach. The most important characteristic of competency-based education is that it measures learning rather than time. Students progress by demonstrating their competence, which means they prove that they have

mastered the knowledge and skills (competencies) required for a particular course (O'Sullivan and Bruce, 2014). The advantages of the CBA far outweigh the advantages of the more traditional approaches to education that rely more on knowledge and skills acquired than on whether the knowledge and skills can be appropriately and reliably applied in the ever-changing complex situations that graduates will face (Saucier et al., 2012)

According to Piaget, meaningful learning means that the learner can organize the information and assimilate them in his /her knowledge framework. Leou and Liu (2004) suggested that learning can be enhanced if the learning involves interaction, that permit learners construct their understanding in order to make learning organized and meaningful. CBA is therefore supported by constructivism (Markow and Lonning, 1998). Throughout the process, it is important for the teacher to make adjustments to the activities based on each student's unique learning needs, language proficiency, and progress (Toe, Shaw, Chen, and Wang, 2016).

With regard to recommendations, training sessions and workshops need to be organized to better inform and drill teachers on how to go about the competency based approach. Teachers are expected to be drilled on the type of instruction methods to use, how to develop test items to suit the learning objectives, what teaching resources are appropriate and most importantly, they are expected to be informed that the approach is highly student-centered making teachers facilitators.

In evaluation of student learning outcomes, the competency-based assessment or criteria based assessment approaches should be used. Students assessment has also referred to "authentic assessment" that relates to solving day to day riel life problems. Those types of assessment are, especially, project-based, problem-based, portfolio, and self assessment (Sutartu, 2017).

Also, since the CBA employs student-centred teaching approaches an increase in human and material resources are paramount. The education system should get into partnership with industries in the society. This will help maximize competences required by students during the teaching learning process and better prepare them for the job market

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The Epidemiological Profile of Sexual Violence Notifications in the Capitals of the Northeast of Brazil: An Ecologic Time Series

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Abstract

This study aimed at outlining the epidemiological profile of the notifications of sexual violence in the capitals of the Northeast of Brazil. It is a descriptive, analytical, and ecological study, made with the information about sexual violence recorded at SINAN (the Information System of Health Problem Notifications). The nine capital cities of the Northeast of the country were selected, and data from them was analyzed from 2012 to 2014. The depending variables were notifications of sexual violence and rape. Independent variables included sex, age group, educational level, and race. For a statistical analysis, the Chi-squared and Fisher's exact tests were used when the expected frequencies were below 5. The statistical treatment of variables was done using the R software. Regarding the results, 6811 sexual violence cases were notified in the capitals. Most of them took place in Recife (31.2%), Teresina (16.5%), and Aracaju (13.3%). In most cases, the victims were females, children or adolescents, and brown. Most victims had less than eight years of study. The city with the most notifications of rape was Recife. The results show the association between socioeconomic factors and sexual violence, outlining a profile of the victims of this type of violence in the capitals of the Brazilian Northeast. A high prevalence of sexual violence was found in the investigated cities.

Keywords: violence; sex offenses; compulsory notification;

1. Introduction

Sexual violence is understood as any type of sexual activity that is not consensual, being imposed through force, intimidation, threats, or coercion (SOUZA; MINAYO, 2017; BASILE; SMITH, 2011). A commonly observed result of this practice is the severe emotional, economic, and social damage to the victim and their relatives. Furthermore, there are other aspects involved in the context of sexual abuse, such as: the risk of being contaminated by sexually transmissible infections, psychological traumas, and unwanted pregnancies, the latter of which also increases the number of abortions (MUTTA; YELA, 2017; SILVA et al., 2019).

The World Health Organization proposed an ecological model of violence, taking into account risk factors that are considered to be milestones to understand the complex interaction between them. That leads to the understanding of key-factors with regard to preventing and intervening with this problem. These factors are divided in individual factors, which include biological factors and the history of the individual; relational factors; community factors, understood as the relations established with the society; and, finally, social factors, including a broader, macro-social view, such as gender inequality, religious influence, economic policies, and social norms, which are a subject of Collective Health studies (KRUG, E.G. et al., 2012; SILVA; MELO NETO; NÓBREGA, 2020).

It has been estimated that, every year, nearly 12 million people are victims of sexual violence in the world. Six out of every ten women experienced some type of unwanted sexual relation in their lives. In adolescence, from 6 to 59% report experiences of sexual assault, especially by intimate partners (OLIVEIRA et al., 2013). Data from Martins and Alencastro (2015) identified a reality in which the general prevalence of sexual violence in Brazil was found to be 20.4%. On an individual level, the frequency of sexual violence against women (26.4%) is twice as high as that against males. Concerning age group,

children are seven times more likely to be submitted to violence than adults. Adolescents, on the other hand, are six times more likely. Among children, the prevalence found was 11.9%, compared to that of adolescents, which was of 8.8% (BRAZIL, 2011; LI; ZHAO; YU, 2019).

It is mandatory for professionals in health units to notify cases of sexual violence, registering the information in the Sistema de Informação de Agravos de Notificação (SINAN, the Information System of Health Problem Notifications), whether the cases are suspected or confirmed. To do so, they must use the Form of Notification/Investigation of Domestic Violence, Sexual Violence, and Other Types of Violence (FNI). The data is computerized, consolidated, and sent to the Sistema de Vigilância de Violências e Acidentes (VIVA — the Surveillance System of Violence and Accidents), integrated to SINAN since 2008. Previously, these data were processed using the EPI-info software, but this change took place due to the need to improve the quality of information, which is essential to get to know the reality.

Even considering the advances obtained by the health information systems, the persistent conditions that prejudice the quality of information — undernotification, incomplete data, negligence when completing the FNI — shows that improving the quality of the information generated is necessary in all hierarchical levels of the health care network (MEZZAVILLA et al., 2018).

Considering the above, the objective of this study was outlining the profile of the notifications of sexual violence and verify their prevalence in the capitals of the Northeast of Brazil, from 2012 to 2014.

2. Methods

2.1 Type of study

This is an exploratory, descriptive, analytical study, whose design is that of an ecological time series, using secondary data from sexual violence recorded in the SINAN-VIVA, from cities in the Brazilian Northeast. An inductive approach was used as a scientific method, since this study used private data to infer a universal truth (LAKATOS; MACONI, 2003).

2.2 Data collection procedure

The tabulation of the information was carried out by the Epidemiological Surveillance service of each city, after the forms with the individual notification were received from the health units. Data was extracted from the database of the Ministry of Health (DATASUS) through a consultation to the section of epidemiology and morbidity information. To do so, the software Tabwin 3.6b, from the Epidemiological Surveillance Management, was used. The notification form includes, among other information, content that identifies the victim and the potential aggressor, as well as characteristics of the event, specificities of the sexual violence — when there are any —, consequences of the violence, and data about the progression of the case and referrals.

The nine capital cities of the Northeast of the country were selected, and data from them was stratified and analyzed from 2012 to 2014. The notifications of sexual violence and rape were included as dependent variables. The independent variables, in turn, were sex, age group, educational level, and race.

2.3 Statistical analysis

Regarding the analysis of tabulated data, descriptive statistics were used, through simple absolute and relative frequencies (%) for the categorical variables and the organization of the results in tables and graphics. Aiming to verify possible associations between the variables analyzed, the Chi-squared (X^2) and Fisher's exact tests were applied when expected frequencies were below 5 (SIEGEL et al., 2006), considering a confidence interval of 95% (CI95%) and a significance level of 5% ($p<0.05$) to determine the statistical significance of the variables included in the study. The statistical program RStudio was used to analyze the cases of sexual violence notified (GBIF, 2015).

2.4 Ethical aspects

Since this is an ecological study, in which data has already been processed and the population investigated has not been identified, there was no need to submit it to a research ethics committee (DELZIOVO et al., 2017).

3. Results

6,811 notifications of sexual violence cases were registered in the Epidemiological Surveillance Secretariats (Figure 1), a mean of 756.8 considering all the cities. The capitals with the highest number of notifications were Recife (31.2%), Teresina (16.5%), and Aracaju (13.3%), as opposed to Natal, where only 3.7% of the notifications took place.

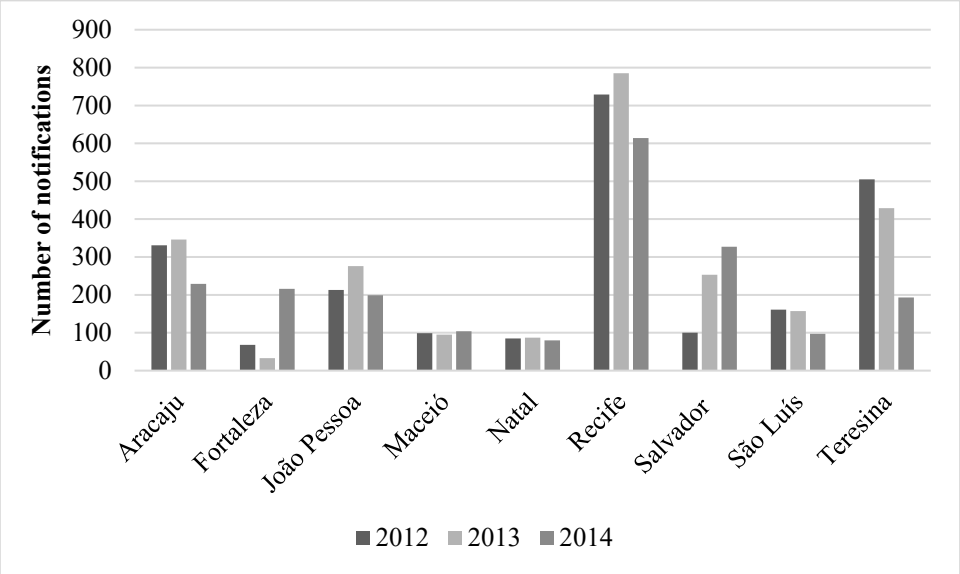

Figure 1. Distribution chart of notifications of sexual violence among the capitals of the Northeast

Females were overwhelmingly more affected by sexual violence in all capitals, with statistical significance in Recife (p=0.01), São Luís (p=0.01), Maceió (p=0.01), and Teresina (p=<0.001).

Sexual violence mostly affected children and adolescents, according to the classification of the data base. This result had a statistical significance in the cities of Natal (p=0.02), João Pessoa (p=0.02), Aracaju (p=0.008), São Luís (p=0.006), and Fortaleza (p=<0.001). With regard to the educational level, most

victims had less than eight years of study.

Notifications showed that most victims were brown, followed by those with white skin. This result was only statistically significant in Fortaleza (p=<0.001) (Table 1).

Table 1. Profile of notifications of sexual violence in the northeast (2012-2014)

Characteristics	Aracaju	Fortaleza	João Pessoa	Maceió	Natal	Recife	Salvador	São Luís	Teresina
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Sex									
Male	145 (16,0)	8 (2,5)	21 (3,1)	16 (5,4)	13 (5,2)	196 (9,2)	95 (14,0)	53 (12,8)	93 (8,3)
Female	760 (83,9)	309 (97,5)	667 (96,9)	282 (94,6)	239 (94,8)	1932 (90,8)	584 (85,9)	362 (87,2)	1034 (91,7)
Ignored	1 (0,1)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	1 (0,1)	0 (0,0)	0 (0,0)
X²(p-value)	2,90 (0,2349)	3,80 (0,1670)	3,57 (0,1679)	8,61 (0,0111)	3,09 (0,2192)	8,68 (0,0130)	3,51 (0,1725)	8,59 (0,0136)	18,48 (<0,001)
Age Range									
Ignored	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	3 (0,4)	0 (0,0)	0 (0,0)
0-19	769 (84,9)	261 (82,3)	325 (47,2)	190 (63,8)	144 (57,1)	1434 (67,4)	546 (80,3)	342 (82,4)	969 (86,0)
20-49	125 (13,8)	55 (17,4)	330 (48,0)	105 (35,2)	96 (38,1)	635 (29,8)	124 (18,2)	69 (16,6)	142 (12,6)
>50	12 (1,3)	1 (0,3)	33 (4,8)	3 (1,0)	12 (4,8)	59 (2,8)	7 (1,0)	4 (1,0)	16 (1,4)
X²(p-value)	13,42 (0,0088)	106,88 (<0,001)	10,80 (0,0289)	0,48 (0,7854)	10,76 (0,0239)	7,56 (0,1076)	5,54 (0,2359)	9,95 (0,0069)	5,22 (0,2695)
Scholarity									
Ignored	522 (57,6)	67 (21,1)	196 (28,5)	93 (31,2)	109 (43,3)	915 (43,0)	194 (28,5)	121 (29,2)	334 (29,6)
Illiterate	16 (1,8)	2 (0,6)	5 (0,7)	5 (1,7)	3 (1,2)	5 (0,2)	5 (0,7)	0 (0,0)	24 (2,1)
Elementary School	327 (36,1)	160 (50,5)	258 (37,5)	118 (39,6)	66 (26,2)	780 (36,7)	376 (55,3)	217 (52,5)	629 (55,8)
High school	26 (2,9)	77 (24,3)	160 (23,3)	62 (20,8)	57 (22,6)	315 (14,8)	72 (10,6)	60 (14,5)	117 (10,4)
University education	15 (1,7)	11 (3,5)	69 (10,0)	20 (6,7)	17 (6,7)	113 (5,3)	33 (4,8)	17 (4,1)	23 (2,0)

X^2(p-value)	7,62 (0,2663)	21,38 (0,0001)	13,77 (0,0081)	2,52 (0,6462)	8,36 (0,0806)	14,85 (0,0040)	7,38 (0,1198)	12,76 (0,0142)	5,17 (0,5251)
Race									
Ignored	151 (16,7)	17 (5,4)	17 (2,5)	26 (8,7)	13 (5,2)	313 (14,7)	104 (15,3)	19 (4,6)	56 (5,0)
White	125 (13,8)	30 (9,5)	161 (23,4)	51 (17,1)	57 (22,6)	466 (21,9)	55 (8,1)	70 (16,9)	202 (17,9)
Black	61 (6,7)	15 (4,7)	101 (14,7)	27 (9,1)	9 (3,6)	251 (11,8)	169 (24,9)	52 (12,5)	123 (10,9)
Indigenous	6 (0,7)	2 (0,6)	17 (2,5)	2 (0,7)	2 (0,8)	32 (1,5)	7 (1,0)	1 (0,2)	46 (4,1)
Brown	563 (62,1)	253 (79,8)	392 (57,0)	192 (64,4)	171 (67,9)	1066 (50,0)	345 (50,7)	273 (65,8)	700 (62,1)
X^2(p-value)	5,22 (0,2655)	70,82 (<0,001)	8,04 (0,0901)	4,42 (0,3577)	4,30 (0,3646)	0,63 (0,9595)	6,18 (0,1864)	3,88 (0,4291)	5,23 (0,3567)

When the analysis evaluated specifically the variable "rape", a total of 5,848 notifications was found. Recife (29.9%), Aracaju (15.1%), and Teresina (14.1%) had the highest prevalences (Figure 2).

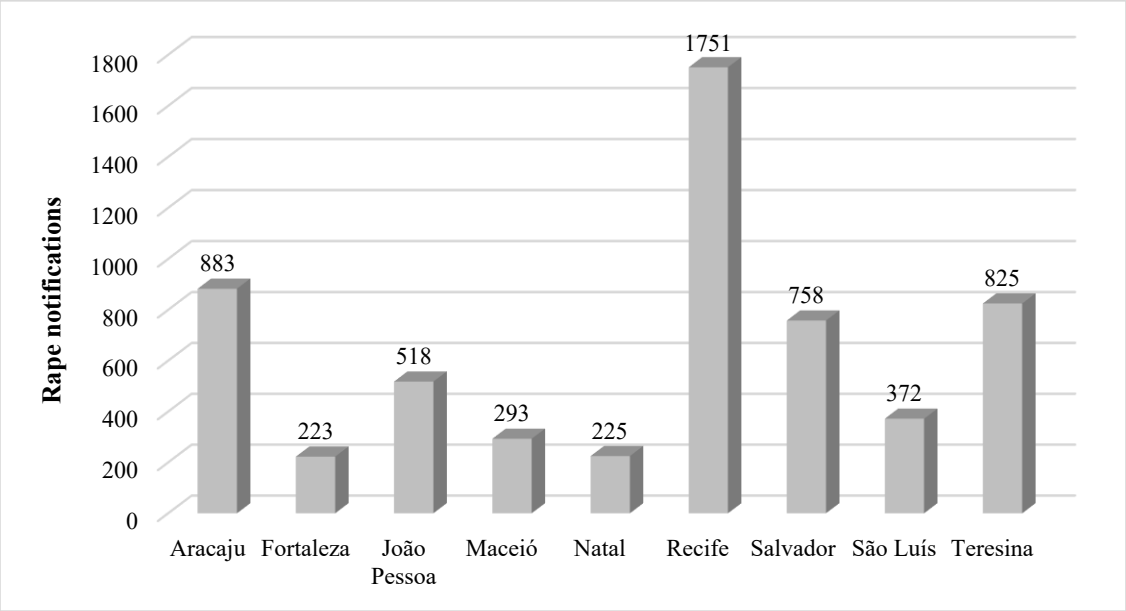

Figure 2. Rape prevalence among reports of sexual violence

4. Discussion

Understanding how sexual violence propagates is significantly effective to indicate the destructive potential of this problem to the population affected by it and their relatives, since it is difficult to diagnose this reality in certain contexts, since the victims, oftentimes, feel ashamed to report the reality in which they are in. Discussions on the theme have been increasingly common, but intersectoral actions are still needed to

confront this type of violence with effective actions (CAMARGO et al., 2019).

Among the capitals investigated, and considering a reality in which a large number of notifications was found, some capitals — despite having registered a high prevalence of sexual violence — have shown to be on a downward trend with regards to notification numbers, which could be connected to the actions of public policies to confront this type of violence. This tendency can be affirmed due to the Human Development Index, which measures some aspects inherent to the development of human beings. Recife is the city with the highest index (0.78) among the Northeast capitals (BRAZIL, 2018).

The capital Recife also registered the highest number of notifications of sexual violence at SINAN, a result similar to the one found by another study (ALVES et al., 2018), which identified 867 records of sexual violence in the same capital, based on the records of cases which had been confirmed and archived in the files of the Legal Medicine Institute.

The research found that females were the most common victims of sexual violence, corroborating previous findings in literature (SCHRAIBER; D'OLIVEIRA, 2008). The highest prevalence of this type of violence among females is a historical fact throughout the world, and is related to the sexualization of women's bodies, especially by men. Sexism, as a form of domination, in addition to financial dependence, are factors that contribute for sexual violence (MEZZAVILLA et al., 2018). There was a statistical association in most capitals, reiterating the influence of sexual violence in females.

Regarding the age group, Lindner et al. (2015) have shown that young adults — from 20 to 29 years old — are more likely to be affected, since this is an age group in which sexual relations are more practiced, coupled with the fact that people are more deeply inserted in society through work, study, or leisure, increasing the exposure to violence. In this article, the most prevalent victims of sexual violence were found to be children and adolescents in all capitals in the Northeast, except João Pessoa.

This research shows a strong statistical association, in some capitals, between the educational level of the population investigated and sexual violence. All capitals investigated had a similar pattern, which is in accordance to studies by Alves et al. (2018) and Marinheiro et al. (2006). This could lead to inferences according to which sexual violence is inversely proportional to educational levels, that is, the lower the educational level, the highest the proportion of sexual violence experience, since the most frequent victims were those under eight years of study.

In the case of the variable race, the findings of this research were in accordance to other studies by Facuri et al. (2013) and Matias et al. (2013), according to which the most prevalent victims of sexual violence are non-white people, that is, brown and black ones. The high frequency of brown people may be related to the fact that Brazil is considered to be a country of mixed races, due to the influence of its many different colonizing peoples.

Worldwide, thousands of people are forced to practice unwanted sexual acts, which leads to irreversible damage, such as psychological disorders, higher risk of suicide, the formation of violent personalities, trauma related to sexual life, in addition to a higher risk of contamination by Sexually Transmitted Infections (STIs) (BARROS et al., 2016).

There are many ways in which sexual violence can take place, from physical violence, using various types of aggression, to sexual coercion. This article followed the structure of the variables proposed by DATASUS — which subdivides sexual violence in sexual harassment, rape, indecent assault, child

pornography, and sexual exploitation —, choosing the variable "rape" for analysis due to the high frequency of this type of sexual violence in a similar research (LIMA et al., 2017). When sexual violence is restricted to rape, the most common typology, the results are in accordance to previous studies (D'ABREU; KRAHÉ; BAZON, 2013; ASSIS; GOMES; PIRES, 2014).

Data from the Ministry of Health indicate that less than 10% of rape cases are notified to the responsible bodies (BRASIL, 2005). Due to the negative effect a rape has on the victim, such as the fear of it happening again, the prejudice with regard to STI infections, the submission and dependency from the attacker, and unwanted pregnancies, oftentimes the possibility of making a report is neglected (SOUTO et al., 2014). These rapes frequently go unnoticed by the public powers, not only because victims do not report them, but also because professionals are unaware that the notification system has been standardized, or even due to their fear of retaliation, all of which make it much more difficult to confront sexual violence (KURG, 2002).

It is extremely important to highlight the limits of cross-sectional studies, such as the impossibility of establishing causal relationships, the memory bias, the undernotification from health workers, and/or the lack of training or of awareness of those responsible for transmitting this data to DATASUS. In addition, the system is lacking updates with regards to national Epidemiological Surveillance data, since the last year available for consultation is still 2014. Still, the data presented here, despite its shortcomings, is not less reliable, and the issues mentioned above only mean that it requires more care to be analyzed.

One of the positive aspects of this work is the relevance of the information collected, considering it as true. Also, it raises the possibility of presenting a comparative analysis of Northeastern capitals, since no other studies were found that specifically analyze these cities and have a broader geographic scope, enabling an analysis of the profile of the victims.

5. Conclusion

The results presented show the association of socioeconomic factors with sexual violence, outlining a profile of the victims of this type of violence in the capitals in the Northeast of Brazil. Furthermore, it shows which capitals have the highest prevalence of sexual violence notifications.

Therefore, advances must be done in the use and analysis of the data generated by health information systems, due to the considerable power of data validation. As a result, it is essential to use methods and techniques of sexual violence monitoring, minimizing the causes of undernotification through intersectoral action.

Therefore, it can be concluded that the instruments of mandatory sexual violence notification are still challenging to public health workers, despite being indispensable to portrait health indicators and subsidize the elaboration of public policies.

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Thermal and energy balance of a fuel cell during hydrogen supply from metal hydride materials

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Abstract

The present article deals with the material and energy balance of a fuel cell during hydrogen supply from a metal hydride tank. It describes potential utilisation of heat from a fuel cell for heating a tank in order to achieve the required kinetics of the process. The concluding part hereof contains a numerical calculation of the thermal field of the designed tank during the fuel cell operation.

Keywords: hydrogen; metal hydride; fuel cell

1. Introduction

The energy content of one mole of hydrogen is determined by the value of change in enthalpy ΔH which equals the heating value of hydrogen. When hydrogen is used for the production of electric energy, the efficiency of such conversion is limited by the applied production method. For example, in thermomechanical methods of electric energy production, maximum efficiency of a device is determined by the Carnot cycle, as it is with other fuels. Even though it is possible to achieve a higher combustion temperature in hydrogen combustion, the cycle efficiency, which is limited by the thermodynamic laws, is approximately the same as that of fossil fuels. As hydrogen represents a very high-grade type of energy, its chemical properties make it an excellent fuel for fuel cells (FCs). A reaction between hydrogen and oxygen in a fuel cell is a reverse process of water electrolysis, while these two processes exhibit a lot of common theoretical and practical patterns. At present, fuel cells with a PEM (Proton Exchange Membrane) are becoming the most frequently used fuel cell type (Fig. 1). Their mechanism is based on supplying hydrogen molecules through a distribution layer to a catalyser (Pt) where a hydrogen molecule dissociates into atoms. Then electrons leave atoms and a hydrogen cation (proton) is formed. Proton passes through the membrane towards the cathode where it accepts an electron and merges with the supplied oxygen to produce water.

Electric voltage in the fuel cell is produced by electrochemical oxidation of hydrogen:

$$H_2 \rightarrow 2H^+ + 2e^- \tag{1}$$

and electrochemical reduction of oxygen:

$$\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O \tag{2}$$

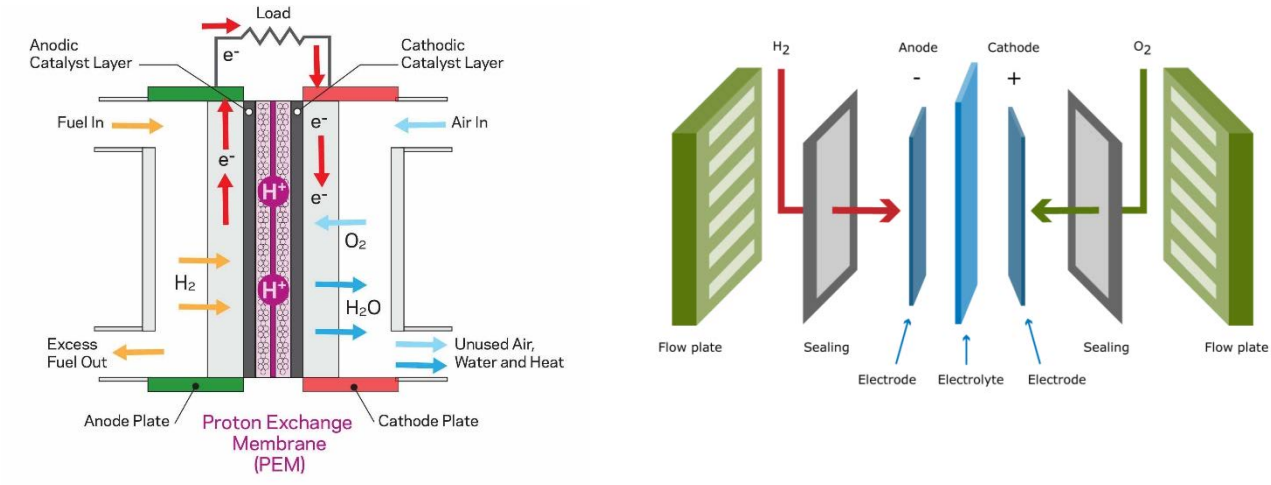

Figure 1. The mechanism of action of a PEM fuel cell and its structure scheme [3] [4].

However, the use of hydrogen as a fuel brings several problems, including a low heating value relative to a volume unit caused by low gas density, i.e. 0.08988 kg·m^{-3} (at 101,325 Pa and 0 °C). This negatively affects hydrogen storage as such, whereas the efforts are aimed at achieving the highest possible energy density. The efforts aimed at eliminating the use of extremely high pressures have led to mass investigation of absorption-based method of hydrogen storage in form of metal hydrides (MH). They

facilitate hydrogen absorption directly in their structure at lower pressures and ambient temperatures. A commonly available MH type is the intermetallic alloy $LaNi_5$ and especially its related alloys containing cerium. The working pressure of $LaNi_5$ ranges from 0.1 to 1 MPa and the temperature ranges from 20 to 60 °C; these values are compatible with selected types of high-pressure electrolysers and fuel cells. Storing hydrogen which is firmly bound to a metal alloy facilitates significant reduction of the pressure in tanks with the same amount of fuel as in the standard storage in pressure vessels. This results in the reduction of energy demand during hydrogen compression into tanks. Furthermore, during hydrogen combustion in FCs, the relative pressure must be reduced to approximately 50 kPa; this means that the application of high-pressure methods of hydrogen storage is unnecessary.

2. Experimental Section

Hydrogen absorption into metal hydride is accompanied by heat generation. Therefore, during the "tank charging" it is necessary to apply cooling and the heat may subsequently used for heating purposes. While hydrogen is supplied from a MH tank to a FC, hydrogen desorption occurs and this requires supplying heat to the alloy, otherwise the heat is absorbed at the expense of its internal energy. This causes that the temperature of the MH material decreases and so does the kinetics of hydrogen release. For a commonly used alloy $La_{0,85}Ce_{0,15}Ni_5$, absorption heat amounts to 1.01 MJ per 1 m^3 of absorbed hydrogen, representing 7.9 % of the heating value of hydrogen (12.76 $MJ \cdot m^{-3}$).

During hydrogen combustion in the PEM FC, electric energy is produced with the efficiency of approximately 50 %, while the remaining portion of chemically bound energy is transformed into thermal energy. This process may be described using the energy balance as follows:

$$\sum Q_{in} = W_{el} + \sum Q_{out} + Q_{dis} + Q_c \tag{3}$$

wherein ΣQ_{in} represents the enthalpy of gases at the inlet (J), W_{el} is the produced electric energy (J), ΣQ_{out} is the enthalpy of unused gases at the outlet, including the heat contained in the produced water (J), Q_{dis} is the heat loss into the surrounding environment (J) and Q_c is the heat removed by active cooling (J). Active cooling may be achieved through the cooling medium flowing between the fuels, or at the edge of the active part of the FC, or by using the phase transition. Total heat generated in the fuel cell is calculated using the following formula [1]:

$$Q_{gen} = \sum Q_{out} + Q_{dis} + Q_c = \left(1.482 - U_{cell}\right) \cdot I \cdot n \tag{4}$$

wherein U_{cell} is the voltage in one cell (V), I is the current passing through the FC (A) and n is the number of cells (1).

Equation (4) applies when the produced water is in the liquid state at the temperature of 25 °C. If water leaves the cell in the gaseous state (vapour), Equation (5) is more appropriate [1]:

$$Q_{gen} = \left(1.254 - U_{cell}\right) \cdot I \cdot n \tag{5}$$

The material balance of the FC is determined by the mass of hydrogen, oxygen and produced water per unit time:

$$m_{H_2} = m_{H_2}^{1C} \cdot I \cdot \tau \cdot n \qquad m_{O_2} = m_{O_2}^{1C} \cdot I \cdot \tau \cdot n \qquad m_{H_2O} = m_{H_2O}^{1C} \cdot I \cdot \tau \cdot n \tag{6}$$

wherein $m_{H_2}^{1C}$ is the mass of hydrogen used during the passage of electric charge 1 C ($10.441 \cdot 10^{-9}$ kg·C^{-1}), $m_{O_2}^{1C}$ is the mass of oxygen used during the passage of electric charge 1 C ($82{,}914 \cdot 10^{-9}$ kg·C^{-1}), $m_{H_2O}^{1C}$ is the mass of water produced during the passage of electric charge 1 C = 1 A·s ($93.355 \cdot 10^{-9}$ kg·C^{-1}) and τ is the operation time (s). If the power at FC terminals is 1 kW, efficiency is 50 % and the operation time is 1 hour, the fuel cell receives 0.403 kg of oxygen and 0.0502 kg of hydrogen, and 0.453 kg of water is produced; however, such water must be removed from the fuel cell [2].

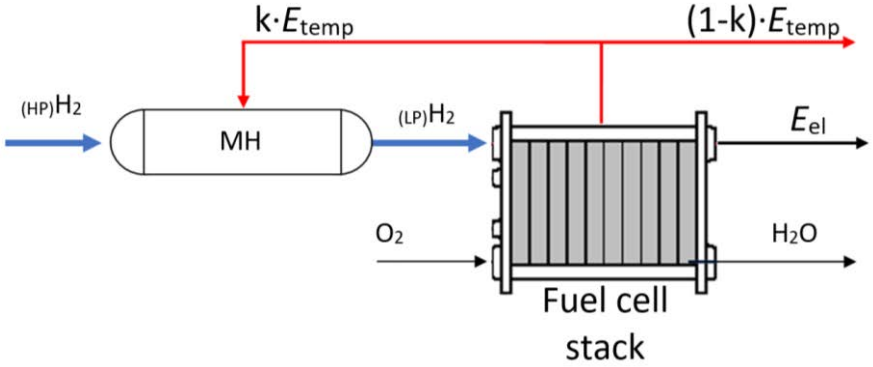

Figure 2. Scheme of material and energy flows when H_2 is supplied from MH.

Fig. 2 shows the material and energy balance of the fuel cell while hydrogen is supplied from a MH tank. As already mentioned above, a MH tank needs a supply of heat while hydrogen is released. With the use of a FC with the power of 1 kW, hydrogen must be desorbed from the alloy at the flow rate of $1.56 \cdot 10^{-4}$ m^3·s^{-1}. In the case of $La_{0,85}Ce_{0,15}Ni_5$ alloy, 158 W of heat output is needed.

3. Results and Discussion

As the fuel cell produces approximately 500 W of heat output, a certain portion may be used to heat up the tank. However, in a real operation it is possible to supply a lower heat output because the internal energy of the tank may be used as well. In this case, hydrogen temperature and pressure decrease, but it does not constitute a problem, unless the pressure falls below the minimum operating pressure in the FC. The purpose of the simulation was to verify the use of heat from cooling the FCs and optimise tank parameters. The numerical calculation was based on the expected power of FC of 1 kW while hydrogen was desorbed from 0.955 kg of $La_{0,85}Ce_{0,15}Ni_5$ alloy, and this facilitated covering the FC consumption for 1,000 seconds of operation. In order to ensure the required kinetics of a hydrogen desorption process, it was necessary to use a ground MH material. This facilitated achieving a large surface area of the material. However, there is a disadvantage of a low value of heat transfer coefficient which impairs the heat supply to the tank's core. Therefore, the tank material extends to the core of the MH material because the inner space of the tank was divided into several chambers (Fig. 3). In order to intensify the heat transfer, the aluminium tank was chosen, and the chambers were created by drilling. The outer diameter of the tank was 130 mm and its height was 200 mm. 26 ribs were formed along the perimeter and they were washed

by the heated air from the system cooling the fuel cell. The speed of the flowing air was 1.31 $m \cdot s^{-1}$ at a temperature of 35 °C (average values obtained by measuring the cooling of the FC, type MES DEA 0.5). The baseline temperature of the tank was 35° C. Thermal conductivity of the powder MH material was 0.45 $W \cdot m^{-1} \cdot K^{-1}$.

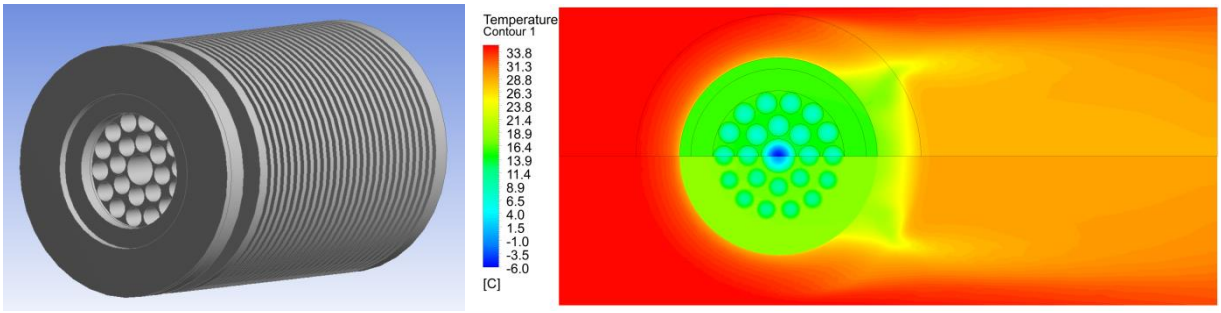

Figure 3. Model of a MH tank and thermal field in the transversal cross-section at time 1,000 s.

The simulation duration was 1,000 seconds with 5-second calculation increments. Fig. 4 shows the curve of average temperatures of MH and the aluminium tank changing over time.

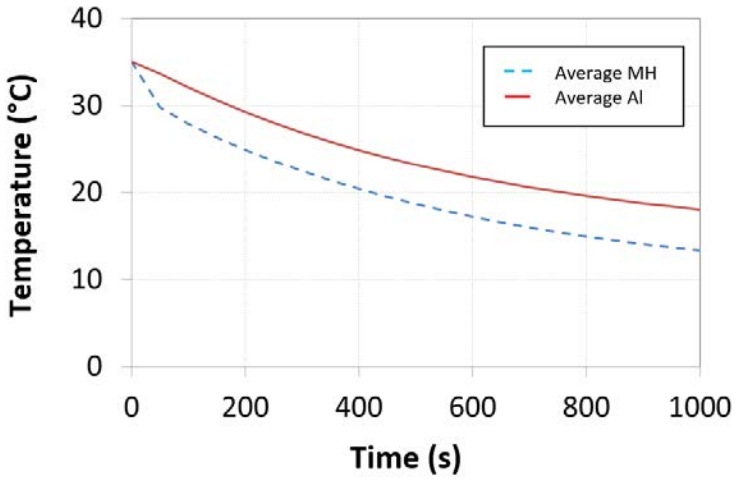

Figure 4. Curve of temperatures of MH and the Al tank changing over time

The curve clearly shows that the average temperature of MH did not fall below 10 °C, i.e. the point when the equilibrium pressure of the alloy is approximately 100 kPa which is sufficient for a stable operation of FCs. By making an analytical calculation of the material and energy balance, followed by a numerical calculation, it is possible to design and optimise MH-FC systems which will use the combined thermal management.

3. Conclusion

The article deals with thermal and energy balance of a fuel cell during the supply of hydrogen from a MH tank into which the required heat was supplied for the purpose of desorption using the cooling air from FCs. A numerical calculation was made to identify thermal fields of the tank over time and this facilitated the assessment of the appropriateness of the used system for real operations.

4. Acknowledgement

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Socio-economic model for the operation of a solar platform for the conservation and valorization of local milk in the village of Tatki in Northern Senegal

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SUMMARY

Livestock is a strategic sector that occupies nearly 60% of rural households and accounts for 4.3% of Senegal's Gross Domestic Product (ANSD, 2016). The dairy sector plays a decisive role in this sector, given its importance in the food security of the population and the income it generates (Alari et al, 2011). However, national milk production is in deficit; the country relies on imports of large quantities of milk powder, 25,000 tons/year, to cover its consumption needs (MEPA, 2016). These imports weigh heavily on public finances, up to 60 billion FCFA/year, thus accentuating the trade balance deficit, which was 2,977 billion FCFA in 2016 (ANSD, 2018). The analysis of the milk value chain highlights, in addition to the difficulties of securing production in the dry season, the poor access to energy in production areas (Enda Energie, 2015). Thus, in these localities, the milk can neither be preserved nor processed to be valorized and allow producers to earn stable incomes. It is in this context that a milk valorization platform was installed in 2016, in the village of Tatki located in a dairy basin in northern Senegal. After two years of operation of the platform, the financial results showed real difficulties in making the business of selling fresh milk to dairy industries profitable, given the landlocked nature of the area. Indeed, the cost price is 320 CFA francs per liter, for a price proposed by the industrialist set at 325 CFA. According to economic calculations, the floor price of a liter of fresh milk should be set at 550 CFA francs, for a minimum average commercialized volume of 471 liters per day, within the framework of a concessional credit at a rate of 5%. These conditions do not correspond to the reality of the current market and could not be applied without a subsidy. Thus, in order to make the platform profitable, it seems essential to add value to the milk by processing it on site. In this regard, the production of yogurt has given very interesting results that could be replicated in other villages in the northern zone. The financial analysis of the activity, for financing at a subsidized rate of 7.5% per year for a period of 7 years and a deferred repayment of 2 years, shows a rate of return of 18% for a period of 15 years, when local milk is processed into yogurt. The wealth generated (10% NPV) amounts to 227,269,450 FCFA and the time to recover the capital invested is 3.90 years.

Keywords: operation, platform, solar, model, socio-economic

1. INTRODUCTION

The study area is the commune of Fanaye, precisely the village of Tatki, located in the north of Senegal in the department of Podor, with geographic coordinates 16°31'60" N and 15°13'60" W in DMS. It is an area of sandy plain at an altitude of 14 m.

The area is under the influence of the Sahelian climate, marked by low rainfall and recurrent drought waves. The cumulative rainfall recorded in 2017 in the village of Tatki was 155.4 mm. The vegetation is almost everywhere a pseudo thorny steppe on tropical ferruginous soils, with poor or even non-existent pasture during the dry season that lasts 9 months. In this area of Podor, temperatures are high almost all year round, sometimes exceeding 40°c (ANSD, 2015).

Transhumance, once adapted to the environment for the rational exploitation of pastoral resources, is becoming less and less effective, given multiple anthropic and natural factors. The commune of Fanaye is divided into two parts:

- The Fanaye Walo, which is under the influence of the Senegal River where mainly agricultural activities are developed, particularly irrigated and flood recession crops and, exceptionally, rainfed crops.
- The Fanaye Diéri, which is more continental, where Fulani breeders mainly practice extensive livestock farming over vast areas. It is in this part that the study was conducted.

There are no structured markets for livestock products in the Fanaye Diéri zone, despite the beginning of the structuring of the local milk sector in northern Senegal. This is organized by "La Laiterie du Berger" (LDB), an industrial unit based in the town of Richard Toll, which has set up a collection network targeting primarily villages along the Senegal River valley (Broutin et al., 2018). This network does not cover the 13 villages of Fanaye Diéri because of their remoteness.

This situation motivated the introduction of a solar platform for the conservation and valorization of milk produced in these villages. This is an infrastructure that operates on solar energy. The objective of this platform is to allow the breeders of these localities to have favorable conditions for a better valorization and marketing of their dairy products for the improvement of their incomes and their living conditions.

However, the implementation of such a structure, similar to a dairy power plant, requires several conditions, including:

- a social engineering capable of federating transhumant breeders around this initiative to organize the offer;
- a mastery of technical feasibility for a judicious choice of technology;
- and an entrepreneurial approach guaranteeing the sustainability of the farm.

This study aims to determine for this model of platform :

- The technical conditions of implementation,
- Key profitability indicators,
- A financial model for calculating profitability.

Furthermore, the results of this study should constitute a tool to assist in political decision-making, specifically concerning the development of the milk value chain in Senegal. The results of this study could

constitute a decision support tool for local and political authorities, within the framework of the development strategies of the milk value chain in Senegal.

2. DATA AND METHOD

2.1 Data used

This study is part of the Regional Milk and Solar Energy Value Chain Program called PROGRES-Lait, which is implemented with the support of the European Union and the States of Senegal and Mauritania. The data are from :

- Cooling tests carried out on the tanks of the platform where the milk delivered by the farmers is stored. According to the technical specifications the milk is cooled from 37 degrees to 3 degrees in 3 hours for a good conservation.
- Tests of the quality of the milk received at the Du Berger Dairy from the Tatki platform over a distance of 45 km. The milk was transported in 50-liter cans by a tricycle driven by the platform's collector. The travel time between Tatki and Richard Toll was estimated at 1h30 on average.
- From the PROGRES-Lait project database, with financial and technical information collected every day since the Tatki platform was commissioned in 2016. The data relate to the salary charges, the costs of the energy used and are as follows: the salaries of an administrative staff consisting of a manager, a hygiene and quality manager, an accountant and a janitor, which amount to 330 000 Fcfa/month; the level of energy consumption of the platform estimated at 76 305 Kwh. It is calculated on the basis of the power of the installed equipment, to which is applied the operating time observed with an efficiency of 98% for new equipment. The price of Kwh harmonized at the national level is 90.7 Fcfa/kwh (Commission de Régulation du Secteur de l'Electricité, 2019).

In addition, the databases of the technical services of the Podor department's livestock breeding department, the Senegalese Rural Electrification Agency (ASER) and the Saint Louis Regional Development Agency (ARD) were used.

2.2 Data Collection Methods

The protocol followed is the one proposed by the equipment supplier. It consists in putting a volume of water in the tank, starting it, taking the temperature at the start, and every ten (10) minutes taking the temperature until the tank is stopped. The temperature measurements were taken with a mercury thermometer graduated from 0 to 100 degrees. Before performing another cooling test, the Tank is turned off, and the water is drained, until the Tank returns to normal temperature (ambient temperature). We performed 10 tests on 1 tank with a capacity of 300 liters filled successively with 50 liters and 100 liters of milk. The results presented are the average of the observations on the 10 tests for each volume of milk.

2.2.2 Measurements of the quality of the milk transported from the platforms to the plant

The milk cooled at the Tatki platform was transported in 2 x 50-liter cans to the LDB plant, using tricycles as a means of transport for a distance of 45 km. The LDB uses this means of transport within its collection

radius. Upon receipt at the plant, the milk is directly analyzed in the laboratory. Thus, alcohol, acidity and PH tests are carried out on the milk. In order to avoid prolonged exposure to the sun, the 50-liter cans were transported from 7:00 am and the tricycle conveyors arrived at 9:00 am on average.

2.2.3 Data processing methods for cost-effectiveness and modeling studies

For the profitability study, the data used were collected over an 18-month period of commissioning of the solar milk valorization platform installed in the village of Tatki by PROGRES-Lait. From these data, projections were made over a period of 10 years. A profitability calculation model was developed, based on sensitivity tests of the evolution of the different milk collection factors and the platform's operating conditions. Subsequently, multiple regression methods were used to determine the relationship between profitability and these factors of production.

3. RESULTS

3.1 Cooling tests

The results of the evolution of the temperatures recorded during the cooling tests of 50l and 100l milk volumes, carried out in a real environment, are represented by figure n°1.

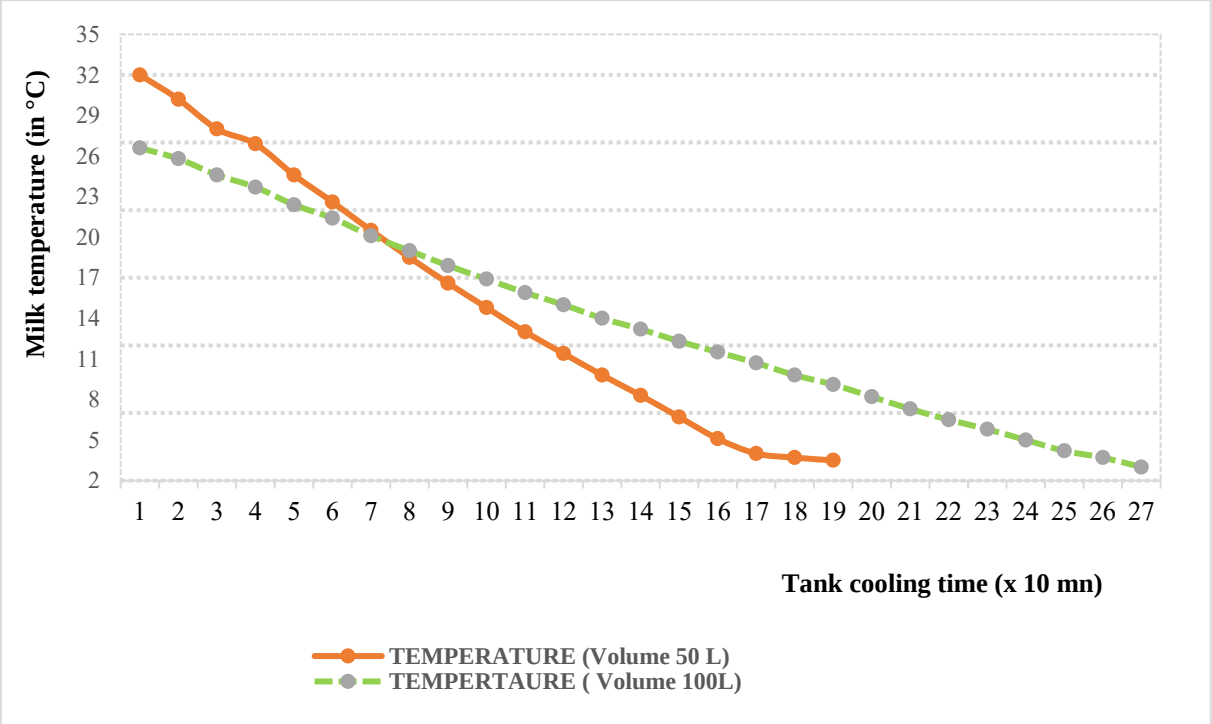

Figure 1: evolution of the drop in milk temperature according to the volume and cooling time of the tank

For the first experiment carried out on a 50l volume, the start and stop times were respectively 18h 08mn and 20h 48mm, i.e. a duration of 2h 40mm during which the temperatures noted fell regularly from 32°C to 3.5°C. This duration is slightly below the supplier's reference value of 3 hours. After shutdown, the tank automatically restarts every 15mm for 2 minutes to maintain the same temperature of 3.5°C.

For the second experiment carried out on a 100l volume, the Tank was started at 14h 12mn at 27°C and stopped at 18h 21 at 3.5°C, i.e. a duration of 4h 09mn; it restarts every 15mn for 2mn. In order to improve

this result which was not conclusive, we changed the protocol by pre-cooling the tank before putting the milk to be preserved. That is to say, put water which is cooled down to a temperature of 20-15°c, then empty the water and immediately put the milk to be preserved. The result was conclusive, with a temperature of 3.5°c reached in less than 3 hours of operation as recommended.

Milk conservation technology must be adapted to the degree of aridity of the environment. For the Fanaye-Diéri area, where the daily temperature can reach peaks of 45°C during the summer, it is more desirable to install tanks of reduced capacity (300 liters) and to pre-cool the tank to reach a temperature of 15°C before pouring the milk into it if the volume to be preserved exceeds 100 liters.

3.2 The quality of milk supplied to the LDB from the Tatki platform

The milk supplied to the LDB, stored in two 50-liter cans, meets the plant's standards with normal pH, acidity and density. The results of the analyses performed by the LDB are presented below:

- Canister1 : Weight of 49.2 kg; Alcohol negative; pH of 6.73; Acidity of 18; Density of 1025 and temperature of 21°.
- Canister2 : Weight of 48.9 kg; Alcohol negative; pH of 6.72; Acidity of 19; Density of 1025 and temperature of 21.1°.

Through this experience, we can see that despite the large distances (up to 45km) between the milk production areas and the areas where the dairy plants are located, breeders can supply quality milk to these processors.

3.3 Profitability of the milk collection platform activity

The amount of the platform's investment has been evaluated at 131 660 000 FCFA. This cost includes, as presented in Table 2, the various headings related to the constructions that will house the solar and cooling equipment (200-liter tank), the offices, the installation of the rural electrification network, and the operating and collection equipment.

Most of the investment is related to solar equipment and the installation of the rural electrification network (78%). The buildings to house the platform require a minimum surface area of 200 m² and represent 14% of the investment. Collection and operating equipment and furniture represent only 7% of the investment.

Table 1: Investment costs of the Tatki platform

Designation	**Amount (Fcfa)**
Construction	17 923 000
Solar equipment	76 550 000
Cold equipment	1 205 000
Installation network electrification	15 932 000
Installation materials for households	9 900 000
Collection materials (tricycle, motorcycle, and materials)	3 300 000
Small operating equipment	4 250 000
Studies	2 600 000
Total investments	**131 660 000**

It should be pointed out that the cost of the land where the infrastructure is installed was not taken into account in the investments, because the platform was built as part of a community project, with the support of the local community of Fanaye. Thus, the land was made available free of charge by the town hall as part of its contribution to the implementation of the project.

The commissioning of the platform requires a working capital requirement (WCR) which, in Tatki's current conditions, must cover a period of six months. This period is necessary to ensure continuity of operations (especially the payment of fixed expenses). Indeed, at the beginning of the commissioning of a platform, the volumes of milk collected from the breeders may be low and may not allow the platform to be profitable. Indeed, during these first months, farmers are not yet used to the job of milk producer.

Table 2: Structure of working capital requirements (WCR) (in CFAF)

Loads	**Quantities**	**PU**	**Total price (Fcfa)**
Purchase milk breeders	10800	290	3132000
Collector remuneration	12	50000	600000
Water	6	30000	180000
Electricity	9085	91	824005
Cleaning products	6	5000	30000
Platform staff salaries	6	330000	1980000
Transmission and distribution network	51750	24	1242000
Monthly package contingencies	6	55000	330000
Total WCR			**8318005**

This WCR covers expenses related to :

- The purchase of milk from the breeders (90 l/d) for 4.5 days/week,
- To the remuneration of the collectors (2 times/month) and to the payment of the salaries of the platform staff,
- To the payment of the current charges of water, electricity, and cleaning materials,
- Contingencies and coverage of transport charges on the LDB.

The aggregation of the technical data collected after 18 months of operation of the platform, supplemented by financial and collection volume projections, made it possible to determine the actual and projected operating accounts in year 1 and over the next 3 years. Profitability levels are thus calculated.

The collection was carried out with a price level of 290 FCFA /l from farmers, the resale of milk is carried out at the LDB price, i.e. 385 Fcfa/liter. The platform hired two collectors paid 50,000 FCFA/month and equipped with tricycles. This system made it possible to collect, on average, in the first year 168 l/d, 323 l/d in the second year, 471 l/d in the third year, and 717 l/d in the fourth year, with a very high variability according to the season.

The revenue of the solar platform is made up of revenue from the domestic energy distributed to rural households and from the sale of preserved milk. The village of Tatki has 63 households that have requested and obtained an energy connection. Similarly, the project has proceeded with the public

electrification and the electrification of community buildings (1 mosque, 1 school and 1 health post). Revenues from energy supply are very low and represent 1.6% of the platform's revenues.

Table 3: Platform Forecast Operating and Cash Flow Accounts

Designation	**Year1**	**Year2**	**Year3**	**Year4**
Purchase of milk	11 745 000	22 475 000	32 770 000	49 880 000
Collector and staff salaries	5 160 000	4 080 000	5 160 000	4 200 000
Water	360 000	360 000	360 000	420 000
Electricity	1 648 010	2 096 636	2 491 503	2 940 128
Cleaning input	100 000	120 000	140 000	150 000
Transmission and distribution network	780 000	1 080 000	1 200 000	1 380 000
Technical amortization	8 507 038	8 507 038	8 507 038	8 507 038
Financial expenses	-	-	-	-
Unexpected	660 000	660 000	660 000	700 000
Office automation	60 000	70 000	80 000	80 000
Under total operating expenses	**29 020 049**	**39 448 674**	**51 368 541**	**68 257 167**
Fresh milk	15 280 650	30 938 600	50 558 200	70 932 400
Domestic energy	1 134 000	1 134 000	1 134 000	1 134 000
Sub-total operating revenues	**16 414 650**	**32 072 600**	**51 692 200**	**72 066 400**
Results of Operations	12 605 399	7 376 074	323 659	3 809 233
CAF	4 098 360	1 130 964	8 830 697	12 316 272
Amortization capital invested	-	-	-	-
Cash flow	4 098 360	1 130 964	8 830 697	12 316 272
	4 098 360	2 967 396	5 863 301	18 179 572

Under current operating conditions and in the context of a total subsidy that bears the cost of the investment, the platform's activity is not profitable. The shortfall must be borne by the project over the first two years, which thus bears part of the operating costs. At the end of the project, there is a real risk of the platform ceasing operations if collection does not reach at least 471 l/day, which represents the break-even point. This will require a significant change in the production system, which is marked by seasonality and the abandonment of transhumance by a large number of farmers in the Fanaye Diéri area.

To achieve a minimum profitability of 5%, in order to remunerate the capital invested under a concessional credit, a milk transfer price of 550 Fcfa/l must be applied. This price would put the platform out of the market, as the LDB manages to collect at a price of 385 Fcfa in its current collection radius.

This is why tests of valorisation of the fact have been carried out in order to bring an added value to the platform to ensure its sustainability.

4. DISCUSSIONS

4.1. The added value provided by the milk processing activity

Yoghurt milk processing activities have been undertaken at the platform level, in order to improve the platform's profitability and to have a solvency to support operating costs.

The prerequisites for the launch of these activities were :

- The animation of training modules on hygiene and quality for farmers, collectors and staff of the platform, and training sessions dedicated to the staff for processing: It is thus not only to work with farmers to increase the volumes of milk produced and sold to the platform, but also to limit milk losses related to quality problems and technical control of processing into yogurt.
- The definition and application of quality control levels at each stage of the process, from collection to processing, including the equipment of collectors and the technical manager of the platform with milk test kits to ensure good quality milk or yogurt produced.
- And the obtaining of the FRA approval before the release of the product on the market; this approval is a release attesting the conformity of the product to the sanitary, microbiological and organoleptic standards of consumer goods on the Senegalese market. This authorization is the responsibility of the Ministry of Trade and more specifically the Directorate of Internal Trade through the Division of Consumption and Consumer Safety (Ministry of Livestock, 2005). It will facilitate the marketing of the platform's products.

Processing requires an additional level of investment, such as the acquisition of freezers (2) essential for preservation, and means of transport (refrigerated vehicle in the cruise year) essential for the preservation of finished products. The global investment for the installation of a platform is on average 156 million Fcfa. The WCR must be strengthened for a period of 6 months taking into account the cost of packaging, inputs or lactic ferments and the transport of the finished product from Tatki to Dakar, the main target market. This WCR is 13.4 million Fcfa.

The major constraints for this processing activity can be summarized as follows:

- The collection of milk from farmers: despite general assemblies at village level and training sessions, farmers have been slow to adhere to the organizational scheme proposed by the platform. The volumes collected did not exceed 100 liters/day for the first 6 months, despite the application of a rather high price of 290 Fcfa/liter and the guarantee of payment at the end of the month at the platform. It is this long delay that justifies the duration of at least 6 months of the WCR for a recovery platform in rural areas. The expenses related to collection and the remuneration of collectors represent 52% of the platform's operating expenses.
- Transport of finished products to market: the isolation of the production zone has made it difficult to transport the dairy product to urban centers (Dia, 2009). The distribution of the product (yogurt) was carried out in the city of Dakar, 400 km away, where there is a wider demand for 100% local and more solvent yogurt. Indeed, consumers can buy the 1 kg pot of yogurt at 1200 Fcfa (Gret, Enda Garf Sahel, 2006). This price is in line with the market price. The level of activity had not yet necessitated the investment in refrigerated trucks, so the product was transported using ten or so coolers with a capacity of 100 l each. Thus, a special organization was

set up using tricycles to take the finished products out of the production area (Tatki) to Dagana (the nearest town). And from this city to Dakar, the products are transported by public transport buses at a cost of 3000 Fcfa/glaciere. The return of empty coolers from Dakar to Dagana is done by means of public transport buses at a cost of 1000 Fcfa/cooler. The area where a development platform is to be set up must take into account the landlocked nature of the area in order to avoid an overly complicated and costly transport organization.

- The cost of packaging: The costs of packaging in Senegalese dairies can be heavy and can compete with local dairy products (Ferrari S, 2017). At the platform level, in order to market the yogurt, the product must be labeled and presented in plastic jars made in factories located mainly in Dakar. These jars with the product label cost 177 FCFA per jar when the order exceeds 5000 jars at the factory and between 225 and 250 FCFA per unit if purchased at the market level. When buying at market level, the cost of buying labels must also be taken into account, as it is not possible to market food products in anonymous packaging. On average, a label can cost 120 francs per unit. The platform has adopted a factory sourcing strategy to achieve economies of scale. Packaging accounted for 26% of operating expenses.

4.2. The cost of yogurt production

The revenues of a dairy platform are mainly made up of the sale of dairy products such as yoghurt in Tatki (98%), but also the monthly payment of electricity bills provided by the solar network.

The selling price of milk applied by the platform is 950 francs per liter for the distributors. This price, from year 3 of operation, covers the production cost of one liter of yogurt, which is valued at 873 FCFA. Indeed, production costs vary between year 1 and 4, from 1323 FCFA to 774 FCFA, for respectively total volumes processed per year of 48,600 liters and 280,800 liters and operating costs of 64,319,332 FCFA and 217,317,447 FCFA.

This price of yogurt (100% local) was determined to allow distributors to align themselves with market prices which is 1200 FCFA per 1 liter pot. Under these conditions, the distributor achieves a gross margin of 250 FCFA per pot and Tatki's platform obtains a margin of 237 FCFA per pot in a cruising year. The distribution of the margins on this new yoghurt sector, per liter of product, is as follows:

- Breeder's margin: 145 FCFA
- Platform margin: 176 FCFA
- Margin of the yogurt distributor : 250 FCFA

Preliminary surveys of farmers before the platform started its activities made it possible to determine the production cost of a liter of milk at 145 Fcfa, while the platform applies a collection price of 290 Fcfa/l.

4.3. Profitability indicators of the milk to yogurt processing platform

In order for this model to be replicated by private individuals, we studied the profitability of the activity with financing at a subsidized rate of 7.5% per year and a deferred repayment of the invested capital of 2 years for a total duration of 7 years. Under these production conditions, with 5 workdays/week, control of the transformation process (2% loss rate) and prices applied to collection and distribution, the profitability of the platform for the transformation of local milk into yogurt is 18%, for a period of 15 years. The wealth

generated (10% NPV) amounts to 227,269,450 FCFA and the time to recover the capital invested is 3.90 years.

To support the local milk sector and improve the income of farmers, it is important that the State encourages the installation of solar milk processing platforms in the production basins. The example of Tatki defines the conditions of technical feasibility and the levels of performance and financial profitability expected. The definition of a good policy in this field should allow private promoters to invest in it. The contours of this policy would take into account the need to put in place three conditions, namely :

- An interest rate subsidy mechanism of up to 7.5% per year, as is the case in Senegal for the financing of major crops such as groundnuts, cotton, rice and industrial tomatoes;
- A line of credit for medium-term investment financing repayable over 7 years and short-term working capital and inventory requirements over 24 months.

A support strategy to sustain the cost of packaging, which weighs quite heavily in operating expenses.

4.4. Modeling the financial profitability of a milk processing platform

The technical results obtained at Tatki and the observation of the various indicators that influence the platform's profitability allowed sensitivity tests to be carried out. They can be summed up by varying the 4 main performance indicators of a transformation platform that we call the 4Ps:

- Labour productivity materialized by the number of working days,
- The processing performance or quality illustrated by the loss rate,
- The collection price of milk from farmers,

And the price or cost of packaging.

Profitability levels, according to the project financial analysis approach, were thus calculated based on the observed variations in these indicators, as shown in Table 4.

Table 4: Determination of IRR based on project financial analysis with variation in parameters (specify parameters)

IRR (in %)	Breeder price	Packing price	Number of working days	Loss rate (in %)
18	290	177	6	10
21	290	177	5,5	5
18	300	195	5,5	5
5	300	195	5,5	15
11	325	195	6	10
5	325	195	5	10
10	290	195	5	10
15	290	204	6	10
8	290	212	5	10
8	290	251	6	10
4	290	177	6	20
9	290	177	4,5	10

The analysis showed that the correlation coefficients are all close to 1 (see Table 5, with a low standard deviation of 0.4%, showing a close relationship between these parameters and profitability.

Table 5: Presentation of the results of the multiple regression between the different profitability parameters

	Coefficients	**Standard Error**	**Statistical T**	***Probability***	**Limit (SC=95%)**	**Upper Limit (SC=95%)**	**Lower Limit for Confidence Threshold = 95.0%**	**Upper Limit for Confidence Threshold = 95.0**
Constant	5,70E-01	3,68E-02	1,55E+01	1,14E-06	4,83E-01	6,57E-01	4,83E-01	6,57E-01
Breeder price	-1,31E-03	1,06E-04	-1,24E+01	5,09E-06	-1,56E-03	-1,06E-03	-1,56E-03	-1,06E-03
Packaging price	-1,25E-03	7,00E-05	-1,79E+01	4,26E-07	-1,42E-03	-1,09E-03	-1,42E-03	-1,09E-03
Number of work days	5,72E-02	2,85E-03	2,00E+01	1,92E-07	5,05E-02	6,40E-02	5,05E-02	6,40E-02
loss rate	-1,33E+00	3,71E-02	-3,59E+01	3,38E-09	-1,42E+00	-1,24E+00	-1,42E+00	-1,24E+00

Under these conditions, where several factors interact with profitability, the analysis allows to model the profitability of the activity of milk to yogurt processing for a solar platform installed in a landlocked rural area with an extensive production system as in the case of the villages of Fanaye Diéri. The financial model is presented as follows; it comes from the results obtained by statistical analysis from multiple regression simulations.

IRR = (-1.31304E-03*Collection price) +(-1.25072E-03*Packaging price) + (5.72037E-02*Productivity) + (5.72037E-02*Productivity) + (-1.3319E+00 *Performance transformation) + 0.5696797

This financial model was tested and the levels of profitability obtained, by varying the four parameters of which it is composed, coincide exactly with the IRR results of the financial analysis presented in Table 4.

5. CONCLUSION

The characteristics noted in our study area (13 villages of Fanaye Diéri), reflect the reality of the dairy basins of Senegal. The sites are landlocked, marked by a significant deficit in infrastructure. Very few roads and tracks connect these production centers to urban markets where there is a solvent demand for dairy products. In periods of milk overproduction, such as during the rainy season, herders are sometimes forced

to waste fresh milk because they have no conservation infrastructure and cannot take their products to these markets. The difficulties in the milk sector are quite profound.

The study made it possible to define the technical conditions for the installation of solar platforms in landlocked areas, in order to provide solutions to the problem of dairy product conservation. To enable these investments to be sustainable, these platforms must operate activities to enhance the value of milk such as processing into 100% local yogurt. Profitability criteria and conditions are defined with the control of four key performance indicators, referred to here as the 4Ps. The private sector will be able to invest in the sector with institutional support for interest rate subsidies and the necessary support to reduce the cost of packaging. The approach has been tested in the village of Tatki and could be replicated in large, landlocked dairy centers. The proposed financial profitability model is a decision-making tool for investors, enabling them to measure the performance of this activity each time and to make adjustments. In addition to the dairy storage and processing aspect, such a platform provides other benefits, such as public lighting and access to domestic energy for the populations of the villages concerned. In Senegal, the rural electrification rate remains too low. It rose from 8% in 2000 to 33.7% in 2016 (ASER, 2017).

Taking into account the energy dimension in the definition of agricultural and pastoral policies in Senegal should facilitate these transformations for an increase in income and improved living conditions for 350,000 families living from livestock activities (Ministry of Agriculture and Rural Equipment, 2015).

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BioQuest: Gamified software for teaching molecular biology

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Abstract

Science teaching in basic education aims to provide content for individuals who can handle with new information and are able to understand, question and position themselves before ethical debates related to biotechnology and molecular biology. However, the information flow generated in the molecular biology field is not accompanied by the dissemination of scientific information into the school environment, nor is it incorporated into the teaching knowledge on a continuous basis. In addition, the teaching of molecular biology and its related concepts, which involves great abstraction capacity on the part of students, requires the elaboration and use of specific didactic resources. Thus, this work aims to present the gamified software BioQuest and its usability and interface evaluation made by 131 Brazilian high school students from the São Paulo State public school system in São Carlos region. The data show that there is no significant difference in the game evaluation made by students with previous experience with games and those without the habit of playing, except when it comes to understanding the commands proposed by the game. This implies that students with previous experience in games have greater ease in using this teaching resource. Regarding the impact on their learning, the data show that students who interacted with the game performed better on conceptual issues related to Molecular Biology when compared to students who did not. Specifically, the questions related to game phases that contained gamification elements of the narrative and extrinsic motivation types, correlated with better grades obtained by the students. The practical experience of BioQuest proposed for high school students allowed to observe a significant improvement in the quality of teaching that can contribute to became a reference in this area.

Keywords: teaching; molecular biology; gamified software.

1. Introduction

The understandings of concepts related to molecular biology and biotechnology are presented to the students in the last years of elementary school when they have the first contact with terms such as cell, DNA, proteins and biotechnological use of microorganisms. This is important to relate and understand more complex concepts and processes, in addition to enabling analysis and decision making on issues involving science, technology and society. Therefore, it is fundamental the mastery of these concepts by teachers and students for a meaningful learning.

It is observed in literature, publications that highlight challenges in teaching molecular biology.

Cirne (2013) showed that few studies address the learning difficulties of biology content studied in elementary school, especially basic notions of genetics and cell biology. Also, in a research conducted with 8th grade students of a public school in the state of Rio Grande do Norte (Brazil), it was detected their difficulty about concepts of gene, DNA and chromosome.

Kazitoris and Neto (2015) point out, in a study that investigated alternative conceptions (of the evaluated subjects) in biology, documented in dissertations and theses from 1972 to 2012, that the themes of heredity, sexual reproduction, transgenics and DNA were widely explored in the considered works. The previous conceptions show the difficulty in learning scientific definitions such as: Mendel's Law, chromosomal theory, mitosis, meiosis and the location of genetic material. Furthermore, they do not understand cell as a morphophysiological unit, they cansuppose that the genetic material is restricted to mammals and is present only in blood. They do not conceive the existence of other types of cells, neither perceive the DNA as part of all cells, and the relation between DNA and transgenics or DNA and phenotypic characteristics.

In a work that discuss the teaching resources adopted by biology and science teachers in public schools, Moura and collaborators (2013) state that the use of the text book as a unique teaching tool, with abstract and superficial contents, it is also a relevant problem that increases the gap between reality and the knowledge obtained in school. Thus, being or not a unique teaching instrument, it is necessary to evaluate how the New Biology is inserted in high school textbooks.

Xavier, Freire and Moraes (2006) analyzed, in 18 text books, the presence of themes associated to the New Biology: transgenics, Genome Project, mammalian cloning, stem cells, paternity testing, genetic variability, recombinant DNA, hybridization, sequencing, restriction enzymes, plasmids, introns and exons, electrophoresis and PCR technique. From this analysis, the following points are highlighted:

i. Themes such as sequencing and electrophoresis are mentioned in some of the works analyzed, without containing any explanation, sequencing being the most impaired, quoted only once;

ii. The results of this research indicate that the updates in the textbooks are the same made in 1997 by Amaral and Megid-Neto (1997) apud Xavier et al. (2006);

iii. Regarding the illustrations on the researched topics, it is important to point out that some topics that were mentioned have no illustrations whatsoever.

The above authors ratify that the Modern Biology approach presented in textbooks does not contribute to the student becoming a critical citizen.

At the national level these and other works in the area (Cirne, 2013; Fontes, Chapani & Souza, 2013; Tauceda & Pino, 2010; Justina & Ripel, 2003) indicate that the teaching of Molecular Biology and its

underlying concepts encounter many obstacles. Such concepts should be studied in depth in the field of research in teaching molecular biology and related areas such as biochemistry and genetics.

Globally, research has shown that the use of experimentation (Ben-Nun & Yarden, 2009) and diversified resources such as games can improve the quality of learning subjects that require abstraction of concepts as well as making teaching more motivating. (Severo & Kasseboehmer, 2017; Spiegel et al. 2008; Cardoso et al., 2008).

According to Mascarenhas et al. (2016) the exploration of the playful aspect of different practical activities is shown to be an effective tool, as it promotes a significant improvement in the quality of teaching and learning and gives the opportunity for students to actively participate in classes, asking questions and solving proposed problems.

The use of information and communication technologies, such as applications, animations, videos, educational games and / or gamified software (Marbach-Ad, Rotbain & Stavy, 2008; Cheng, Lin, & She, 2015). Games and applications (among others) can support learning, enabling the development of knowledge in a fun and interactive way, increasing the motivation of students (Carvalho & Guimarães, 2016).

Although Kim, Park and Baek (2009) state that games can improve the ability of students to solve social problems, it must be considered that acceptance by students is not always guaranteed. In the meantime, it is necessary to observe their experience and their immersion and how they access and use the game, as pointed out by Bourgonjon and collaborators (2010).

Regarding computer games aimed at teaching Molecular Biology and related subjects, the literature presents the games Hangman (Pennington, Sears & Clegg, 2014), Imunne Attack (Stegman, 2014) and MolWorlds (Gauthier & Jenkinson, 2017).

Hangman is a puzzle that allows the student to practice the design of the structures of amino acids and to relate them to their representation of 1 letter and it is aimed at college students. (Pennington, Sears & Clegg, 2014).

Immune Attack (Stegman, 2014) is a third-person game in which the player must activate specific proteins to trigger specific behaviors of various white blood cells. The players travel throughout the veins as micro-robots and nano-robots passing through the connective tissue and reaching the surface of the white blood cells where they receive different instructions to activate certain proteins and they have to solve failures in the patient immune system.

According to the author, there is no explanation of what a protein is, however the students who used the mentioned game were able to obtain a higher score in a questionnaire containing Molecular Biology questions compared to those who did not play it. This reference shows that there are still many possibilities to be explored in the scope of serious games for the teaching of molecular biology, focused on basic education.

MolWorlds: third-person game that allows the students to experience cellular processes such as (translation of RNA among other processes) where they can manipulate variables such as temperature and molecular concentration for example. (Gauthier & Jenkinson, 2017).

Considering all the previously mentioned, this work aims to analyze the learning of concepts related to Molecular Biology using a gamified software / educational game called BioQuest as a tool, investigating

whether the game influences the learning of these concepts, when compared to the traditional approach used in basic education schools. Also, if a prior experience in games can influence the use of students and a better performance of this tool.

2. Development

Author and teaching team opened firstly a continuous training course in self-learning platform applied for teachers from the state school system, in São Carlos-SP, during the month of August in 2017, with the participation of 14 teachers. During this training course, it was possible, through a questionnaire and interaction with participants, to get to know the profile of the science and biology teachers from basic education and to gather data such as: training, professional profile and pedagogical practices for teaching concepts of molecular biology.

These data supported the creation of the gamified software Bioquest, using the games development platform GameMaker. The game development can be divided into two major stages:

1) Conception and Game Design stage in which it is decided which elements of gamification and mechanics will be inserted in the games, as well as the contents / skills and objectives of the game.

2) Coding and prototyping: step in which coding is done into the chosen computer language, in which the arts, sound effects and prototypes are generated for testing. This second stage was carried out in collaboration with an artist and independent game developer Gabriel Lima.

The purpose of the software is to make students understand the strategies involved in Molecular Cloning and to understand the processes in the production of a recombinant protein. In the software, we chose the model of human insulin, however, at the end of the exploration, it is expected that the student will be able to extrapolate that model, applying it to the production of other recombinant proteins.

When accessing the software, after the opening screen is displayed, as shown in figure 1A, a path to be taken by the student marked by nine phases / stations is shown on the screen through which can be navigated freely without blocking or requiring the student to reach a minimum score by pressing the buttons 1 to 9 as shown in figure 1B. This allows the exploration of the tool to take place in more than one class, considering that currently the classes are 45 minutes long and that students have two biology classes per week. Blocking the phases could make their use unviable.

In order to validate such material, classroom interventions were carried out, a total of 131 evaluations made by students on the interface, interactivity, mechanics and relevant aspects of the game, as well as the impact of using the software on the responses to a conceptual questionnaire, answered by 26 students.

2.1 The software

The software is mean of promoting teaching. It takes advantage of information technology to generate learning platform to support teachers teaching.

The narrative begins by proposing to the player the mission of knowing and assisting in the insulin production process. The home screen of the software allows them to navigate freely through its phases without blocking or needing to reach a minimum score to pass the level. It is recommended that browsing through BioQuest is not done in a single class.

Although navigation is free, it is recommended that driving and progressing in the software start with the exploration of phase 1 and finish in phase 9. This order will lead the student to the most known and used molecular biology techniques for the creation of a recombinant bacterium, capable of synthesizing the human protein, insulin.

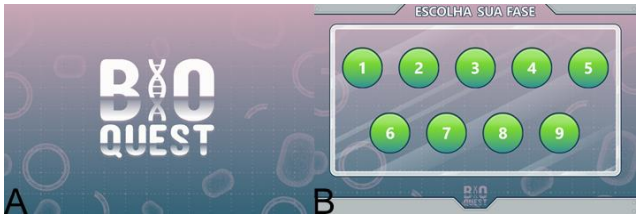

Figure 1. (A) Software opening screen; (B) Navigation screen

Game Phases

- Phase1: introduces to the user the Molecular Biology technique known as Polymerase Chain Reaction (PCR).
- Phase 2: the DNA sample amplified by the PCR was not labeled correctly and it was swapped with others stored in the same freezer. The user can interact with the software by recognizing enzyme restriction sites EcoRI in these DNA samples and cleaving them.
- Phase 3: the samples are submitted to an agarose gel electrophoresis technique and by doing so it is possible to determine through comparison which sample contains the amplified fragment of insulin.
- Phase 4: the player assumes the role of the restriction enzyme in order to cleave the plasmids.
- Phase 5: amplified fragments of insulin will be inserted in the plasmids cleaved in the previous phase.
- Phase 6: transformation of bacterial cells with the recombinant plasmids created in the previous steps.
- Phase 7: selection of which bacteria have actually been transformed.
- Phase 8: possibility to track the expression of the insulin protein in the bacterial cell.
- Phase 9: the player can test his knowledge in a challenging quiz.

3. Intervention and data collection

The invitation for the teachers voluntary participation in this research was made through a partnership with the Board of Education in São Carlos, a public agency with the function to administratively and pedagogically manage public schools in a given region, submitting themselves to the Secretary of Education of the São Paulo State.

The invitation was made through electronic contact with the 32 School Units under the management of this board, containing the main research information, alongside the Informed Consent Form. It was disclosed by the coordinating teachers during the collective pedagogical work class, a weekly meeting concerning the teaching workload, whose primary goal is the teachers continuing education provided by the school, Board of Education or the Secretary of Education of the São Paulo State. 6 out of 52 teachers with assigned Biology classes across the state education network of DER- São Carlos expressed interest in participating in the research, 4 from school unit 1, 1 from school unit 2 and 1 from school unit 3.

Then, a training meeting was held with interested teachers, in their school units, to instruct about the

information contained in the software and how to use it. The requirement for the intervention to take place in the classroom was that the teacher had already worked on the concepts related to Molecular Biology in the classroom. According to the Official Curriculum of the State of São Paulo (2012), such content can be found in the third and fourth bimester of the 2nd grade of high school. All interventions were carried out throughout November 2019.

Each teacher used the BioQuest software for two 50-minutes classes, in the computer room of their respective school units (Figure 2). They received explanations referring to the conceptual classes of each subject in the classroom and then asked each student to complete a printed assessment of the software.

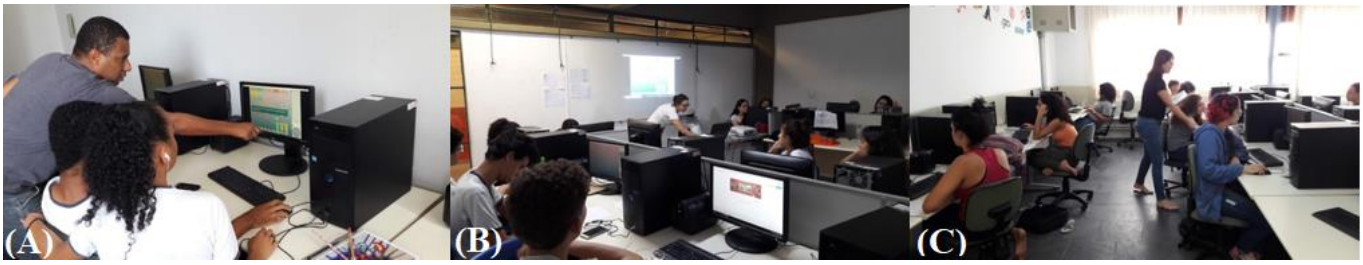

Figure 2. Use of the BioQuest Software at school 1 (A), 2 (B) and 3 (C) during the month of November in 2019.

The evaluation of the software was carried out through a post-test questionnaire that used the semantic differential (Jappur, 2014), as shown in Table 1, to gather information about the design of the software, controls, screens, mechanics, usability and questions related to its interaction with classmates, teacher and the BioQuest tool during class. The public had contact with content related to Molecular Biology.

Table 1. Questions used to assess the perception of students using the game.

Statements related to the opinion of students after using the BioQuest software.		Selection of a value between -3 and 3 that best represents the opinion of students regarding the statements.
S1	The *design* of the game is attractive (screens or objects, movement of objects, etc.).	Ugly -3 -2 -1 0 +1 +2 + 3 Attractive
S2	The design helped me to keep an eye on the game.	Irritating -3 -2 -1 0 +1 +2 + 3 Nice
S3	The game content is relevant to my learning.	Irrelevant -3 -2 -1 0 +1 +2 + 3 Relevant
S4	It was easier to understand the game.	Difficult -3 -2 -1 0 +1 +2 + 3 Easy
S5	I'm happy because I'm going to use things I learned from the game at my residence.	Dissatisfied -3 -2 -1 0 +1 +2 + 3 Satisfied
S6	I didn't notice the time passing while playing, when I saw it, the game was over.	Uninteresting -3 -2 -1 0 +1 +2 + 3 Interesting
S7	I was able to interact with other people during the game.	Off -3 -2 -1 0 +1 +2 + 3 Interact
S8	This game is challenging for me, the tasks are difficult and make me think	Weak -3 -2 -1 0 +1 +2 + 3 Challenger

S9	I had fun with the game.	Boring -3 -2 -1 0 +1 +2 + 3 Fun
S10	I managed to get to the end of the game (results).	I failed it -3 -2 -1 0 +1 +2 + 3 I got it
S11	How do you evaluate your performance obtained in the game.	Terrible -3 -2 -1 0 +1 +2 + 3 Great
S12	The controls for performing actions in the game responded well	Uncontrollable -3 -2 -1 0 +1 +2 + 3 Controllable
S13	It is easy to learn to use the interface (screens) and controls of the game.	Complicated -3 -2 -1 0 +1 +2 + 3 Simple

To analyze the impact of the game on the learning of students, a questionnaire was applied containing ten conceptual questions for both students who used the BioQuest software and for students who had not interacted with the game. (See questions used to assess the impact of the game on learning concepts related to Molecular Biology in Appendix 1).

4. Results and Discussion

Nine interventions were carried out with students of the 2nd grade of high school, in three state schools of São Carlos area, State of São Paulo, a total of 131 evaluated subjects, aged between 16 to 18 years.

The responses to the questionnaires were classified into two groups: group 1 - composed of 32 students (24.4%) who have no experience / consume games, and group 2: composed of 99 students (75.6%) who reported having experience / consume games.

On average, the students consume games 5 times a week, spending 3 hours and 20 minutes a day.

The graphs shown in the following image were obtained from the responses of students (Figure 3).

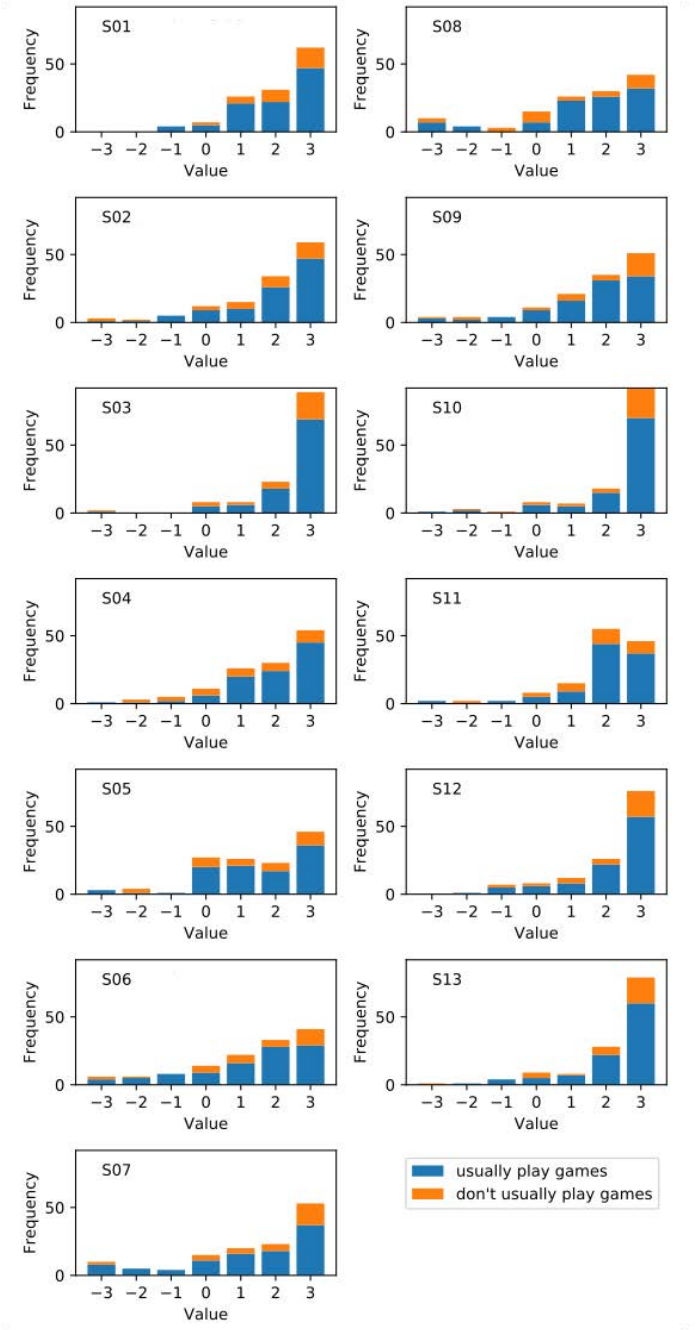

Figure 3. Frequency graphs of the value attributed to each statement evaluated in Table 1.

As it can be observed, these data do not have a normal distribution, thus, the non-parametric test corresponding to the independent T Test, the Mann-Whitney U Test was applied using the IBM SPSS Software to analyze whether the previous experience with games influenced in some aspects of the evaluation of students in relation to its usability, controls, screens, interaction with colleagues and adequacy of mechanics.

The Mann-Whitney U test showed that the fact that the student has a habit of playing / consuming games has an effect on the evaluation of the statement "S04: It was easier to understand the game" ($U = 1149.5$; $p < 0.05$), however, it has no effect on the other statements, as they presented p value> 0.05, as shown in figure 3. The habit of playing should be considered as a point of attention in research involving the use of

serious games for teaching, since it has a significant impact on what the player is able to develop in the game (Gauthier & Jenkinson, 2017). In addition to what directly interferes with student learning, it influences how the teacher will propose the use of this resource in the classroom, and its presence and guidance are indispensable for learning.

Table 2. Test statistics obtained for the Mann-Whitney U Test for statements S1 to S13 considering the independent groups of students who consume games or not.

Statements	Mann-Whitney U	p value
S1	1515	0.692
S2	1399	0.293
S3	1445	366
S4	1149.5	0.015
S5	1484.5	0.581
S6	1496	0.628
S7	1320	0.141
S8	1348	0.193
S9	1360	0.21
S10	1534	0.74
S11	1309	0.116
S12	1583.5	0.998
S13	1550.5	0.838

This result indicates how important is the presence of the teacher on explaining how to use the game correctly and the need of their presence on using this new technology on classrooms. For Meier and Garcia (2007) for the development of learning it is necessary to have an effective mediator to facilitate this interaction between the subject and the stimuli, in this context the student and the software.

The statements that received the best evaluation refer to the student being able to explore the game in its entirety, the relevance of the subject for learning, ease of manipulation and navigation in the game, which obtained, respectively, 70% and 60%.

The worst evaluations were given by 7% of the students who attributed the worst score to the interaction and challenging aspects of the game, and 6% to the perception of the passage of time. Although it was developed to be used a computer per player, the real application situation in the classroom, with a small number of computers available in the school, the software was exploited by trios of students using just one device.

The relationship with the perception of the passage of time while using the game can be related to the motivation for its use. Such data were taken in a classroom intervention situation, in which the teacher freely chose to use the game with students, which for Barendregt and Bekkerb (2010) may indicate a decrease in motivation to interact with the game, once which was the choice of the teacher and not the students.

To analyze the impact of the game on the learning of concepts related to Molecular Biology by students, the questionnaire presented in Appendix 1 was applied to 26 students.
Each question was assigned a value of 1 point, based on the average of correct answers to the questions, the following results were obtained (Figure 4).

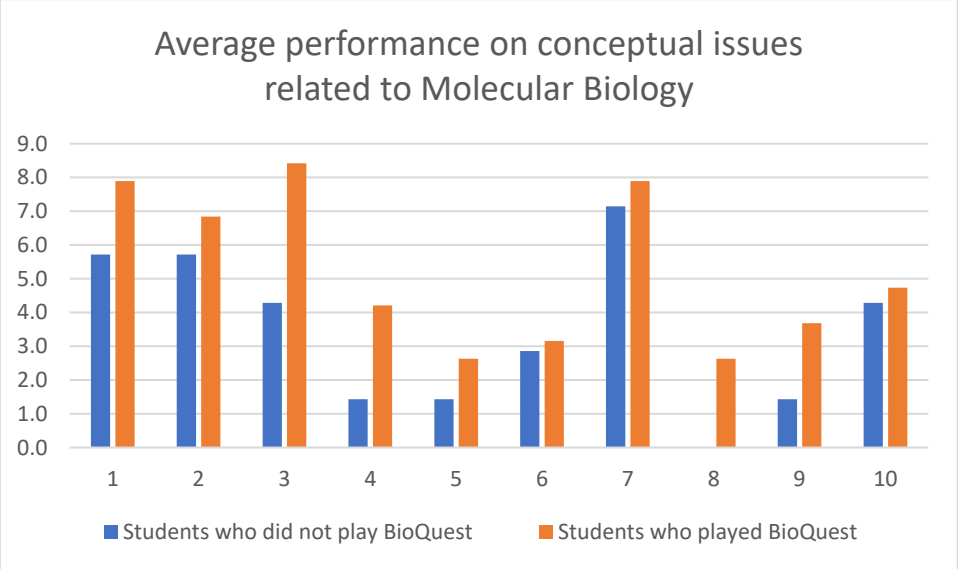

Figure 4. Average performance on conceptual issues related to Molecular Biology, both from students who used the BioQuest Software and students who did not use it.

It is noted that the performance of students who used BioQuest was higher in all questions presented.
From the answers obtained with the conceptual questionnaire, we divided the sample into two groups: group 1- composed of 19 students who had interacted with the BioQuest tool, and group 2 - composed of 7 students who did not interact, both groups had classes on topics related to Molecular Biology with the professors involved in the research. It should be noted that these students were not intentionally chosen, students who used BioQuest in the classroom and students who were absent at the time of applying BioQuest were invited to answer the conceptual questionnaire.

Table 3. Test statistics obtained for the Mann-Whitney U Test for questions 1 to 10 considering the independent groups of students who used the BioQuest Software or did not use it.

Questions	Mann-Whitney U	p value
1	52.00	0.276
2	59.00	0.599
3	31.00	0.039
4	48.00	0.195
5	58.50	0.527
6	64.50	0,885
7	61.50	0.692

8	49.00	0.139
9	51.50	0.278
10	63.50	0.841

The Mann-Whitney U statistical test showed that the use of the BioQuest software has an effect on the score obtained in question 3, ($U = 31.5$; $p < 0.05$), but did not show an effect on the scores obtained in the other questions. It is noteworthy that question 3 is related to the contents treated explicitly in phases 2 and 4.

In these two phases, gamification elements are present that promote student motivation, such as, in phase 2, use of narrative, when it is presented to the player that the DNA sample amplified by the PCR was not labeled correctly and it was swapped with others stored in the same freezer. In phase 4, the player assumes the role of the restriction enzyme to be able to cleave the plasmids which, later, amplified insulin genes will be inserted, there is a marked presence of elements of extrinsic motivation such as time markers, means not obvious, but discovered to perform tasks (manipulating the enzyme to cleave plasmids), punctuation and graphic feedback indicators (Robinson and Bellotti, 2013). Some works indicate that the presence of specific mechanics has the potential to increase the performance of a student, his willingness to participate in meaningful and intellectual games, thus improving his understanding of content and concepts (Domínguez et al, 2013; Busarello, 2016; Gauthier & Jenkinson, 2017).

5. Conclusions

In this paper we present the evaluation of the use of the BioQuest software by 131 students of the 2nd grade of High School. This is a new form of teaching developed based on interactivity.. Our results show that students are able to perceive the importance that the content covered by the game has for their learning in addition to underline that its usability and navigability is quite pleasant and easy. Regarding the impact on their learning, the data show that students performed better in questions involving concepts worked in phases of the game with more evident gamification elements such as narrative, and elements of extrinsic motivation such as time markers, means not obvious, but discovered to perform tasks (manipulate the enzyme to cleave plasmids), punctuation and graphic feedback indicators had a positive impact on learning.

6. Acknowledgement

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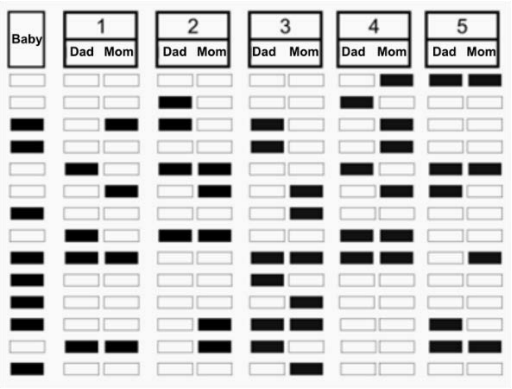
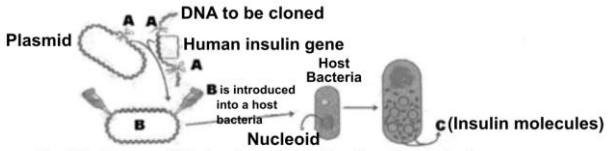
Appendix

Appendix 1.

Table 1. Questions used to assess the impact of the game on learning concepts related to Molecular Biology.

Number	Question
1	One of the techniques used in molecular biology for the manipulation of DNA is the polymerase chain reaction (PCR). The purpose of this technique is: a) Cut long strings of DNA into smaller fragments. b) Create multiple copies of a specific stretch of DNA. c) Separate fragments of different sizes due to their migration in a porous gel matrix. d) Link DNA fragments together. e) I have not studied this subject.
2	The technique known as gel electrophoresis: a) It separates DNA fragments of different sizes due to their ease in traversing a porous gel matrix, when subjected to an electric current. b) It separates fragments of DNA of different sizes because it uses enzymes that are in the porous gel matrix. c) It links DNA fragments together. d) Creates multiple fragments of DNA due to the action of the electric current on an extensive DNA strand. e) I have not studied this subject.

3	Restriction enzymes occur naturally in prokaryotic organisms, and have the role of protecting the cell against invading viruses. Its use in Molecular Biology is due to its function of: a) Link DNA fragments together. b) Create multiple copies of a specific stretch of DNA. c) Recognize and break the links between some of the nucleotides of specific DNA sequences, called restriction sites. d) Copy the nucleotide sequence from a DNA strand. e) I have not studied this subject.
4	The genetic manipulation of a plasmid, in order to synthesize a protein which the organism originally does not produce, involves: a) The cleavage of the circular DNA molecule, the insertion of the gene of interest and the link between the gene and the plasmid. b) The cleavage of the circular DNA molecule, the insertion of the gene of interest, the link between the gene and the plasmid and the bacterial transformation with the recombinant plasmid. c) The cleavage of the circular DNA molecule, the insertion of the gene of interest and the link between the gene and the plasmid and the application of specific antibiotics. d) The cleavage of the bacterial chromosomal DNA molecule, the insertion of the gene of interest, the link between the gene and the chromosomal DNA. e) I have not studied this subject.
5	During the bacterial transformation process, we give the cell a temperature shock and treat it with calcium chloride because: a) We want to create pores in the cell membrane making it easier for DNA to enter the cell. b) We want to close the pores of the membrane and cell wall preventing the DNA from leaving the cell. c) We want to open the pores of the membrane and cell wall making it easier for the DNA to leave the cell. d) This step favors the multiplication of the bacterial cell. e) I have not studied this subject.
6	One of the steps in molecular cloning is to use antibiotics on cells that have gone through the process, such as the kanamycin antibiotic, which serves to: a) Eliminate the bacteria that could contaminate the experiment. b) Eliminate the bacteria that contained the recombinant plasmid, since it contained a gene capable of disabling the action of kanamycin. c) Eliminate bacteria that did not contain the recombinant plasmid, since it contained a gene capable of disabling the action of kanamycin. d) Eliminate the bacteria that contained the recombinant plasmid, since it

	contained a gene capable of increasing the action of kanamycin. e) I have not studied this subject.
7	An exchange of babies had been detected in a certain hospital, such confusion involved five couples who claimed to be the parents of a baby. Thus, confirmation of paternity was requested by DNA examination. The test result is outlined in the figure below. Each person has a pattern of DNA bands (bands, one for the supposed dad and one for the supposed mom) compared to the baby's. Analyze the image below and answer, which of the couples can be considered as the baby's biological parents?  a) 1 b) 2 c) 3 d) 4 e) 5 f) I have not studied this subject.
8	The figure below illustrates the main steps used in the molecular cloning technique used to produce human insulin in bacterial cells: a segment of human DNA containing the code for insulin synthesis, is linked to a plasmid and is introduced into a bacterium a from which clones capable of producing the hormone in question are obtained.  Modified from: J.M. Amabis; G.R. Martho. Biologia das Populações. vol.3. São Paulo: Moderna, 2004. p. 168-69 Analyzing the figure according to your knowledge of the techniques of molecular cloning, identify with T the true statement (s) and with F, the false (s): () The letter A indicates the restriction enzyme representation. () The letter B represents a recombinant plasmid. () The letter C indicates the human insulin molecules synthesized from information given by the human gene induced to function in the bacterium. () The letter B represents the structure that, after being introduced into the host bacteria, prevents the nucleus from functioning.

	The correct sequence is: a) TTTF b) TTFT c) TFTF d) FTTF e) FFFT f) I haven't studied this subject
9	On June 21st, 2000, the sequencing of the human genome was announced, this announcement represents that scientists have determined: a) the nucleotide sequence of human chromosomes. b) all types of proteins encoded by human genes. c) the amino acid sequence of human DNA. d) the amino acid sequence of all human proteins. e) the correct number of chromosomes of the human species. f) I have not studied this subject.
10	What is Genetic Engineering? a) Set of procedures used in the manipulation of DNA. b) Process by which genes make proteins. c) Biology branch that studies human genes. d) Specialized branch in the production of scientific equipment. e) I have not studied this subject.

Answer Key: 1B, 2A, 3C, 4B, 5A, 6C, 7C, 8A, 9A and 10A.

Organizational Structure and Its Influence on Decision-Making: A Bibliometric Analysis

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Abstract

This research aimed, through a bibliometric analysis, to generate a Bibliographic Portfolio of articles submitted for aligning organizational matters and taking public administration. National and international literature was used in order to contribute and facilitate the investigation of future research on the related theme. For the analysis, the Proknow-C methodology was used, with a publication time limit of 20 years, from 1999 to 2019, using Scopus, Web of Science and Spell as databases. A research resulted in the construction of a portfolio containing 4 research articles that shown alignment with the topic. Two articles aimed to build models to optimize management decision making in the complex environment of applicable technologies and resources, while the other articles analyze the decision making process, one article related to structured ethical decision and the other to public participation in decision making in four different countries. The content of the Bibliographic Portfolio allows a direction for future research, allowing the development of theoretical bases on the articles that stood out in the research.

Keywords: Organizational structure; Decision; Decision-making process; Bibliometric; Proknow-C.

1. Introduction

The need for organizational transformation due to the great instability of the world, such as the pandemic caused by COVID 19, means that countries are in constant adaptation. Organizations in this environment have become unstable, face daily challenges and each direction to be followed need constant decisions and

restructuration to meet the different scenarios to which they are subject. However, the organizations must be able to measure their capacities in the face of future decisions, seeking to circumvent the barriers and seize the opportunities shown at their doors.

These rapid transformations of the scenarios in which they are inserted make them take immediate and consistent decisions (Nunes, Ribeiro & Oliveira, 2019). Guimarães and Évaro (2004) point out that there are several decision models, they recognize that the decision will always be a result of a sequential, structured and directed process to solve any problem or opportunity. The authors also emphasize that information is a primary resource for the decision-making process, and it is extremely important that the processes are structured. Thus, the more the structure of the organizational process is aligned with the organizational objectives, the more conducive to achieving the objectives the organization is.

In this context, the guiding question of this study arises: where to find sources of information and scientifically relevant data that address the organizational structure in the decision-making process in public organizations?

Thus, the general objective of this research is to identify sources of information and most relevant scientific data on organizational structure and its influences in the decision-making process. With this identification, we seek to indicate articles and authors who research on the theme, serving as a guide for other researchers on decision making, in order to fill the review gap on the theme's productions. The data and information were limited to those available on the following scientific resources: Scopus Platform, Web of Science (ISI) and Spell, in the period from 1999 to 2019.

As an intervention instrument, it was used the Knowledge Development Process-Constructivist method (ProKnow-C), developed by the Laboratory of the Multi-Criterion Decision Support Discipline (MCDA) at the Federal University of Santa Catarina (Ensslin, Ensslin, Lacerda & Tasca, 2010; Afonso, Souza, Ensslin & Ensslin, 2011; and, Ensslin, Ensslin, Pacheco, 2012).

This research is justified by the need to explore, in a structured way, the theme “organizational structure and its influences in the decision-making process”, which according to Daft (2014), the asymmetry of information makes decision makers feel overwhelmed, since the information is not part of the organization's process. Another point to be raised is the difficulty of any researcher in finding a systematic search method for searching databases (Vilela, 2012). This article also seeks to debate the topic clearly, providing researchers in the area with a measure of productivity and guidance for decisions, as well as serving to explore the state of the art of research aimed at that topic.

This article consists of six more sections, in addition to this introduction section. The study is structured as folows: section 2, presents a brief conceptualization of organizational structure and decision making; section 3 deals with the methodological procedures adopted in the present research; section 4 presents the results achieved; section 5, presents the implications of this study; section 6, presents the final considerations; and finally, the references used for the construction of this research are presented.

2. Theoretical foundation

The theoretical basis intended to demonstrate, under the academic view, the concepts and definitions on the subject applied in this study. The idea raised in this section is of paramount importance, since the

selection of articles used in the research is related to the knowledge that the researcher has on the researched subject. In this sense, this section aims to provide the conceptual foundations on organizational structure and decision making.

2.1 Organizational structure

A basic conceptualization for organizational structure would be to consider it as a set of units or bodies interconnected by functional and hierarchical lines integrating all the resources of the organization, establishing the functions and activities, as well as, determining the communication channels (Oliveira & Silva, 2006). There are many definitions of organizations, for example: Prevé, Moritz and Pereira (2010) conceptualize organization as being an entity that provides goods and services, being constituted by a group of individuals organized to achieve a common goal.

Robbins (1990), on the other hand, defines the organization as "a consciously coordinated (led) social entity, with a relatively identifiable frontier, which works on a relatively continuous basis to achieve a common objective and/or objectives". For Cury (2000) an organization is a planned system of cooperative efforts in which each participant has a defined role to perform and duties and tasks to develop". The survival and growth of the organization is what most people aspire to. Objectives that require groups of two or more people, which establish between these cooperation relations (coordination), in formally coordinated actions and differentiated hierarchical functions.

Still with the purpose of understanding the organizational structure, Daft (2014) mentions the difficulty in conceptualizing the organization as it involves the definition of several characteristics. Thus, it is understood that organizations have distinct characteristics of difficult standardization of their specificities, in addition to encompassing several structures interconnecting the diverse resources that compose them.

Every organization must be prepared to offer a flow of horizontal and vertical information, following the needs to achieve its objectives, being entities built and directed towards the achievement of goals, designed as activities in systems and linked to the external environment (Daft, 2014). However, the organizational structure is affected by the complexity of the external environment, mainly influencing centralized decision-making, since decision-making is limited to the group of senior managers (Wagner & Hollenbeck, 2012).

Also according to the last authors above, because there are several types of structure, there is no single type to satisfy all organizations. However, there are some types of structures designed with the intention of adapting to the characteristics of the organizations.

Therefore, the organizational structure is responsible for keeping the organization aligned with its objectives, according to Silva (2017). The term organizational structure refers to a set of units or organs used to integrate all the resources of an organization, such as: human, material, technological, among others. Daft (2014) states that the organizational structure can be grouped into three key components: the first, determines the formal relationships of subordination; the second, identifies a group of agents by area and as a whole; and, the third, develops and maintains a system of communication, coordination and integration of efforts between the areas. However, they must be limited according to the objectives and strategies established to achieve the objectives, defining the divisions, formalities, centralization, integration and amplitude of control (Oliveira & Silva, 2006).

Thus, the structure of an organization determines the processes, the division of activities and resources to reach the established goals, performing the interconnection between the different sectors and functions. As it is the object of connection with the organization's objective, the structure must adapt and meet the needs disposed in the activities of each scenario involving the complex internal and external environment, as well as ensuring a precise direction for the decision making of managers in organizational processes.

Therefore, the structure of an organization must follow the needs of each scenario of complex and changing environments in the course of its operations. The dynamic element that corrects the directions and adapts the structures according to the environment is presented below. It is about decision making, a function of competence of the organization's managers.

2.2 Decision Making

Every organization needs to manage resources in order to achieve its established strategic objectives. Making decisions is part of the daily routine to achieve the goals set. For this reason, the organizational decision-making process becomes an extremely important factor for an organization (Maçães, 2017).

The decision-making process is the search for solutions to problems and opportunities that arise daily, ranging from decisions that are part of everyday life to decisions that involve short and long-term project planning. Decisions can also be short to long term, involving small and large organizations, with large investment of capital or not (Prevé, Moritz & Pereira, 2010). Thus, it is possible to see that the decision-making process can involve several factors, as well as several problems and solutions, making it an important element for every manager and every organization.

In public organizations this reality is no different, the public manager must carry out his activities based on rigid laws and routines with different decisions. In this context, Andrade (2007) makes it clear that the decisions made by managers can indicate peculiarities of different models of decision making, such as: rational model of decision making; limited rationality model; incremental model; procedural model; and, political model of decision making.

Still according to the author, the most worrying, however, is to note that there is no ideal among these models, as the limitations of one model can be complemented by another, depending on the scope of the manager's view. However, for Daft (2014), each decision has different degrees of complexity and categorization, in which the main aspect that the administrator must keep in mind is that each decision process is specific to a certain organizational situation, and its adaptation is considerable according to the change of the scenario.

Also according to Daft (2014), the decision-making process normally involves two stages: identification and solution of the existing problem. The identification of the problem relates to the collection of information about the conditions of the problem, seeking to know the state of the environment and its factors, in order to diagnose the irregularities and measure the level of performance to be involved. The solution of the problem involves all the alternatives elaborated and that can be considered to solve the existing problems, where one is selected to be implanted.

For Carneiro et al. (2017), the practice of the decision-making process should seek to answer four questions: 1) what are the feasible alternatives?; 2) what are the consequences of each one?; 3) what is the value of the consequences that we attribute, related to each of the previous alternatives?; and, 4) what criteria will

be used for the final choice? Thus, by analyzing the questions, it is possible to understand the importance of the organizational structure as a driver for decision making. If an organization's structure is aligned with its main purpose, decision making can be more effective.

3. Methodology

For a better presentation, the methodology was divided into two subsections: methodological procedures and intervention instrument.

3.1 Methodological Procedures

The study was carried out from an exploratory research of a descriptive nature with a quantitative approach through the Proknow-C method. The main objective of the research is to explore the subject matter of the study, as well as to clarify concepts and points of view. Typically, a descriptive research involves bibliographic and documentary studies, in addition to being considered an initial stage of most researches (Gil, 2010).

The quantitative research seeks the approval of hypotheses through the use of structured data, statistical procedures, in addition to the use of analyzes of many representative cases (Mattar, 2001). Regarding technical data collection procedures, it can be classified as bibliographic, based on secondary sources, such as scientific articles indexed in the Scorpus and Web of Science search platforms, both international bases, and Spell, a national base. As a delimitation of the sample, scientific articles in the Portuguese, English and Spanish languages from 1999 to 2019 were considered, and researched in the indexers of the subject area.

The technique used was the bibliographic review instrument called the Knowledge-Constructivist Development Process (ProKnow-C), created by the Multi-Criterion Decision Support Laboratory (MCDA) at the Federal University of Santa Catarina (UFSC), which, in a structured and sequential manner, presents a process that produces knowledge about a given topic in the literature (Ensslin et al., 2010; Afonso et al., 2011; Ensslin et al., 2012).

3.2 Intervention Instrument

The intervention instrument operated in this article, as already noted, is the Proknow-C, which presents a structured and rigorous sequence, in order to decrease the randomness in the creation of knowledge, according to the limitations placed by the researcher, based on a constructivist view (Afonso, 2011). The aim of the article is to produce knowledge about a specific gap in the scientific literature. This instrument consists of sequentially structuring the procedures, consisting of four phases. However, this research is limited to the first and second stages of Proknow-C, that are a portfolio selection and a bibliometric analysis, as the procedures of the chosen method.

3.2.1 Selection of the bibliographic portfolio

The selection procedure of the bibliographic portfolio in the Proknow-C method, established by LabMCDA, consists of a succession of mechanisms, such as the search engine determination, following pre-defined steps, such as the selection of keywords, adherence test and filtering articles. Each step

containing suggestions for the selection of articles, in order to produce a bibliographic portfolio of publications with scientific relevance and alignment with the subject, according to the researcher's understandings and restrictions (Ensslin et al., 2010; Afonso et al., 2011; Ensslin et al., 2012).

The construction of the articles roll is divided into two sub-processes: 1) selecting the articles in the databases to compose the Overall Article Bank; and, 2) filtering article selections based on the defined theme. The result of this phase and the selection of a set of articles considered relevant by the researcher is called the Bibliographic Portfolio (Afonso et al., 2011; Ensslin et al., 2010; Vilela, 2012; Ensslin et al., 2012; Waiczyk, 2013; Luiz, Ensslin, Mussi & Dutra, 2016). To facilitate the visualization of the Proknow-C process, figure 1 presents the summary of all steps.

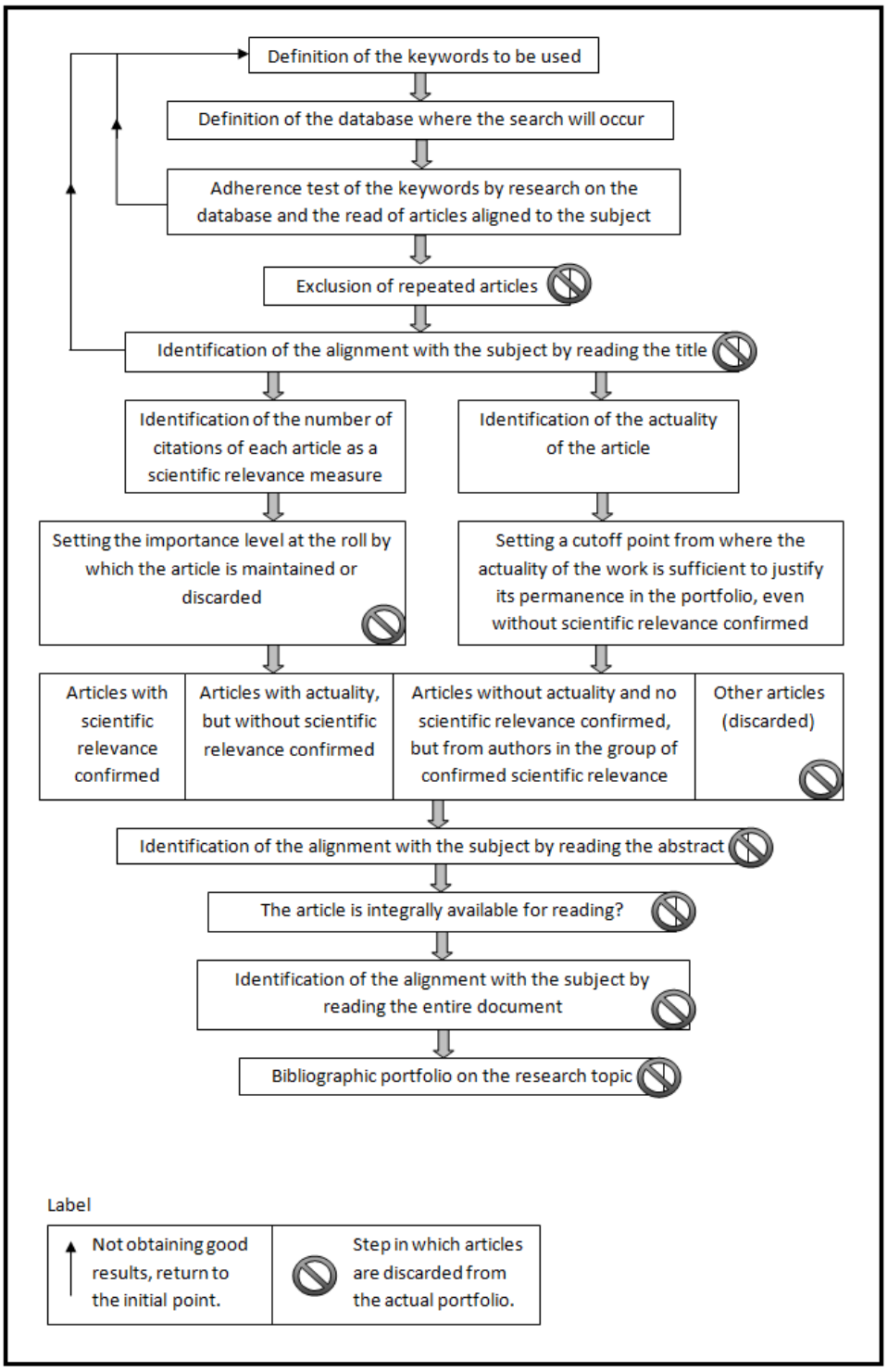

Figure 1. Summary of selection of the bibliographic portfolio.

Source: Afonso et al. (2011, p.6)

As seen in the diagram disposed in figure 1, there is a sequence of steps to be followed systematically to reach a Bibliographic Portfolio directed to the research topic.

4. Presentation of the results

The objective of this section is to present the results obtained, based on the processes defined in the previous section, specifically in figure 1, with details the procedures and decisions taken to achieve the objective of the study.

4.1 Result of Selection of the Bibliographic Portfolio

The procedures adopted for the selection of the portfolio are presented in this subsection, with the presentation subdivided into three stages: selection of keywords, selection of databases and selection of articles by filtering the results.

4.1.1 Selection of keywords

The objective of this step is to identify the keywords that can lead to better results for the research on the topic “Organizational structure and its Influences on Decision Making”. Following the procedure defined in the methodology, the definition of keywords started. For this purpose, the keywords of 60 articles selected by relevance in the Google Scholar basis were used, 30 in Portuguese, for further research in the national base, and 30 in English, for the search in the international bases.

The search for the mentioned articles was carried out from the combination of the two main terms in this research area, in the period from 2015 to 2020. Thus, the terms used were: “organizational structure” administration; “decision making” administration; and "organizational structure" "decision making" administration. At the end of the verification, 3 Portuguese terms were defined, those that appeared more times, adding another 3 terms to cover synonyms, resulting in 6 terms in Portuguese: decision making; decision-making process; public administration; public Management; public organization; and, public sector.

Then, two research axes were defined. The first, covering articles related to the organizational structure in the administration, and the second, containing productions alluding to decision making in the administration. Figure 2 shows the combination of keywords in their proper research axis.

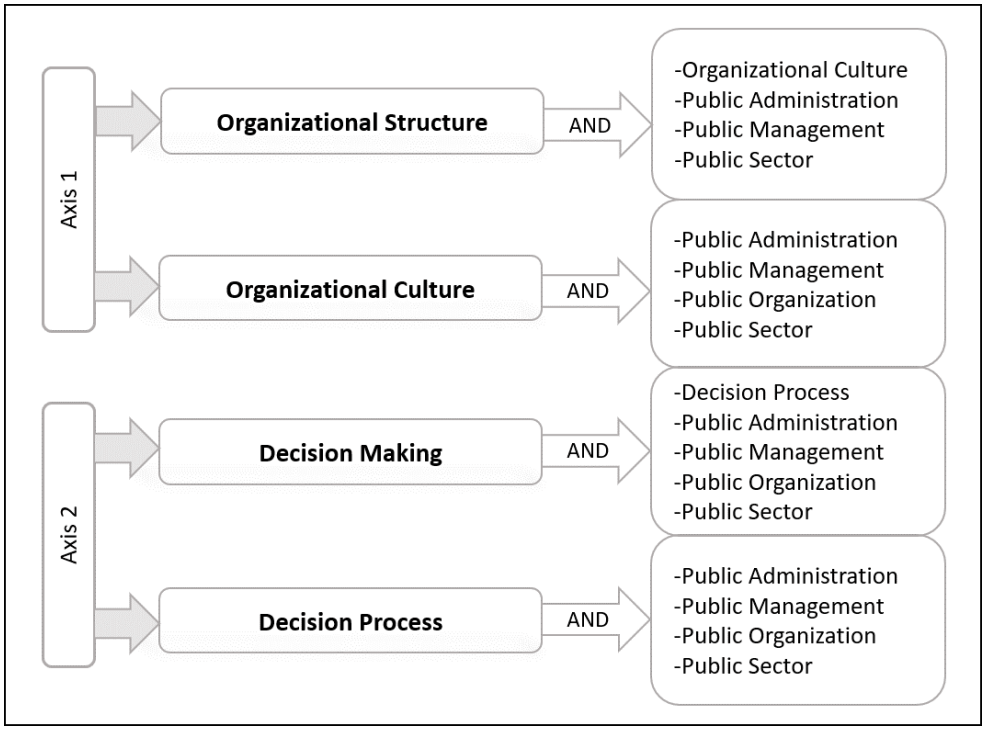

Figure 2. Combination of keywords for base searches.

The 6 terms for consultation in international databases were defined in the same way in English and in Portuguese, when analyzing the 30 articles in English, there was a variety of terms, making it difficult to standardize the keywords, therefore, it was decided to use similar terms among those consulted, resulting in identical terms as those in Portuguese.

4.1.2 Selection of databases

For the research, in a first phase, multidisciplinary bases were chosen that have an impact factor index for international journals-JCR and SJC, as well as for the national base. Thus, we chose to consult the Web of Science (ISI) and Scopus indexing databases for research in English, and Spell for research in Portuguese.

With the consultation bases determined, the search was carried out with the keywords defined in the previous step, together with the search adherence test on the chosen bases. The adherence test is one of the steps in the ProcKnow-C methodology, which aims to verify whether the defined keywords are adequate to find articles related to the theme in a specific base searched.

The method recommends reading two articles from the overall portfolio. With this, the author would be able to analyze the keywords used in the article and check their relationship with the chosen theme. If it results in new words or the search runs away from the topic, it is recommended to return to the first step of selecting the keywords (Vilela, 2012). As a search criterion, it was decided to consult the databases through the fields: title, abstracts and keywords for international databases, and abstract for the national database.

The initial research resulted in 13,576 articles found in the Scopus and Web of Science databases, and 409 articles in the Spell database. To achieve this result, 9 combinations of keywords in English and 9 combinations in Portuguese were performed, resulting in 18 combinations applied.

4.1.3 Filtering selection

This step aims at filtering the Total Bibliographic Portfolio, finding the articles of greatest relation to the topic and of scientific relevance. At the end of this stage, the selected articles will result in the Final Portfolio.

The first step used to filter the portfolio is the exclusion of repeated articles, using the software EndNote, in the "References" menu, and using the option "Find Duplicated", which found 4,328 repeated productions, resulting in 9,657 non-repeated productions. After the automatic removal of duplicate items, the remaining items were exported to Microsoft Excel 365, to verify the removal of all duplicated publications.

With the 9,657 articles selected and not repeated, the next step aimed at the adequacy of the articles with the theme. This step refers to reading the title of all articles. The analysis of this stage resulted in 132 articles not repeated and in line with the research subject.

The third stage established by the ProKnow-C process aims to identify the scientific relevance of the articles. For this, it was defined in the research the use of the query via Google Scholar, to verify the relevance of each article, in which the sum of all citations of the articles reached the total of 1,824 citations. For scientific relevance, two parameters were determined, one for articles in English and another for articles in Portuguese.

The citations of the articles in the Scopus and Web of Science databases were added and the average was calculated, based on the number of articles (1,619 citations / 106 productions). Resulting in 33 articles with at least 15 citations, constituting approximately 79% of the total citations. For the Spell database, the same calculations were performed, resulting in 8 articles with at least 8 citations (205 citations / 26 articles), equivalent to approximately 78% of the total citations. In addition, 41 productions of greater scientific relevance were reserved for reading abstracts. The remaining 91 productions were analyzed according to the criteria contained in the ProKnow-C process.

Thus, the articles with less than two years of publication had their abstracts read, however, due to the short time of publication, the opportunity to be well cited, as well as to go through the process of verification of authors were impaired. The ProKnow-C method suggests the authors' evaluation step. Therefore, the authors' correlation with their respective productions was carried out, in order to verify the scientific relevance of their articles. In this step, if the articles of the selected authors have no scientific relevance, the article would be discarded. Of the remaining 91 articles, 36 of them had less than two years of publication, being separated for reading the abstracts.

From the 55 oldest productions, after an analysis of the authors, only one author of the portfolio presented confirmed recognition. Adding the referred work to the articles for reading abstracts, it resulted in the sum of 78 articles. They were separated for further analysis, as defined in the methodology.

Thus, the 78 separated articles had their abstracts read, observing the alignment with the theme, which resulted in only 16 productions aligned with the researched topic. So, 8 articles of recognized importance and 8 articles with less than two years of publication, from authors with recognized importance in the field of research, remained, totaling 16 articles to compose the overall portfolio.

Then, those articles were read by the full text available, and it was found that all of the works were of free access in the databases. After reading the texts, 12 productions were excluded because they were not

aligned with the researched theme. In the end, the portfolio resulted in 4 articles with scientific recognition and aligned with the research theme, as shown in Table 1:

Table 1. Result of the Overall Portfolio.

Author	Title	Year	Publisher
Leonardo de Oliveira Leite; Denis Alcides Rezende	Municipal management model based on the strategic use of information technology resources for government management: formatting the model and evaluation in a municipality	2010	Revista de Administração Pública (RAP)
Azizan Marzuki	Challenges in the public participation and the decision marking process	2015	Sociologija i Prostor
Valerio Gatta; Edoardo Marcucci; Michela Le Pira	Smart urban freight planning process: integrating desk, living lab and modelling approaches in decision-making	2017	European Transport Research Review
Mısra Ciğeroğlu Öztepe; Onur Kulaç	Ethical decision-making in Turkish public administration and policy	2019	Public Administration Issues

4.2 Bibliographic Analysis

This section is part of the phase defined in the ProKnow-C methodology for the quantification of the articles that make up the bibliographic portfolio. The main objective is to present information about the portfolio created through a quantitative analysis of its characteristics (Afonso et al., 2012; Ensslin et al., 2010), delving into the scientific specifications of the journals and authors corresponding to each article in the bibliographic portfolio.

4.2.1 Articles in the Bibliographic Portfolio

The articles defined in the first phase of the methodology were analyzed, in a total of four. The first parameter analyzed was the relationship of relevance of the journals, in which the SCImago Journal Rank (SJR) was used to measure the scientific influence of each journal academically, since each article was published in different journals, making analysis difficult only by quantity publications. Table 2 shows the results of all journals.

Table 2. Periodicals of the articles in the Bibliographic Portfolio.

Publisher	Country	SJR	H-Index
European Transport Research Review	Germany	0,704	22
Public Administration Issues	Russia	0,268	5
Sociologija i Prostor	Croatia	0,157	7
Revista de Administração Pública	Brazil	0,282	15

The H-index relates to the number of citations per publication of each journal based on the selected quantity, where it is not always related to the value of the SJR, as can be seen in table 2. The Journal "Public Administration Issues" has an SJR of 0.268 with H-index of 5, while the journal "Sociologija i Prostor", represents SJR of 0.157 and the H-index of 7, demonstrating that they are analyzes with different directions and are not always equivalent. Table 3 shows the journals and their respective areas.

Table 3. Journals and their areas.

Journal	Editor	Category	Area
European Transport Research Review	*Springer Verlag*	Enginnering	Automotive engineering; mechanical Engineering
Sociologija i Prostor	*Institute for Social Research in Zagreb*	Education	Geography, Planning and Development; Sociology and Political Science; Urban Studies
Public Administration Issues	*National Research University Higher School of Economics*	Social Sciences	Public Administration
Revista de Administração Pública	Fundação Getúlio Vargas	Social Sciences	Public Administration

It is worth noting that the direction of this research is related to the use of the organizational structure as an object for decision making in Public Administration, in addition, it is related to the areas of social sciences and urban planning, as well as to the other areas of knowledge that use these means for the performance of its activities, being sustainable, therefore, the areas of the journals and the publications selected for the bibliographic portfolio.

When looking at the categories of the articles, two of them belong to social sciences in the area of public administration, and the journal's names already demonstrates the scope. The other articles belong to different categories. The "European Transport Research Review" serves as a magazine in the field of automotive engineering and mechanical engineering, its articles cover procedures, models and tools to integrate the complex environment of urban freight transport. "Prostor", is the oldest journal on sociology in Croatia, addressing issues in the area of geography, planning and development, sociology and political science and urban states, directing its work towards approaches that use the basis of sociological thinking with the theme treated by the journal referred to.

In sequence, table 4 presents the list of authors of the Bibliographic Portfolio (BP) productions and their respective areas of activity, the organization in which they work and the country where the organization operates. Despite each author present a particular area of research, these authors have in common: urban direction; related to Transport; Urban planning; Public Administration and Municipal Management; as well as discrete choice models; and, Political Science and Information Technology, demonstrating that there is not always a relationship between the research area and the journal area. It is also observed that some authors work in different organizations, being possible to involve the vision of different realities, making the production to be applied in other scenarios.

Table 4. Authors and their actuation areas

Authors	Research Field	Institution	Country
Valerio Gatta	Discrete choice models; Transportation; Freight; Econometrics; Marketing	*University of Roma Tre*	Rome, Italy
Edoardo Marcucci	Transport Economics; Transport Policy; Transport Modeling; City logistics; Discrete choice models	*University of Roma Tre; Molde University College*	Rome Italy; Molde, Norway
Michela Le Pira	Transport planning; Public participation; Multicriteria analysis; Agent-based modeling; Discrete choice models	*University of Catania*	Catania, Sicily
Azizan Marzuki	Urban planning; Impact assessment and tourism planning	*Universiti Sains Malaysia*	Northern Malaysia
Mısra Ciğeroğlu Öztepe	Political Science and Public Administration	*Pamukkale University*	Denizli, Turkey
Onur Kulaç	Political Science and Public Administration	*Pamukkale University*	Denizli, Turkey
Leonardo de Oliveira Leite	Distance education; Playful education; Educational technology; Virtual learning environments; Educational Informatics	Faculdade Senac Minas	Belo Horizonte, Minas Gerais, Brazil
Denis Alcides Rezende	Strategic Digital City; Smart City; Municipal strategies and information; Information Technology; Municipal Management	Pontifícia Universidade Católica do Paraná	Curitiba, Paraná, Brazil

Still with respect to the authors, the number of citations from Google Scholar was listed, with only two profiles not found, namely: the profiles of the author Mısra Ciğeroğlu Öztepe and Leonardo de Oliveira Leite. Both are not included in table 5.

Table 5. Authors and their relevance.

Author	Google Scholar Citations	Year with more citations
Valerio Gatta	1.300	2019 (341 citations)
Edoardo Marcucci	2.830	2019 (469 citations)
Michela Le Pira	559	2019 (211 citations)
Azizan Marzuki	1.072	2017 (210 citations)
Onur Kulaç	49	2019 (19 citations)
Denis Alcides Rezende	4.041	2019(325 citations)

The author with the highest number of citations, according to the Google Scholar query, was Denis Alcides Rezende, who works at the Pontifical Catholic University of Paraná, located in the city of Curitiba, Paraná-Brazil. The author's article, co-authored by Leonardo de Oliveira Leite, “Municipal management model based on the strategic use of information technology resources for government management: formatting

the model and evaluation in a municipality" was the only article in Portuguese to be selected for the PB. In the paper, the authors seek to develop a model for the public manager that integrates management theories, aligns with resources of systems and information technology, to provide timely and personalized information for decision making, according to the performance of the municipal government, management of relationships with citizens and control of administration processes.

Table 6 shows all the articles that compose the BP and its relevance according to the research carried out on Google Scholar. Therefore, an article from the selection of the last two years is observed with only one citation. It is justified as it is a production of the most recent publication: from the year 2019. The article with the least number of citations belongs to the journal Public Administration Issues, which deals with structured ethical decision making in Public Administration.

Table 6. Scientific recognition of the selected articles

Title	Year	Citations
Municipal management model based on the strategic use of information technology resources for government management: formatting the model and evaluation in a municipality	2010	22
Challenges in the public participation and the decision-making process	2015	39
Smart urban freight planning process: integrating desk, living lab and modeling approaches in decision-making	2017	39
Ethical decision-making in Turkish public administration and policy	2019	1

The two most relevant articles, both with 39 citations, represent approximately 78% of the total citations in the Bibliographic Portfolio (PB). Both articles were published in the last 5 years and in the English language, with a noticeable difference in citation for the article published in Portuguese in 2010, which has 22 citations, even with almost 10 years of publication. Is observed a greater demand for articles in foreign languages related to the topic addressed. Despite the articles being published in journals from different countries (Table 2), the English language remains the most prominent language in journals with the greatest recognition.

The last stage of bibliometric analysis, according to the Proknow-C methodology, is the identification of keywords, which were composed of 15 different words for the four articles in the Bibliographic Portfolio, which are presented in figure 8. Among the words presented in the articles of the PB "decision-making process" and terms related to public administration such as "Public participation", "Public Administration and Policy" and "Municipal Public Management" stand out for being related to the framework of the keywords of the initial research of the PB.

Although the articles do not have the same words, it is understood that each article has a specific direction, with the common objective being the relationship with the structure, model and study of decision making covering Public Administration. As shown in table 7:

Table 7. Keywords of the articles in the BP

Title	Keywords
Smart urban freight planning process: integrating desk, living lab and modelling approaches in decision-making	Citylogistics
	Urban freighttransport
	Innovative solutions
	Behavioural models
Challenges in the public participation and the decision-making process	Public participation
	Decision-making process
	Approaches
	Case studies
Ethical decision-making in Turkish public administration and policy	Decision-making
	Public Administration and Policy
	Ethics
	Turkey
Municipal management model based on the strategic use of information technology resources for government management: formatting the model and evaluation in a municipality	Strategic information systems
	Municipal public management
	Group decision support system

4.2.2 References from the Bibliographic Portfolio

Starting from the data mentioned in section 4.2.1, 196 references mentioned in the 4 articles belonging to the BP were analyzed. Then, the next step of the ProKnow-C methodology was carried out. In this stage, first, the journals of each article were analyzed, where the 10 most prominent journals were selected, being the "Public Administration Review" with 4 referenced articles among the articles of the BP, the most prominent among the other journals, as shown in figure 3 , as follows:

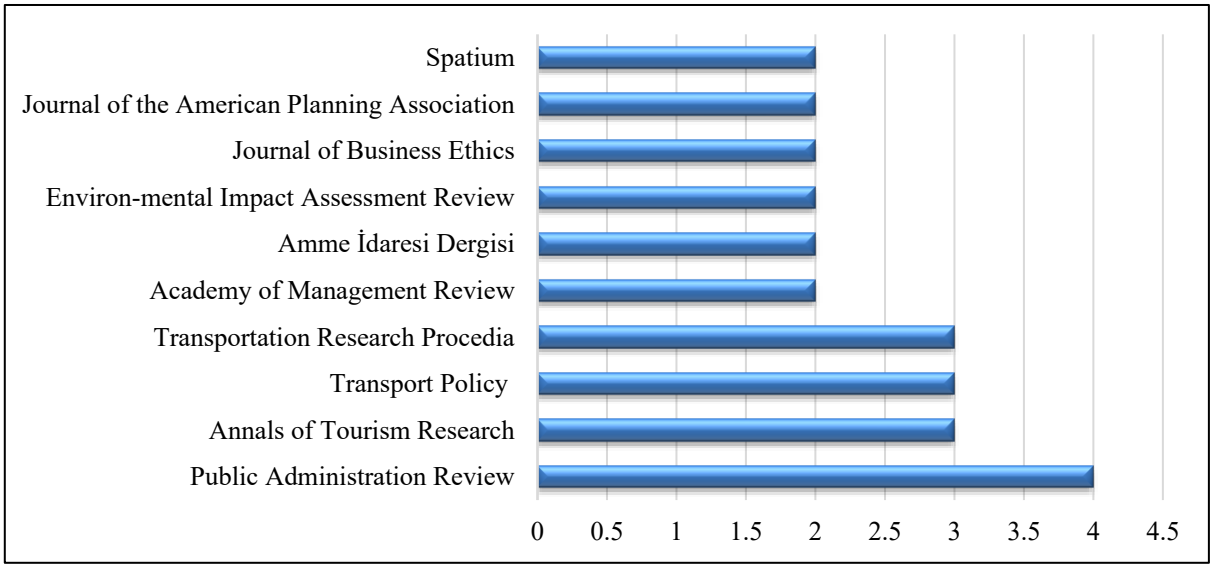

Figure 3. Main journals of most prominent references.

Based on the figure 3, and just as table 2, it was created with the SCImago Journal Rank (SJR) and the H-index to measure the academic or scientific influence of the journals of articles belonging to the Bibliographic Portfolio, the journals in the figure 3 were related with their respective impacts in table 8.

Table 8. Main journals of higher references.

Journal	SJR	H-Index
Public Administration Review	2.867	130
Annals of Tourism Research	2.228	158
Transport Policy	1.657	88
Transportation Research Procedia	0.476	25
Academy of Management Review	7.482	260
Amme İdaresi Dergisi	0.113	4
Environmental Impact Assessment Review	1.234	87
Journal of Business Ethics	1.972	168
Journal of the American Planning Association	1.554	90
Spatium	0.201	7

The "Academy of Management Review", despite having only two articles mentioned among the references of the BP, stands out among the other journals with SJR of 7,482 and H-index 260, showing its high scientific influence, evidencing the use of relevant articles in the construction of the research.

Then, the citations of each reference were analyzed according to Google Scholar. The 10 highest citations were selected again. Analyzing the list of references, it was found that 80% of the references were published before the 2000s, the oldest in 1959 by Lindblom, C. E. and the second most cited with 14,748 citations. The most recent references are from 2011 and 2010, with 6,373 and 11,976, respectively, in which the 2010 publication is the third most cited, as it is seen in table 9.

Table 9. Articles with higher scientific recognition.

Article	Citations
Lipsky, M. (1980). Street-Level Bureaucracy: Dilemmas of the Individual in Public Services. New York: Russell Sage Foundation.	17.640
Lindblom, C. E. (1959). Th e Science of Muddling Th rough. Public Administration Review, vol. 19, no 2, pp. 79–88.	14.748
Osterwalder, A., Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. Published by John Wiley & Sons, Inc., Hoboken. New Jersey	11.976
Cohen, M. D., March, J. G. & Olsen, J. P. (1972). A Garbage Can Model of Organizational.	11.443
Kohlberg, L. (1969). Stage and Sequence: Th e Cognitive-developmental Approach to Socialization. In: Goslin, D. A. (eds). Handbook of Socialization Theory and Research. Chicago: Rand McNally, pp. 347–480.	9.788

Deterding S, Dixon D, Khaled R, Nacke L (2011) From game design elements to gamefulness: defining gamification. In proceedings of the 15th international academic MindTrek conference: envisioning future media environments, pp. 9-15.	6.373
Jones, T. M. (1991). Ethical Decision Making by Individuals in Organizations: An Issue-Contingent Model. Academy of Management Review, vol. 16, no 2, pp. 366–395.	4.722
Howlett, M. & Ramesh, M. (1995). Policy Cycles and Policy Subsystems. Canada: Oxford University Press.	4.678
Trevino, L. K. (1986). Ethical Decision Making in Organizations: A Person-Situation Interactionist Model. Academy of Management Review, vol. 11, no 3, pp. 601–607.	4.157
Ferrell, O. C. & Gresham, L. G. (1985). A Contingency Framework for Understanding Ethical Decision Making in Marketing. Journal of Marketing, vol. 49, no 3, pp. 87–96.	3.231

Finally, the list of authors of the article references, noting that, unlike the authors of the 4 productions of the Bibliographic Portfolio, which presented different authors for each production, the most prominent authors were Valerio Gatta and Edoardo Marcucci with 11 articles cited among the references, which is shown in figure 4.

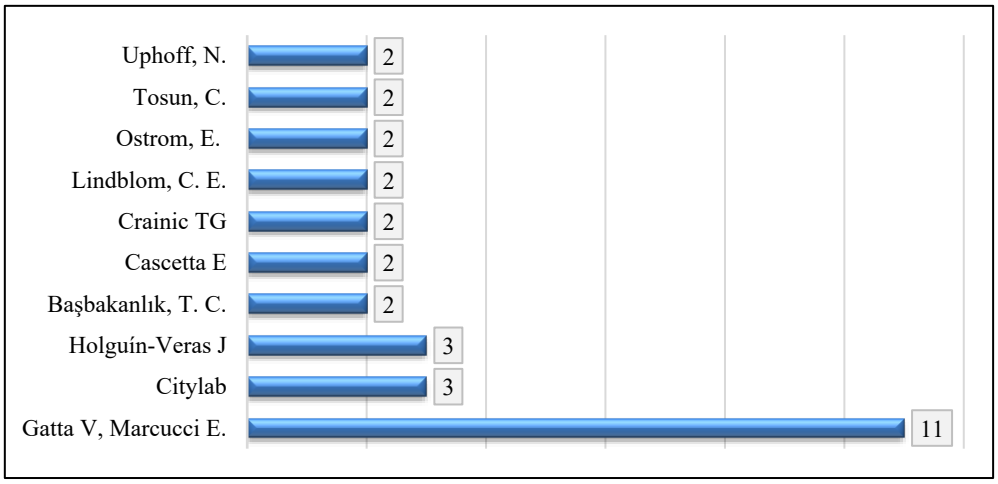

Figure 4. Authors scientific importance by the references.

Still on the authors Valerio Gatta and Edoardo Marcucci is noteworthy in relation to PB, since the authors also produced the article "Intelligent urban freight planning process: integrating desk, living lab and modeling approaches in decision making" belonging to the PB of this research. A verification was carried out to verify which articles cited these authors. It was found that only the authors' articles cited them.

5. Implications of this study

As implications of this work, suggestions are presented for future investigations on the subject. To this end, we highlight new conceptions of studies and application of models based on the execution of personalized organizational management, where the understanding of the activities performed by all individuals, which influence internal and external actions, play a representative role in the development of the structural model.

The conceptions presented in the articles argue, in their analysis of the individual characteristics of each organization and / or nucleus studied, one of the noteworthy aspects being the search for understanding the dynamic scenarios to direct decisions in a personalized and congruent way to the objectives set.

Another perspective to be explored is related to the number of works pertaining to the studied theme, with a low percentage of studies that seek to align the organizational structure with the performance of the decisions taken by the organization. In this way, the continuation and inclusion of this topic becomes relevant in view of the management practice, as well as in the know-how of teaching and applied studies.

In addition to these issues mentioned, several investigations are possible using studies of organizational structures for decision-making, as applied in the article “Ethical decision-making in Turkish public administration and policy” that seeks to unite the analysis of the ethical system with the decisions made by public officials , thus relating two aspects present in any scenario studied: structure and ethics.

Another point to be highlighted is the search for structuring the actions of individuals, developing strategies, models and processes to direct actions based on the alignment of personalized information. This is observed in common in the four articles, in which the authors seek to analyze the scenario in order to investigate current actions and define future actions.

6. Conclusion and final considerations

Organizations are increasingly facing the versatility of scenarios, going through daily transformations that directly interfere in the entire process of internal and external development. Facing barriers and seizing opportunities has become a key step in measuring the capacity of managers in the face of the current scenarios.

In face of this reality, knowing how to face the transformations of the scenarios requires that the entire organizational process is aligned with the company's objectives. In this way, the Organizational Structure acts as a determining factor for company communication, becoming an important resource for managers' decision making.

This research sought to meet the central objective, identifying the most relevant articles that address the theme “Organizational Structure and its influences on decision making”. The ProKnow-C instrument was used to build a set of relevant scientific articles for future research. As a delimitation of data collection, we chose to search the Scopus, Web of Science (ISI) and Spell databases from 1999 to 2019, using only freely accessible articles.

This survey provided a selection of 4 academically relevant articles, each belonging to a different year: 2010, 2015, 2017 and 2019, adding 101 citations, in which are emphasized: “Smart urban freight planning process: integrating desk, living lab and modeling approaches in decision-making" and "Challenges in the public participation and the decision making process” each with 39 citations.

The article “Smart urban freight planning process: integrating desk, living lab and modeling approaches in decision-making” presents a framework (modeling approach) bringing together knowledge acquisition and co-creation of behavioral, technical, operational, organizational and financial policies for use by heterogeneous actors. The article “Challenges in the public participation and the decision making process”

was based on four case studies of public participation from four different countries to analyze public participation and restrictions in the decision-making process.

Still with the focus directed towards the individual, the research "Ethical decision-making in Turkish public administration and policy", tries to analyze the ethical system of Turkey, on which the process of ethical decision making of public officials is supported in a structured way. The article "Municipal management model based on the strategic use of information technology resources for government management: formatting the model and evaluation in a municipality", as well as previous research applied in Turkey, relates to the public manager, in which is elaborated a model to unite management theories, aligning system resources and information technology, enabling personalized information for decision making.

Among the barriers of this bibliometric analysis, we can point out the limitation of the focus, of the last twenty years focusing specifically on the organizational structure as influential in decisions. Another point to be cited is the view of the researcher, who despite going through careful steps, presents a single view of delimiting the articles. Regarding the choice of the database, although the Scopus, Web of Science and Spell databases are considered to be multidisciplinary bases, there were limitations on the central themes of the articles, highlighting articles directed at the health area, making it difficult for this research performance.

After analyzing the results and weighing up the limitations, it is recommended to continue this research by performing the other phases of the Proknow-C method, in addition to using other databases to complement the portfolio of articles on the topic addressed or the use of journals. directed to the theme for greater precision of the results. As a suggestion for future research, is proposed the development of a framework that can be used in different organizations, whether public or private, based on the improvement of the organizational structure, presenting the positive and negative points of the structured application, in which it aims to take quick decision making, personalized information and the construction of heterogeneous scenarios for managers.

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Recycling to Save Lives: Making Manikins from Recyclable Materials for Cardiopulmonary Resuscitation Training

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Abstract

***Introduction**: Cardiopulmonary Arrest (CPA) is a global public health problem and, for this reason, once it is identified, early Cardiopulmonary Resuscitation (CPR) must be initiated and effectively carried out in order to improve the victim´s prognosis. **Objective:** The objective of the project was to train students and civil servants from a public university in order to promote their interaction with the population assisted by the DIST/Shopping Park program through workshops on making recyclable manikins; training on Cardiopulmonary Arrest (CPA) identification and Cardiopulmonary Resuscitation. **Methodology**: The RECYCLE TO SAVE LIVES - CPR project was an activity promoted by the Federal University of Uberlandia (UFU), in 2018, which associated environment with health promotion and education and encouraged the initial training of 28 people to serve as volunteers in the external community of the University, 44 people from different age groups then received a similar training through workshops. **Result:** The project approach was efficient, as it managed to associate theory with practice, through the use of the recyclable manikins. However, it was found that health education activities need to be more present in educational environments, and not just at specific moments of intervention, as proposed by the project, as we assume that over time, theoretical and practical knowledge might be forgotten. **Conclusion:** The project achieved*

good results with the training offered through workshops, and while working directly with the community it played a significant role of social intervention, which is one of the responsibilities of the University.

Keywords: Cardiopulmonary Arrest; Cardiopulmonary Resuscitation; Basic Life Support; Health Education; Health Promotion; Community Health Nursing.

Introduction

Cardiovascular diseases (CVD) are the main cause of death in Brazil and worldwide [1-4]. Ischemic heart diseases [5] alone are responsible for 80% of sudden death cases, most of which happen in the pre-hospital environment [6]. For this reason, Cardiopulmonary Arrest (CPA) is a global public health problem. It is defined as a sudden, unexpected and catastrophic cessation of the systemic circulation, associated with the absence of breathing [7].

However, despite the advances related to prevention and treatment in recent years, CPA mortality rates in Brazil remain high. Whereas the exact dimension of the problem is not clearly understood, due to lack of robust statistics, 200.000 CPA cases are estimated to occur in Brazil every year, half of which happen in an out-of-hospital environment due to rhythms such as ventricular fibrillation and sudden pulseless ventricular tachycardia, and, to a large extent, due to arrhythmias resulting from acute ischemic conditions or primary electrical dysfunctions [5].

Considering the aforementioned reality, Cardiopulmonary Resuscitation (CPR) is of utmost importance for the minimization of myocardial and cerebral sequelae, relief of suffering and preservation of life, when it is possible, which is directly associated with when it is initiated and how effectively it is performed, once according to the Brazilian Society of Cardiology, a person who suffers from a cardiopulmonary emergency has between 6 and 10 minutes to be given the first Cardiopulmonary Resuscitation maneuvers to enable survival conditions. It corresponds to a set of measures performed with the purpose of promoting artificial circulation of oxygenated blood to the heart, brain and other vital organs, until the cardiovascular and ventilatory functions are spontaneously re-established [8].

In this context, from 2015 on, the American Heart Association (AHA) started to recommend the use of different survival chains for in-hospital and out-of-hospital CRA, as these are two environments that require different structural elements and processes. The patients of an Out-of-Hospital Cardiac Arrests (OHCAs) depend on the assistance of lay people, who must know how to identify the arrest, ask for help, start CPR and use defibrillation, if they have an Automatic External Defibrillator (AED) on site, before the emergency service arrives [9]. It is important to state that in Brazil there is still no National Legislation that regulates and obliges public places to make the AED available although some states in this country have independently passed such law. In São Paulo State, for example, establishments with a flow greater than 1500 people are required to make the AED available (Law Nº. 13.945, of JANUARY, 7th, 2005) [10].

Access to this knowledge occurs through studies on Basic Life Support (BLS), which can be carried out by lay people, namely, people other than health professionals, as long as they are trained, with the purpose of identifying and helping in emergencies. The greatest challenges, especially in Brazil, are to expand access to CPR teaching and establish processes for continuous improvement of its quality, so as to minimize the

time spent between CPR and the application of the first shock with the defibrillator [5] once this early defibrillation with the use of AED can improve the patients´ prognosis, prompting greater survival and better neurological prognosis among survivors [11].

This indicates the importance of making AED available in places with a significant circulation of people, as it is advocated by the AHA-2015 [9]. It consists of an easy-to-handle device that applies a large current pulse to the heart to restore the normal rhythm of the heartbeat in patients with ventricular fibrillation or ventricular tachycardia [12]. And a properly trained layperson can perform the defibrillation procedure as skillfully and safely as a healthcare professional [11], because it is a portable device that allows for diagnosing and evaluating the need to provide an electrical discharge, indicating to the operator step by step how to do it in a safe and effective manner [12].

Because of this, the project developed intended to democratize access to health education through the use of a manikin made from recyclable material, which produces an expectation of reality to the participant, simulating the use of a commercial simulation manikin, but at a considerably lower cost. In addition to this, efforts are made for the preservation of the environment as the incorrect disposal of the material in nature is avoided and thus the cooperative of collectors of recyclable materials is assisted with the promotion of health. It is important to emphasize that the simulations that use manikins facilitate the acquisition of skills, fostering the construction of knowledge [13].

Therefore, the objective of the project was to train students and civil servants from a public university in order to promote their interaction with the population assisted by the DIST/Shopping Park[1] program through workshops on making recyclable manikins; training on Cardiopulmonary Arrest (CPA) identification and Cardiopulmonary Resuscitation (CPR).

Methodology

The project RECYCLING TO SAVE LIVES – CPR was an activity carried out by the Federal University of Uberlandia (UFU), in 2018, through the UFU/Community Integration and Extension Program - CIEP, which combined environmental preservation by using recyclable materials in the construction of manikins and health promotion and education by providing CRA identification training as well as workshops on Cardiopulmonary Resuscitation to participants at DIST/Shopping Park, in Shopping Park, a neighborhood in the city of Uberlandia-MG (Brazil). This training was conducted following the American Heart Association (AHA) guidelines, which were updated in 2015.

In this context, the project encouraged the initial training of 28 people, among civil servants and students from UFU, to serve as volunteers in the external community of the University. These volunteers reproduced the knowledge they acquired to an average of 25 people of different age groups in three meetings in different months. In addition, the project was extended as some of the workshops were linked to scientific events, in which 19 other people (students) were trained. During the training, the active methodology was used, as it encouraged the active participation of the students in the dynamic process of knowledge construction, evaluation and problem solving of reality, bringing them to the role of the active subject of their growth, that is, the leading role of the teaching and learning process [14]. We used the questionnaire

[1] Program for Integrated and Sustainable Development of the Shopping Park Territory

with multiple-choice questions (pre-test and post-test) to estimate the participants' knowledge on the subject, CRA and CPR, only in the workshops related to the events. In addition, a folder was prepared with informative content on the subject, as well as the step-by-step guide for the preparation of the manikin.

The workshops for the population took place at DIST/Shopping Park in accordance with the objective of the project and, besides, in workshops at the VII National Meeting for Teaching Biology and I Regional Meeting for Teaching Biology - North (Belém-PA/Brazil) and at the XXVII Scientific Week of Biological Studies-UFU (Uberlandia – MG/Brazil).

The choice of the non-conventional manikin for training in CRA care was a measure of substitution to what is normally used, as it is not easily accessible to every person, as it is still sold for a high price. In order to make training more accessible to all, Cardiologist Agnaldo Piscopo, on behalf of the Cardiology Society of the State of São Paulo [(15)] and as the director of the training center, developed an all-exclusive manikin, known as "Guizinho", a dummy made with a covered plastic bottle full of air, whose pressure is identical to that of the human thorax, and with scientifically proven effectiveness, through tests conducted with 200 students at a school in Araras (SP/ Brazil), which showed that training with "Guizinho" is as effective as training with traditional imported manikins [(16)]. Therefore, the participants of the trainings carried out by our project will also be able to make their own manikins with recyclable material.

Thus, the workshops proceeded in the following way. Firstly, the participants were taught how to build the manikins; secondly, they learned how to identify a patient in Cardiopulmonary Arrest and then how to perform Cardiorespiratory Resuscitation. And, at the end of each intervention, folders were distributed as a review material, support for the performance of CPR and for the construction of the manikins, in order to promote the spread of knowledge.

1- Materials used to make the manikins:

- A basic T-shirt/blouse (It must not be sleeveless or have buttons);
- PET[2] bottles of 1,5 liters or 2 liters;
- A stapler;
- A String;
- A pair of Scissors;
- Styrofoam or pricked or crumpled newspapers or magazines.

[2] Known as PET, polyethylene terephthalate is a type of plastic widely used in the manufacture of bottles (soft drinks, water, juices, oils, etc.).

Source: Authors' collection

Figure1: Materials used to make the manikins

2- Step-by-step guide to make the manikin:

1. Place the open shirt /blouse on a smooth surface and fold the sleeve and trunk ends in the size of 3 to 7 cm.
2. Staple the parts of the shirt /blouse that have been folded.
3. Fill the inside part of shirt /blouse through the neck opening with the chosen recyclable material leaving room to place the PET bottle.
4. Place the PET bottle inside the shirt /blouse, through the neck opening, taking care so that it stays in the middle as it will simulate the center of the chest.
5. Finish filling the inside part of the shirt /blouse if necessary.
6. With the string, attach the cap part of the bottle to the collar of the shirt /blouse so that it does not move out of place.
7. Tie as many knots as necessary and cut the excess string with the scissors.

Source: Authors' collection

Figure 2: Manikins made by the workshops participants

3- Identification of the Cardiorespiratory Arrest:

Checking the patient's condition

1- Touch the patient 's shoulders emphatically and ask or call her in an audible tone "Can you hear me?". But remember that you are not looking for an answer, but some kind of reaction like eyelid contractions, muscle movement, reacting to sounds.
   - ✓ If there is no answer, it means that the patient is not responding.

2- Look for signs of circulation:
   - ✓ The patient 's lips, face and extremities are pale;
   - ✓ Observe if the patient is breathing by checking the movement of the chest region.

If there is no responsiveness combined with no signs of circulation, it means the patient is in CRA.

4- How to perform Cardiorespiratory Resuscitation:

The American Heart Association (2015) [9] currently brings guidelines that make Cardiopulmonary Resuscitation simple and easy to be applied in an emergency situation.

- The CPR maneuver should be performed with the patient lying on his/her back on a rigid, smooth and dry surface, in a place that does not pose a risk to those who are providing assistance.
- The person who is going to perform the cardiac massage should position himself/herself on his/her knees on the floor next to the patient, keeping his/her arms stretched with his/her hands on top of each other in the center of the chest in the final portion of the sternum bone of the person who is going to receive the massage and start rapid and uninterrupted compressions. Compressions should be made using the weight of the body of the person performing CPR without flexing the arms.
- Cardiopulmonary Resuscitation must be maintained until specialized help arrives or until there are signs of return of circulation: return of consciousness, redder skin, breathing returning to normal.

Stages:

1. Evaluate the patient´s, the rescuer´s and the site safety;
2. Call emergency service;
3. Check the patient´s condition (level of consciousness and signs of presence of circulation);
4. Initiate the CPR maneuvers;
5. Place the Automatic External Defibrillator (AED) – if available.

Source: American Heart Association 2015 Highlights: CPR and ECC Guidelines Update.

Figure 3: OHCA chain of survival

Rhythm/frequency

Perform 30 compressions at a frequency of 100 to 120 compressions/min for 2 ventilations only if you have a mask (Pocket Mask); or a manual insufflator (bag-valve-mask) and if you are a health professional according to AHA recommendations [9].

Source: Mountainside Medical Equipment

Figure 4: Pocket Mask

Source: Medicalexpo

Figure 5: Bag-valve-mask

Otherwise, ventilation is not recommended, for the safety of the patient and the rescuer, because if s/he is a lay person, without any BLS training, he will not know the anatomy to open the airways, neglecting the time of compressions, he will not know how to do the ventilation correctly, which can lead to clinical problems such as bronchospraction, decreased blood return and if s/he is a professional or a lay person with BLS training, s/he might come into contact with secretion and might be contaminated with some infectious disease.

As a matter of fact, as the focus of the project is to train people who are not health professionals in accordance with the guidelines of the American Heart Association (AHA) [9], it is not recommended for them to perform the ventilations. So, in these cases, what is recommended are uninterrupted compressions, for two minutes if there is someone to take turns with, and at the recommended frequency of 100 to 120 compressions/min until the emergency service arrives or until there is the reestablishment of the vital signs of the patient.

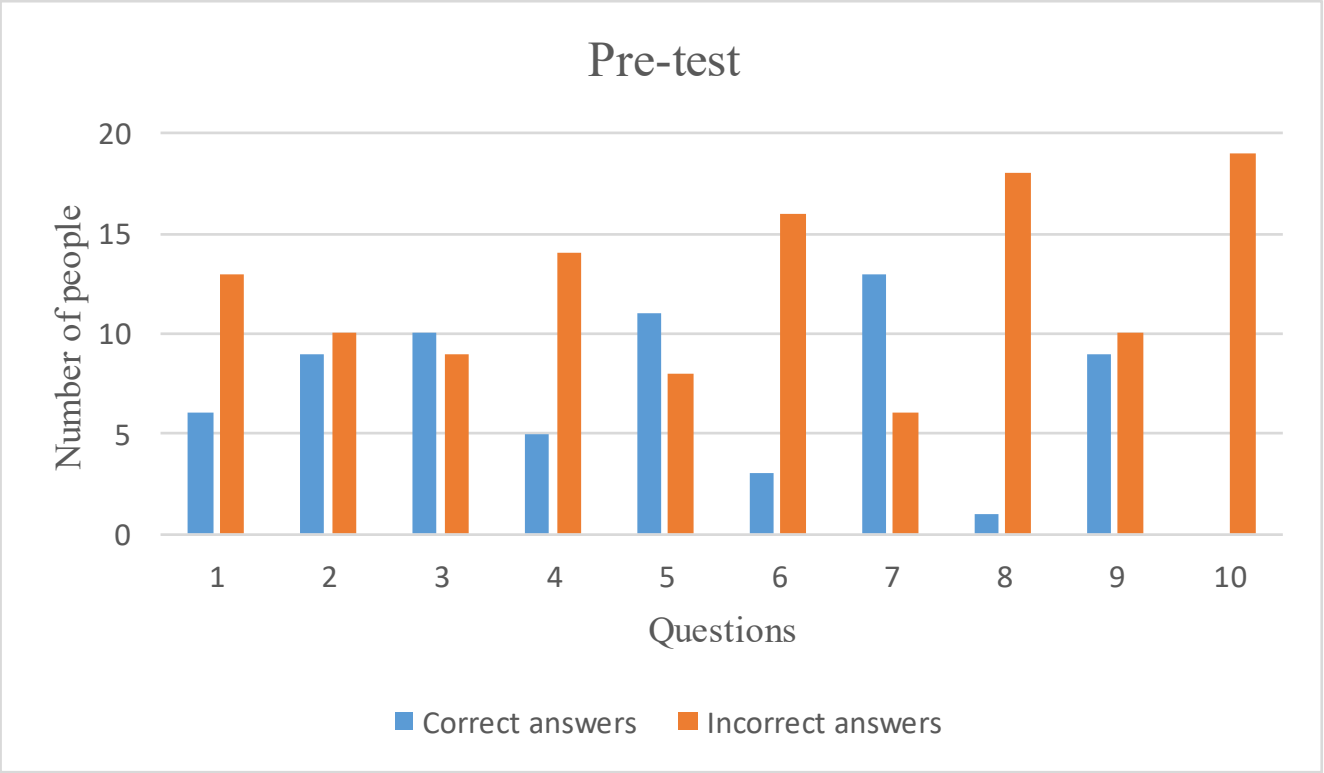
Results and Discussion

The RECYCLING TO SAVE LIVES - CPR project, through teaching participants to identify a CPA and training them how to perform a CPR in manikins with recyclable materials made by themselves, was able to unite civil servants and students from UFU, most of whom were students of the Nursing Undergraduate Course, with the population from DIST/Shopping Park. This reinforced the role a future nurse should play: act in the community as an educator, in order to contribute significantly to the prevention of diseases or even complications that may arise. Likewise, Smeltzer; Bare (2005) [17] emphasizes that the nurse, while planning health education, needs to be available to perform this work outside the conventional environment so he needs to think about alternative strategies that raise awareness in the community, unlike traditionally recommended actions. With the scientific event workshop group, there was a similar training, but with a greater appreciation of the pro-health potential, because it is a target audience mostly linked to the

biological sciences, thus combining a discussion and encouragement to selective collection, due to the materials used in the making of the manikins.

At the first moment, which was the execution of the workshops, held for an average of 25 people of different age groups in 3 meetings in different months, there was no data collection, because this was not the focus of project, but during the process of formation of the participants in the midst of conversations and exchange of knowledge it was possible to observe that some had a vague knowledge on the subject and another large part did not know what a CRA and a CPR meant. Because of this, in order to have an estimate of the population's knowledge on the subject and also in order to expand the project, the proposal of the short course for scientific events was created, totaling the training of 19 students. The data collection was carried out according to the questionnaire used containing 10 multiple-choice questions about CRA and CPR. This was done as a pre-test, before starting the intervention, and as a post-test, only applied one month later, by means of an online questionnaire sent to the participants.

Based on these questionnaires, it was possible to have a chart on participants' knowledge of CRA and CPR, which is presented below as graph 1.



Source: Designed by the authors

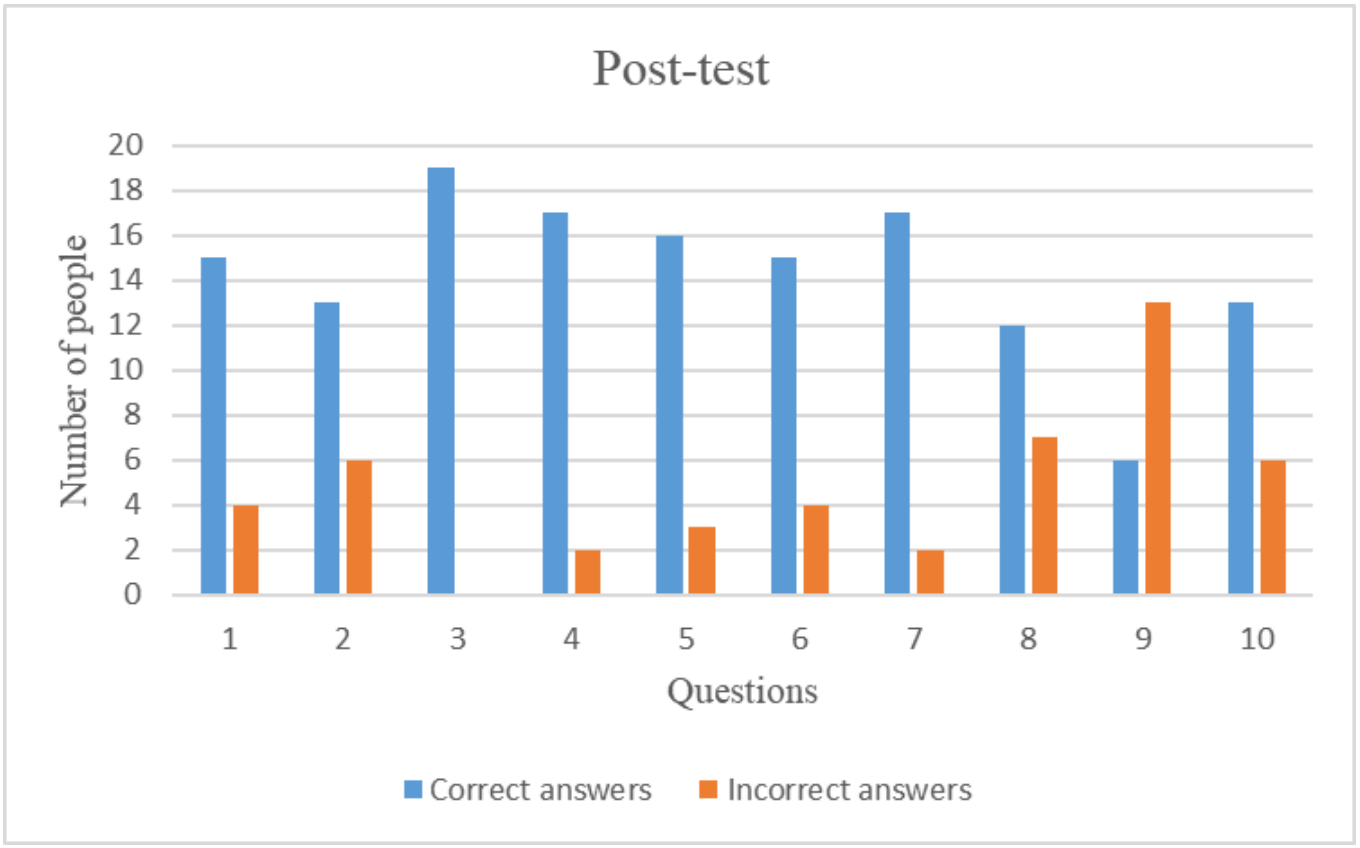
Graph 1 – Participants´correct and incorrect answers before the workshop

The questions with the highest rates of correct answers were 5 and 7, which referred, respectively, to the telephone number of the Mobile Emergency Assistance Service (SAMU) and to ventilation. This indicated that the students had some knowledge on the subject to be addressed. In addition, it's worth mentioning that questions 4 and 5 were elaborated in order to demonstrate the importance of knowing the telephone number of the emergency service that is offered in the city where you live or are passing through. However,

in question 4, which refers to the telephone number of the Fire Department (193), the students had more difficulty, what can be confirmed by the relatively high rate of incorrect answers, mainly because they were confused with the telephone number of SAMU (192) or even with the one of the Military Police (190), but also because it is not the main emergency number in the city, differently from the case of Belém-PA (Brazil), where a workshop took place. There, SAMU (192) is responsible for pre-hospital care.

Although some research participants didn't achieve the expected goal in these questions, this doesn't constitute a disadvantage, as the simple act of calling an institutionalized sector is already a positive aspect when this is compared to those who would not call any in search of help, because they don't know what number to dial. This importance is observed because these institutions usually have an interaction and a partnership to be able to help the patient and speed up the assistance to the population.

On the other hand, the questions with the highest rates of incorrect answers were 6, 8 and 10, whose subject referred, respectively, to the correct sequence that the rescuer must follow in an emergency care of a patient in CRA, the historical issue of CPR and the AED. The latter shows that the population doesn't know what an AED is and what its function is. Hence, from the execution of the project during the workshops, it was possible to notice with the analysis of the quantitative data collected in the pre-test that in an emergency situation lay people, not health professionals, would not be able to recognize a CRA and perform an effective CPR, thus preventing a quick and adequate response, which is essential in these cases until the emergency service arrives.



Source: Designed by the authors

Graph 2 – Participants´correct and incorrect answers 30 days after the workshop

In order for the participants to process the content and the practice offered in the workshops, in their community environments, after 30 days the post-test was conducted online, containing the same questions, but with a different structure from the pre-test, in the perspective of observing the rates of correct and incorrect answers, in addition to distancing themselves from biased results, because it's a short-term approach. Likewise, it was chosen not to carry out the post-test immediately after the completion of the workshops in scientific events. Thus, through the quantitative analysis of this data, it was possible to observe that although the rates of correctness increased in most of the questions, the rates of incorrect answers were still high. Question number 3, which approached how to perform a CPR with quality, reached 100% of correctness, demonstrating that the approach of project was efficient, for not having been restricted only to theory, but having associated it with practice, through the use of recyclable manikin, which prompted to correct and solve the doubts of performance of CPR and enable a better assimilation of the content by the participants. However, Question number 9, which addressed the purpose of CPR, reached low rates of correctness, which prompted the understanding that the participants understood how a CPR is performed and that it needs to follow a sequence (question 6) as well as be carried out with quality (question 3), however, they didn't assimilate its purpose, and this may have occurred because it's a short-term course. Therefore, we consider that health education activities need to be more present in educational environments and not only at certain moments of intervention, as proposed by our project, because we suppose that over time theoretical and practical knowledge might be forgotten.

Based on this study, it is clear that the teaching of BLS should be included in the school curriculum from infant to primary education, but also in universities, where this teaching ends up being restricted to health courses. As it was identified in the conversations with the participants of the scientific event workshop (most of whom were undergraduate students in Biological Science), one of the motivations for having chosen the workshop was the need of having access to more specific health issues in their curriculum. Another motivation was that the topic would help to deal with this situation in the school environment in case of first aid, but also to be able to teach students how to make the manikin, as well as to inform them how to proceed in cases of CRA and how to perform CPR with quality.

In this context, the insertion of this content in the curriculum would be a way for students to have constant contact with this knowledge and systematic training, because studies show the importance of the number of trainings on a short-term basis to obtain a rapid response and early onset of CPR, thus improving the prognosis of a victim in OHCA [18]. Furthermore, according to Fernandes et al. (2014) [19], schools are ideal environments for the population to learn about Basic Life Support techniques, thus improving the chances of a more favorable prognosis for pre-hospital CRA patients.

However, in Brazil, Law Nº 13,722 of October 4th, 2018 [20] only guarantees mandatory trainings in basic notions of first aid for teachers and employees of public and private educational establishments of basic education and of children's recreation establishments, therefore there's no legislation that requires their teaching in educational environments. Hence, it's clear that programs to raise awareness of the population must also be part of the public policy agenda in order to reduce mortality from sudden cardiac death in the country [18].

Through the quantitative data analyzed and the workshops held, it was possible to observe the participants had insufficient knowledge on the subject. Moreover, there is not much data available to make a

comparison, because in the national literature, there are few studies with specific statistics about the knowledge of the lay population on BLS, so the indicators of this study become favorable for the development of new health interventions, including more effective public policies. The fact that this training involves life-threatening situations that should be managed in order to reduce morbidity and mortality caused by accidents and emergencies meets the need to enhance the knowledge of these subjects in the country [21] and to propagate in a similar way to what happens in Sweden, according to a study. There approximately 30% of the population is trained in CPR and out of 30,381 cases of pre-hospital CRA analyzed, 51.1% of the occurrences resuscitation maneuvers were performed before the arrival of the emergency medical service, which was associated with better results in 30-day survival when compared to patients who didn't receive CPR before the arrival of the emergency service [22].

Conclusion

The project achieved its goal, as it reached good results with the training in the workshops, for two different public. In addition, the participation of the students added expanded knowledge on the subject, because they learned, performed and taught the technique of Cardiopulmonary Resuscitation, and also could emphasize the importance of the preservation of the environment, avoiding the incorrect disposal in nature, as well as, helped the cooperatives of recyclable materials collectors, with the promotion of health and health education, with the community, then playing an important role of fundamental responsibility of the University in terms of social contribution.

Thus, through the analysis of the quantitative data of the workshops it was possible to observe that actions on a short-term basis, such as those carried out by our project have effects and are of great help to the population, but over time this knowledge might be forgotten, because they are actions that need to permeate time and be present in people's daily lives. This conclusion meets the fact that these attitudes must be taken in an emergency situation, which could happen at any given time, especially in Brazil, where the CRA rate is high. Thus, the population needs to be trained with BLS to act quickly and effectively for a better prognosis of the patient, if s/he survives. Therefore, it is undeniable that this issue should be inscribed in public policies agendas and in people´s daily lives in different ways, such as through the school curriculum.

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Students can experience flow from problem-based learning in Conservation Genetics

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Abstract

Learning in flow is the ultimate experience. Flow means being completely absorbed and focused in the moment. This study investigates the possibility of achieving flow from problem-based learning in students. Problem-based learning was used to teach Conservation Genetics to nineteen undergraduate students. Their perceptions of the learning experience were evaluated using a focus group interview. Four themes were generated: enjoyment of learning activity, cooperation, independent learning and appreciation of learning. Students were thoroughly engaged in the learning activity and simultaneously driven by curiosity and interest of the subject to remain challenged, focused and motivated at the task at hand. Problem-based learning applied in teaching Conservation Genetics influenced enjoyment, an aspect of flow during the learning activity. These findings suggest that the flow experience induced from problem-based learning enhances student learning and appreciation of the subject.

Keywords: problem-based learning, flow, focus groups, students, cognition, Conservation Genetics

1. Problem-based learning

Problem-based learning (PBL) is a teaching model where students learn by facilitated problem solving (Hendricus Gerard Schmidt, 1983; Henk G Schmidt, 1989). Using problem-based learning offers opportunities for students to collaborate with each other and develop critical thinking skills (Pennell & Miles, 2009) and problem-solving abilities (Henk G Schmidt, 1989; Tiwari, Lai, So, & Yuen, 2006). Other reported benefits from problem-based learning include improvement in communication skills, motivation and a wider appreciation of knowledge among students (Duch, 1996; Duch, Groh, & Allen, 2001). Throughout this paper, the abbreviation PBL will be used to refer to problem-based learning.

Depending on the pedagogical design and how teaching occurs, problem-based learning can carry different meanings and generate different educational objectives (Barrows, 1986). A subject area can be adapted to PBL with a little creativity (Duch et al., 2001). In PBL, the instructor takes on the role of an educational facilitator rather than that of an authoritarian role in transmitting knowledge and dispensing facts to students (Maudsley, 1999). Problems used in problem-based learning should not only reflect course learning

objectives but also possess a level of complexity that will allow students to apply their knowledge from previous courses and relate solving the problem to real world examples. By solving the problems used in a PBL session, students should feel encouraged to gain deeper understanding and learning of concepts and be confident in the decisions they make in solving the problem (Duch et al., 2001; Kilroy, 2004).

At Monash University in Australia, problem-based learning was incorporated into several courses in the civil engineering degree (Mills & Treagust, 2003). The courses included Hydraulic Engineering, and Water and Wastewater Engineering. Problem-based learning was used to address teaching issues in Engineering such as the lack of design experiences, insufficient integration of technical courses related to industrial practice and the need to incorporate more opportunities to students to develop communication skills and teamwork experience (Williams & Williams, 1994). Results from a survey of second to fourth year students in the engineering degree showed that problem-based learning was well received by students. Students reported positive feedback on using real world applications and the development of technical and problem-solving skills (Hendy, P. L. & Hadgraft, R. G, 2002). Besides engineering, PBL has also been used in other academic areas such as architecture (Maitland, 1997), teacher education (Oberlander & Talbert-Johnson, 2004) and the health sciences (Poulton, Conradi, Kavia, Round, & Hilton, 2009; Savin-Baden et al., 2011).

Several studies have published on PBL in science subjects (Belt, Evans, McCreedy, Overton, & Summerfield, 2002; Dahlgren & Dahlgren, 2002; Dochy, Segers, Van den Bossche, & Gijbels, 2003; Hsieh & Knight, 2008; Padmavathy & Mareesh, 2013; Ram, 1999). Current review of literature related to PBL in science is mostly in favour of this teaching model despite differing interpretations and approaches in research design and analysis (Walker & Leary, 2009). Despite several positive aspects of problem-based learning, it is not without shortcomings, for instance how accurately can instructors gauge students' comprehension of complex science data through problem-based learning, and whether faculty time for instructors to impart factual knowledge to students is at risk during a problem-based learning (Albanese & Mitchell, 1993). Lessons taught in PBL tend to cover less content in class time and may also deviate from the syllabus which is more reliably covered by traditional lectures (Woodward, 1996). Therefore PBL students do face a dilemma of meeting the expectations of covering both sufficient and relevant content (Dahlgren & Dahlgren, 2002). Yet, these students retain a greater proportion of their learning in comparison to their traditionally taught peers (Coulson, 1983; Eisenstaedt, Barry, & Glanz, 1990).

Most of the studies in problem-based learning have focused on pedagogy and the learning process. The relationship of the facilitation of flow in problem-based learning is still understudied. In fact, few studies have discussed student experience of problem-based learning through the concept of flow. While there is evidence in the literature concerning the contribution of both flow (Scherer, 2002) and PBL to students' learning (Kilroy, 2004), it would be interesting to add to the knowledge gap by investigating whether problem-based learning has the potential to induce flow amongst students during the learning process. As such, the aim of this study is to investigate the potential of problem-based learning in inducing flow during the learning process.

2. Flow theory

Flow is a state of optimal human experience where an individual is completely immersed in an activity which is intrinsically enjoyable with a simultaneous integration of concentration, challenge and management of skill at task (M. Csikszentmihalyi, 1990; M. Csikszentmihalyi & Csikszentmihalyi, 1988). Csikszentmihalyi describes flow in nine dimensions: autotelic experience (akin to enjoyment and self-rewarding feeling in the task), clear goals, feedback, balance between challenge and skills, sense of control, loss of self-consciousness and an altered sense of time (M. Csikszentmihalyi, 1990; M. Csikszentmihalyi & Csikszentmihalyi, 1988). Individuals in a state of flow perceive the activity to be almost effortless and in essence, reacts in harmony with the activity akin to being present in the moment where the experience becomes its own reward (Nakamura & Csikszentmihalyi, 2002). Maintaining a balance of challenge and skills is important for flow to occur because when this balance is disrupted, feelings of apathy, boredom or anxiety are likely to be experienced. Individuals in a state of flow seek to continue the activity that brings the experience to them, resulting in a development or improvement of their skills (M. Csikszentmihalyi, 1990; Mihaly Csikszentmihalyi, 1997; Nakamura & Csikszentmihalyi, 2002).

Flow theory is universal and inherently related to learning (Mihaly Csikszentmihalyi, 1997; Shernoff & Csikszentmihalyi, 2009). In the context of flow in education, most published studies agree that students experiencing flow are likely to become engaged in learning and motivated (Ellwood & Abrams, 2018; Raettig & Weger, 2018; Schworm & Holzer, 2018). Despite extensive research in flow, only one study has published on problem-based learning linked to flow experience (Barrett, 2010). Using a critical discourse analysis, Barrett (2010) proposes that the concept of the PBL process as finding and being in flow will encourage instructors' thinking and facilitating of practising PBL in new ways. For students, Barrett argues that the long-term benefits for those who experience flow during problem-based learning are the fostering of thinking and creativity in the learning process which may be extended across a wide range of situations, in higher education and in future employment.

Research in flow has involved both quantitative and qualitative methods. The Experience Sampling Method (ESM) has traditionally been used to gather insights into how people think and feel in their daily life activities (Bechtel & Churchman, 2003; Mihaly Csikszentmihalyi & Larson, 2014). Researchers can also use ESM to obtain empirical data to better understand how people's experiences are shaped (Mihaly Csikszentmihalyi & Larson, 2014). Many studies have researched the psychological states on flow by using the Flow State Scale (Jackson, 1996). Nevertheless, the evaluation of flow from a quantitative perspective differs from that of a qualitative perspective. Quantitative approaches tend to work with facts and values in contrast to the artistic understanding-seeking features of qualitative approaches (Smith, 1983). Thereby this study intends to evaluate the potential attainment of flow by combining inductive and deductive thematic analyses in order to better understand the emotional and cognitive aspects of students during the learning process.

3. Methodology

Participants were nineteen second year undergraduate students enrolled in the Bachelor of Science Zoology programme at the University of Cumbria. The taught module was Conservation Genetics. Following ethical guidelines, written informed consent was obtained from all participants.

The students were randomly divided into four groups. Each group was then randomly assigned a Conservation Genetics problem to identify, solve and share their solutions with their peers in class. The lecturer initiated the PBL session by talking around topics related to the problems and encouraging students to work together on further inquiry into the problem and how answers or solutions could be reached. Each group was encouraged to communicate their answers to the class by taking turns to speak, sharing written work or through visual representations such as PowerPoint slides. The learning process stages undertaken by the students were the following: to identify and select the learning issues in their assigned Conservation Genetics problems, work on the identified learning issues, peer-teach one another, and discuss and deliberate to complete the task given.

A focus group interview (Kitzinger, 1995) was held. The discussion lasted approximately twenty-five minutes and was audio-recorded and transcribed. Data collection was carried out adhering to BERA guidelines (BERA, 2011). Collected data were stored in compliance with the UK Data Protection Act 1998 (ICO, 2015). In this study, data are presented verbatim and should be viewed as illustrative rather than generalisable. The following issues were explored with the undergraduate students: their experience of problem-based learning, the influence of problem-based learning on their perception of Conservation Genetics, and their opinions about the inclusion problem-based learning into their Zoology curricula.

The data was analysed using a hybrid thematic approach of inductive and deductive coding and theme development (Fereday & Muir-Cochrane, 2006; Nowell, Norris, White, & Moules, 2017). Student responses from the focus group interview were transcribed verbatim and subsequently rechecked for possible errors to ensure veracity. Coding of the themes were identified by thorough examination of the transcript by the author and an independent researcher who was blinded to the study. The topic of problem-based learning on Conservation Genetics, data to be coded and rules of interpretation were discussed with the independent researcher. The emerging themes were compared to relevant literature against the backdrop of Csikszentmihalyi's (1990) Theory of Flow as a philosophical framework. There was unanimous agreement between the author and the independent researcher on the themes generated from the data.

4. Findings

All participants in the study perceived the problem-based learning session to be enjoyable and beneficial. Students also described differences between discussions during problem-based learning and the usual lecturer-student discussions held in class. Problem-based learning discussions involved identifying facts, student enquiry and generating ideas related to the problem assigned to them. Students felt that there was more work involved in problem-based learning but believed that learning this way could yield positive

results if they put enough effort into it. Students reported an appreciation of Conservation Genetics and a renewed interest in Molecular Biology. Students welcomed the incorporation of problem-based learning into their curricula.

Four main themes were generated from the data:

- Enjoyment of learning activity
- Cooperation
- Independent learning
- Appreciation of learning.

The following themes are introduced using illustrative quotes from the focus group participants to help make the analysis transparent.

Enjoyment of learning activity

Majority of the students reported having enjoyed working together on the problems and learning from each other. Problem-based learning was perceived to be interesting, thought-provoking and engaging.

> *"This was great! Are we doing this again?"*
> *"I liked it, I thought it was good"*

One student mentioned that problem-based learning helped him to relate concepts of Conservation Genetics to pressing conservation issues such as environmental threats faced by endangered animals.

> *"This is better than usual lectures. I found myself thinking of DNA from ospreys and how it could actually be done, can we use feathers…"*

The spontaneous question of DNA from ospreys led to understanding feather keratin and enquiry into using feathers as a source of DNA because it is a non-invasive method of obtaining DNA from birds.

> *"We covered a wide range of topics and it was easier to grasp concepts."*

Students found themselves having to unpick problems when discussing molecular methods used in solving crimes in wildlife. The issue of sharks fin soup served in Asian restaurants came up which led to students discussing whether DNA could be isolated from cooked foods. The act of learning was deemed enjoyable by students in that asking questions about the origins of sharks sold in food markets led to enquiry about the integrity of DNA isolated from cooked or raw foods, whether cooking temperature had any effect on the quantity of DNA available, if a polymerase chain reaction could still take place with the DNA extracted and whether the size of a fragment to be amplified would affect the determination of species which could in turn, shed light on the origin of the food samples. The process of reaching answers through discovery

and enquiry was presumably enjoyable to students. They were able to appreciate the many practical applications of DNA testing.

Cooperation

Students commented that it was easier to work on the problems together because they could delegate tasks and share the burden of studies. Cognitive collaboration through problem-based learning offered them opportunities for peer teaching and learning:

> *"It took us less time to put the answers together because someone else was doing something and then we just looked at we found."*

It was interesting to observe students taking charge of their learning. Students were seen explaining things to each other according to how they understood them. Whilst working together on the issues of genetic management of endangered species, they assigned tasks to each other looking at small inbred populations, fragmented populations, the management of gene flow involving translocation of pre-adapted individuals, and the genetic impact on reserve design. This showed students taking responsibility for their own learning and developing their own learning experiences which support independent learning.

One student also mentioned that she needed more time to take notes as some of their peers either spoke too quickly when presenting their solutions to the whole class. This suggested that students needed to improve on presenting within the given time limit.

> *"I couldn't take notes when everyone was talking, it was too quick to do so. It was only possible to take notes from the lecturer writing."*

This suggested that students would benefit from further cooperative and collaborative learning. This would not only involve them in active learning but also allow them to reflect and adjust their progress. For example, thinking about how much time they allowed each person to speak during their discussions, reflecting whether they covered their main learning goals and whether they questioned each other and waited for responses. Students could also individually reflect about their working habits as to whether they contributed sufficiently during group work, if they still needed to improve over the time spent working with their peers, and what else they would need to develop or work on to improve their progress. They recognised the value of cooperation in learning.

Independent learning

Students reported that they learned the subject matter more thoroughly through problem-based learning than the usual lecture- and discussion-based session. Problem-based learning had provided opportunities for students to revisit and reflect on their ideas and solutions.

> *"I learned more about the topic by looking into it."*

This indicated students' comprehension of learning and a willingness to structure their own learning by reflecting on how learning would take place for them. In other words, students controlling the pace and direction of their learning. This theme demonstrated a greater degree of student autonomy even though their lecturer had been involved in facilitating their problem-based learning session.

One student mentioned that problem-based learning helped him to critically think about Conservation Genetics concepts and organise the way in which he should study. Having experienced problem-based learning in class, he said that he felt more confident about the written examination.

> *"This will help in preparing for exams. I could try organising material like this at home when I'm studying."*

This observation was one of thought and reflection in a student that indicated intention of independent self-learning and adopting an alternative strategy of studying. Taking responsibility for their own learning charge of their learning may increase their engagement and enhance their appreciation of the subject.

Appreciation of learning

The problem-based learning session bridged the gap between theory and lab practicals. Some students found themselves discussing molecular methods away from the laboratory and how these methods related to conservation crimes and issues. The author's observations were that the PBL session had facilitated meaningful learning of Conservation Genetics for them, rather than Conservation Genetics being studied as merely scientific information.

> *"PCR [polymerase chain reaction] makes more sense now."*

One student described feeling more confident in studying Conservation Genetics.

> *"I will be able to answer if a question on lab techniques comes up in the exam."*

Another expressed an optimistic view of Molecular Biology. If given the opportunity, he felt that he would be able to learn and excel in the subject.

> *"Maybe I could do a molecular biology dissertation."*

During the PBL session, students were not tested but rather, allowed to generate their questions and develop creative solutions to their questions. Hence, conservation topics discussed became more meaningful to them and they perceived the application of Genetics to Conservation to be purposeful and significant. This optimistic perception of learning Conservation Genetics through PBL where students could conduct study at their own pace indicated that their expressions were appreciative of learning.

5. Discussion and conclusion

This study evaluated student experience of problem-based learning in Conservation Genetics. The first theme generated through the analysis is *Enjoyment of learning activity*. It is an important finding because enjoyment is one of the subjective conditions postulated in Csikszentmihalyi's concept of flow (M. Csikszentmihalyi, 1975; M. Csikszentmihalyi & Csikszentmihalyi, 1988; Mihaly Csikszentmihalyi, 1997). When one enjoys an activity whilst experiencing a balance in challenge and skill, he becomes completely immersed in the activity and is likely to continue engaging in the activity (M. Csikszentmihalyi, 1990). In this study, the students' enjoyment of learning encouraged their further exploration of DNA methods in Conservation Genetics. They wanted to find out more about the topic and their learning involved other issues or queries that came up from the topic in question. In education, flow experience has been examined in music (Bakker, 2005; Custodero, 2002; Fritz & Avsec, 2007), science (Ibáñez, Di Serio, Villarán, & Kloos, 2014), design (Reid & Solomonides, 2007) and physical education (González-Cutre, Sicilia, Moreno, & Fernández-Balboa, 2009). Collectively, these studies suggest the importance of enjoyment in setting a conducive attitude to learning amongst students. If students enjoy learning, their depth of understanding of concepts will increase (Blunsdon, Reed, McNeil, & McEachern, 2003; Prosser & Trigwell, 1999). Students will then be more willing to think critically (Inkelas and Weisman, 2003). The findings of the current study also agree with Blunsdon and colleagues' (2003) that enjoyment occurs prior to learning but can also be conceived as a parallel experience or as a result of learning.

The second theme is *cooperation*. Student interaction in class can either be competitive, individual or collaborative including taking on responsibility for each other's learning (Webb, 1982). Cooperation is a functional component from Johnson and Johnson's (1999) educational theory of cooperative learning which postulates that cooperative learning is achieved when students working together on a shared learning goal. In their study, Khine and colleagues (2017) found that cooperation correlated significantly with student cohesiveness, student involvement and task orientation. Task orientation refers to the extent in which students organise required actions and perform activities involved in solving the problem (Fraser, McRobbie, & Fisher, 1996). This implied that cooperation amongst students was influenced by how well students knew, communicated and connected with each other. Cooperation in turn, influenced how students negotiated problems in class (Blumenfeld, Marx, Soloway, & Krajcik, 1996; Khine, Fraser, Afari, Oo, & Kyaw, 2018). Cooperation amongst students leads to team building (Hansen, 2006; Kagan, 1989) and encourages peer learning, teaching and problem solving (Qin, Johnson, & Johnson, 1995; Tannenbaum, Beard, & Salas, 1992; Topping, 2005). It has the potential to enhance critical thinking (Gokhale, 1995). *Cooperation* in the current study also highlighted issues in the development of presentation skills (J. R. Johnson & Szczupakiewicz, 1987) where students could benefit from learning to control the pace of their presentation to keep time and allow audience interest and responsiveness (MacIntyre, Thivierge and MacDonald, 1997). Previous studies have shown that students in cooperative conditions enjoy learning more than those involved in individualistic learning (D. W. Johnson & Johnson, 1999; R. T. Johnson & Johnson, 1986, 1991; Slavin, 1983). In their game-based civic learning study, Raphael and colleagues (2012) reported that students who experienced high quality cooperative learning also experienced higher levels of

flow compared to those who had less cooperation amongst themselves. The relevance of *cooperation* to *enjoyment of learning activity* in this study suggests the compatibility of these themes in problem-based learning. While it may be that students in the current study experienced alternating states between *cooperation* and *enjoyment of learning activity*, the author's observations during the problem-based learning session were that students discussed their self-generated questions and answers, and collaboratively interacted with each other, suggesting simultaneous engagement in both *cooperation* and flow through *enjoyment of learning activity.*

The third theme is *independent learning*. Independent learning involves effective organisation of study material and preparation (Cottrell, 2013; Kember & Gow, 1994). It also paves the way for self-enquiry (Kimmons & Spruiell, 2005) and academic maturity in students (Berzonsky & Kuk, 2005). Students who take responsibility for their learning are likely to achieve better academic performance (van Den Hurk, 2006). Student responses in the current study accentuated the advantage of the PBL session over the usual discussions held in class which was indeed, the process involved in problem-based learning. While usual class discussions revolved around a topic that was being taught, the dynamics of learning during PBL involved students identifying facts, generating ideas and encountering learning issues related to the problem assigned to them (Hmelo-Silver, 2004). This led to students taking charge of their learning and generating self-explanations in solving and understanding the Conservation Genetics problems assigned to them (Chi *et al.*, 1989). In the context of flow, *independent learning* in the current study is synonymous to developing skills, talents or creativity which occurs in individuals who continue to follow their sense of enjoyment in the task they choose to do (M. Csikszentmihalyi, 1990). In the current study, students' experience of enjoyment may have encouraged independent learning by way of their further inquiry and expressed intention of self-studying the Conservation Genetics topics discussed in the problem-based learning session.

The fourth theme is *appreciation of learning*. *Appreciation of learning* has important implications particularly in overcoming barriers to understanding molecular biology concepts linked to conservation (Taylor, 2006). In the current study, students were able to relate Conservation Genetics principles to real life examples of issues and problems encountered in this area of study (Distlehorst, Dawson, Robbs, & Barrows, 2005). Appreciation of the Conservation Genetics module through problem-based learning may encourage self-directed learning traits and motivate students to excel in their studies (Abdullah & Abas, 2011; Albanese & Mitchell, 1993; Walton & Matthews, 1989). When students express appreciation of learning, they are likely to be more engaged in meaningful learning and progression of their studies (Abdullah & Abas, 2011; Brophy, 1999).

The findings of the study suggest that *enjoyment of learning activity, cooperation and independent learning* contribute to *appreciation of learning* (as illustrated in Figure 1). Flow experienced through *enjoyment of learning activity* during the PBL session encouraged students to appreciate, value and seek to learn more of Conservation Genetics. Mohammad-Davoudi and Parpouchi (2016) reported that enjoyment of learning activity correlated with team cooperation in their study of team-based learning environments amongst medical students in Tehran. They found that team cooperation, enjoyment and motivation significantly

influenced learning results. Although the current study's analyses did not yield motivation as a theme or evaluate learning results, the findings broadly support Mohammad-Davoudi and Parpouchi's work in linking enjoyment and cooperation in learning. The current study also corroborates the ideas of Covington (1999) who suggested that students were more likely to appreciate learning if they were interested in their subject of study, when they could achieve their study goals and more likely when the reasons for learning were mostly task-oriented. The problem-based learning session was also task-oriented and students had worked together to reach possible answers to the problems posed to them. Brophy (2008) argues that students' appreciation of learning can be fostered with engaging and motivating learning activities and by shaping what they learn in ways that will help them to appreciate the value of their lessons. Instead, this study shows that appreciation of learning may be shaped by students' learning, reflecting, actions and reactions from problem-based learning. Once they show commitment and responsibility to their own learning, they tend to appreciate it more.

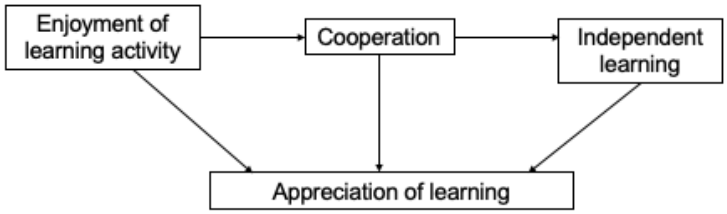

Figure 1. Themes derived from problem-based learning in Conservation Genetics

While the results of the current study are promising, they should be evaluated in light of the study's limitations. Students served as their own controls. Whilst this study focused on the perceptions of undergraduate Zoology students in the delivery of a Conservation Genetics session through problem-based learning, it did not include comparisons with student experience of traditional lecture- and discussion-based instruction. Future research under the same theme could examine the implications of longer term PBL instruction to enable the evaluation of student perceptions over time. Further work could also employ complementary analysis approach in mixed methods (Bazeley, 2017).

To summarise, problem-based learning in Conservation Genetics was well received by the undergraduate Zoology students. Students reported positive outcomes from their experience of problem-based learning. This results discussed in this review show that problem-based learning has the potential to induce flow amongst students during learning. The findings of the current study support the view that problem-based learning is an effective pedagogical approach in teaching and learning, and attainment of flow experience from problem-based learning.

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Contextualisation Method for Measuring the Degree of Innovation in Micro and Small Enterprises

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Abstract

The methodologies proposed for measuring the degree of corporate innovation require a relevant selection of indicators. Nowadays, there is a growing number of indicators that can be used to describe innovation management and measure the degree of innovation. However, these indicators only provide a partial outlook of the degree of innovation, being often incomplete. Therefore, it is important to create compound indexes comprising different indicators, weighting factors and coefficients able to contextualise the conditions and characteristics of the elements analysed. This enables an assessment of the importance of contextualising indicators for measuring the degree of innovation based on the influence of different weighting factors and coefficients directly related to the context analysed. In this regard, the present work was aimed at contextualising the tool used for measuring the impact of innovation – INOVA-tec – and draw a comparison with the Innovation Radar for measuring the degree of innovation of a Micro and Small Enterprise (MSE). In addition, the present work developed a new methodological approach focused on contextualising the process for measuring the degree of innovation of business organisations based on the analysis of two MSEs. Both methodologies were applied for the measurement of the degree of innovation of 2 different retail companies from the textile and clothing sector. The results obtained concluded that the adapted version of INOVA-tec allows to contextualise the process of measuring the degree of innovation in MSEs by considering different perspectives and particularities taking into account the context of the companies analysed and the innovation actions implemented. Moreover, it enabled to assess the relevance of the indicators with regards to the value chain or type of service provided, considering different time frames and geographical scopes of the actions and their respective impacts. The adapted version of INOVA-tec also provides a greater range of analysis of the results, with a wider scope of categories which are directly proportional to the weighting criteria, weight ranges and correction factors adopted in the indicators considered. The Innovation Radar, which provided a contextualisation of the indicators analysed, showed an overlap of the degree of innovation between the different profiles of business innovation.

Keywords: innovation; INOVA-tec; Innovation Radar.

1. Introduction

As a result of the extraordinary changes that have taken place worldwide, innovation has become a fundamental requirement for small, medium or large enterprises from various economic sectors. Therefore, it is no longer enough to offer high-quality goods and services to customers. Many companies which used to produce goods and offer high-quality services remained wedged in the past as a result of the lack of innovation, being overtaken by companies that boast unique products and services (SILVA et al., 2008).

The innovation process of goods and processes can be defined by the act of producing new products or processes, or even simply the improvement of existing goods or processes. Moreover, they should be introduced in a specific market or used throughout processes or productive workflows, aiming at generating new products or boosting existing ones. To be considered technologically innovative, a certain good or process does not necessarily require uniqueness, although it should be unprecedented within the enterprise to which it is inserted in (OECD, 2004).

Innovation is the main agent of change in today's world, with innovation granting various competitive advantages to companies, also leading to economic growth and a more sustainable development. Companies from any sector require constant innovation in order to ensure growth, competitiveness and success (MARTIN; NAMUSONGE, 2014).

The importance of innovation as a factor for economic growth or a certain organisation has been acknowledged in various researches present in the literature, which have shown that innovation is able to incorporate new high-quality products and services aiming at a reduction in the price of the goods offered to society. This allows taking over new customers and expanding production (CAVALCANTI et al., 2015). Moreover, Martin and Namusonge (2014) and Silva et al (2008) verified the direct relationship between the level of innovation and profitability of companies analysed as part of their studies.

The contemporary corporate world is full of innovative actions which constantly emerge. Companies from almost all economic sectors are faced with new products, as well as novel processes and services which are created and deployed in the consumer market at an unprecedented speed (SILVA, 2008). In this regard, most innovative companies experience a greater turnover of products and services introduced within a certain period of time (MARTIN; NAMUSONGE, 2014).

Therefore, innovation is a process which grants a certain advantage to companies when compared with their competitors, by reducing costs from improving processes, increasing productivity, distinct marketing strategies, new forms of relationship with customers, among other improvements (OECD, 2004).

In this regard, innovation management provides greater market viability, even enabling to reduce the time between launching a given product and the effective return of investment (JESUS, 2011).

Within the context of sustainable development, Cavalcanti et al. (2015) pointed out that innovation must be based on decisions supported by policies and processes which are reliable, transient and boasting appropriate metrics. However, the greatest drawback of innovation management is associated to the lack of metrics capable of providing information related to the best innovation investment options, or the absence of an assessment of the actions that should be promoted to boost the development of an organisation. For companies to boom, they must be supported by an innovative approach which grants them a competitive advantage in their predominant business environment (MARTIN; NAMUSONGE, 2014).

The search for innovation indexes to analyse companies requires an initial selection and an appropriate assessment of existing indicators. Nowadays, there is a growing number of indicators which can be used to describe an innovative process, enabling to capture relevant aspects of this process. Nonetheless, these indicators often partially descriptive or even incomplete, thus justifying the development of compound indexes consisting of several indicators (FURTADO; QUEIROZ, 2007).

According to Furtado and Queiroz (2007), innovation indicators can be subdivided into those that measure inputs or efforts, and into those that measure products or the results of innovation. On the other hand, Bachmann and Destefani (2008) consider that the indicators traditionally used to measure the level of innovation in organisations, such as the "number of patents" and "R&D expenditure", are not entirely applicable to micro and small enterprises (MSEs). According to the authors, "although financial metrics are relevant to the corporate world and possibly the best form of assessing both the strain and benefits of innovation processes, this approach was considered incompatible within the context of MSEs".

In this regard, the measurement of a company's level of innovation is based on issues originating from different dimensions and scope. These require the use of diagnostic tools, monitoring and support to decision-making in MSEs, capable of analysing and reflecting on certain peculiarities related to the specific context of MSEs.

With this in mind, this work was aimed at contextualising the INOVA-tec measurement tool on the impact of innovation. Moreover, this measurement tool was compared with the Innovation Radar on the measurement of the degree of innovation in MSEs, aiming at developing a methodological approach focused on the contextualisation of the measurement of the degree of innovation in business organisations, taking into account the analysis of MSEs.

2. Contextualisation of indicators for measuring a company's degree of innovation

Innovation is a wide concept consisting of various scopes and dimensions. Therefore, measuring innovation in terms of performance is not straightforward (CAVALCANTI et al., 2015). The level of innovation of a certain company can be measured using several indicators. The wide range of indicators available in the literature allows that corporate innovation can be measured through different perspectives, under a strategic, cultural, financial, procedural point of view, among others. Nevertheless, a company's classification as innovative is not based on the sum of resources invested in innovation. An inherently innovative company is capable of adding greater value to its customers, with its abilities being consequently used as a reference basis when drawing a comparison with their competitors. Several factors influence the innovative culture of an organisation, being considered as either internal or external factors (NASCIMENTO, 2009).

According to Figueiredo (2005), it is important to identify whether the innovation capacity of a certain company is present, although it is also necessary to verify its direction, extension – or level – and speed. In this regard, it is important to take into account the fundamental principle of management, which enables an effective management of what is measurable. However, before introducing such metric in this context, it is important to consider the drawbacks of the conventional innovation indicators.

Although the four fundamental types of innovation are summarised into product, process, marketing and organisational innovation (OCDE, 2004), these can be further classified into subtypes, providing a more

detailed view of innovation. This more detailed perspective is considered under the tool denominated Innovation Radar, which considers between twelve and thirteen different key innovation dimensions (SAWHNEY et al., 2006; BACHMANN; DESTEFANI, 2008; MATTOS et al., 2010).

An enhancement of the process of measuring innovation can be aimed at overcoming linearities and considering more criteria in the score of indicators and dimensions. Therefore, the allocation of new criteria can lead to a more complex analysis, although being much more detailed and consistent within the given context. In this regard, the INOVA-tec tool enables a more thorough assessment of corporate innovation level, by applying different weighting factors, coefficients and scopes. The tool considers, for instance, inherent aspects to the chain in which the company is inserted in or the time frame of actions.

It is important to note that some companies do not have financial availability to pay for royalties for novel patents, know-how or external expertise. While other companies do have this financial availability, there is no eagerness for preparing the company for this action. Finally, there are also companies which are implementing actions for gathering the resources necessary to fund such royalties, know-how or external expertise. These three cases require considering different weighting factors, coefficients or correction factors for the appropriate indicators.

The implementation of technical standards and certifications is another example of an indicator which could lead to the application of different weights and scopes, taking into account the size, value chain, available resources and the environment where the company is inserted in. Certain companies follow technical guidelines which can be duly documented and updated. However, they do not have the financial resources to afford any advisory service aimed at preparing the company for such certifications. Therefore, as previously pointed out, different coefficients and corrections factors also have to be considered when attributing the score to this indicator.

In this regard, some aspects related to waste management and reuse can also consider different weighting coefficients as a result of the value chain to which the company is inserted in. For example, a company inserted in the food and beverage sectors will have greater opportunities for recycling waste, even generating extra profit from a reuse system, when compared to IT consulting firms, which tend to have a significantly lower volume of waste recycled.

Therefore, the compilation of data for measuring the level of innovation of MSEs can be more thorough than in the approach considered by Sawhney et al. (2006), who represented the level of business innovation by taking into account the average score of the indicators present in all dimensions analysed. These dimensions consist of almost the same coefficients, though without considering intrinsic and extrinsic aspects of companies, such as their size, the time frame, the value chain, the availability of external and internal resources, corporate behaviour, socioeconomic aspects of the region where the company is located in, or even the political, institutional and regulatory context, among other aspects.

The adaption of the INOVA-tec tool for measuring the level of innovation in MSEs enables to offer a new approach for handling the indicators presented in the Innovation Radar. This new approach is based on attributing new weighting coefficients, score ranges and correction factors which are related to the importance of the indicators in each context analysed.

This contextualisation approach for measuring innovation in MSEs was initally briefly presented by Souza and Silva (2020). With this in mind, the present work aims at describing in further detail the design and

respective coefficient, score range and correction factors referring to the development of this contextualisation process for measuring innovation in MSEs.

3. Innovation Radar

The Innovation Radar was initially proposed by Sawhney et al. (2006) and adapted by Bachmann and Destefani (2008). It is a methodological tool developed for measuring innovation by analysing 13 different dimensions related to the process of Innovation Management.

At first, this tool considered the following key dimensions: offerings, platform, brand, customers, solutions, relationship, value capture, processes, organisation, supply chain, presence and networking. Bachmann and Destefani (2008) subsequently included the innovative ambience, being attributed a weighting factor of 2 for its indicators – the only indicator with a distinct weighting factor. The level of innovation considered from the application of this method ranks a company as "Systemic Innovator", "Occasional Innovator" and "Little or not Innovative". These ranks and their respective scores are presented in Chart 1.

Chart 1. Classification of MSEs according to the scores of the degree of innovation

Type of company	Definition	Score of the Degree of Innovation
Systemic Innovator	A company that practices innovation management systematically	Equal or higher than 4
Occasional Innovator	The firm has innovated in the last 3 years, though it is not a systematic process	Equal or higher than 3 and below 4
Little or not Innovative	The company innovates little or does not innovate at all.	Equal or higher than 1 and lower than 3

Source: Néto (2012); Bachmann and Destefani (2008).

Chart 2 presents the dimensions, indicators, scores and weighting factors considered in the Innovation Radar tool, as proposed by Bachmann and Destefani (2008). The degree of innovation obtained with the application of this tool is obtained by the average score of each dimension, taking into account the respective scores of the indicators and their weighting factors (Bachmann; Destefani, 2008).

Chart 2. Dimensions, indicators, score and weight of indicators presented by the Innovation Radar tool.

Dimension	Indicators	Score	Score of the Indicator
A - Offering	- Products - Daring	1, 3 or 5	1 1
B - Platform	- Production System	1, 3 or 5	1
C - Brand	- Brand - Brand leverage	1, 3 or 5	1 1
D - Customers	- Identification of needs - Identification of markets	1, 3 or 5	1 1

	- Use of customers' expressions		1
E - Solutions	- Complementary solutions - Resource integration	1, 3 or 5	1 1
F – Relationship	- Facilities and amenities - Computerisation	1, 3 or 5	1 1
G – Value capture	- Use of existing resources - Use of opportunities for interaction	1, 3 or 5	1 1
H - Processes	- Process improvement - Management systems - Certifications - Management software - Environmental aspects - Waste management	1, 3 or 5	1 1 1 1 1 1
I - Organisation	- Reorganisation - Partnerships - External vision - Competitive strategy	1, 3 or 5	1 1 1 1
J – Supply Chain	- Supply chain	1, 3 or 5	1 1
K - Presence	- Points of sale - New markets	1, 3 or 5	1 1
L - Networking	- Dialogue with the customer	1, 3 or 5	1
M – Innovative Ambience	- External sources of knowledge I - External sources of knowledge II - External sources of knowledge III - External sources of knowledge IV - Technological daring - Innovative funding - Collections of ideas	1, 3 or 5	2 2 2 2 2 2 2
Degree of Innovation	= (Σ (Total score of dimension A / number of indicators A), (Total score of dimension B/number of indicators B), ... (Total score of dimension M/number of indicators M)) / (number of dimensions analysed)		

Source: Néto (2012); Bachmann and Destefani (2008).

Néto and Teixeira (2011) described the aspects related to the dimensions which represent the Radar of Innovation and its respective indicators, which are pointed out below:

- Offering – This dimension considers the offer of new opportunities and its results related to the implementation of new products/services. The following variables are considered: (a) new markets; (b) new products; (c) daring; (d) answer to the environment; (e) design; and (f) technological innovation.
- Platform – Analyses the company's ability of using pre-existing infrastructure resources to offer different products/services. The following indicators are taken into account: (a) production system; and (b) product versions.
- Brand – Considers the opportunities associated to the investments made in order to improving results by taking advantage of the brand to also leverage other business opportunities or using other businesses

to value the brand. Trademark also indicates the company's innovative potential. The following indicators are considered: (a) brand protection; and (b) brand leverage.

- Customers – Identifies the customers' needs, customers' suggestions and new markets, with the use of this information contributing to strengthen the company's competitiveness. The following indicators are considered: (a) identification of needs; (b) identification of markets; (c) use of customers' expressions – processes; and (d) use of customers' expressions – results.
- Solutions – Considers the importance of customised and integration combination of goods, services and information that contribute to solve customers' problems. It also involves the offer of some complementary product/service to the public, creating new revenue opportunities. The following variables are considered: (a) complementary solutions; and (b) resource integration.
- Relationship – Considers the importance of implementing easy-access facilities to customers. The following indicators are taken into account: (a) facilities and amenities; and (b) computerisation.
- Value capture – Considers the importance of adopting new forms of management to generate revenues from the analysis of information of interaction with customers, suppliers and partners. The following indicators are considered: (a) use of existing resources; and (b) use of opportunities for interaction.
- Processes – Use of modern administration methods and instruments, such as certifications, management practices or change of procedures to achieve higher efficiency, quality, flexibility, shorter production cycle or benefits for third parties. For the calculation, the following variables are considered: (a) process improvement; (b) management systems; (c) certifications; (d) management software; (e) environmental aspects; and (f) waste management.
- Organisation – Analyses the way the company is structured, the partnerships established, as well as the methods for reorganising responsibilities. The following variables are taken into account: (a) reorganisation; (b) partnership; (c) external vision; and (d) competitive strategy.
- Supply chain – Considers the importance of assessing logistical aspects of the business, such as transportation, storage and delivery. The following indicator is established: (a) supply chain.
- Presence – Considers the importance of analysing aspects related to distribution channels that the company uses to place its products/services in the market, as well as places where these items can be purchased by consumers. The following indicators are considered: (a) points of sale; and (b) new markets.
- Network – Assesses the importance of assessing aspects related to the network that connects the company and its products/services to the customer. The following indicator is taken into account: (a) dialogue with the customer.
- Innovative ambience – This dimension considers the importance of how innovative actions are stimulated through the use of information originating from external or internal sources or knowledge. The following indicators are taken into account: (a) external sources of knowledge I; (b external sources of knowledge II; (c) external sources of knowledge III; (d) external sources of knowledge IV; (e) intellectual property; (f) innovative daring; (g) innovative funding; and (h) collection of ideas.

According to Carvalho et al. (2015), the Innovation Radar has the potential of contributing to a greater competitive advantage. This tool points out which of the company's dimensions have been innovative, while also flagging which dimensions are not well explored, being important to distinguish a company within the market in which it is inserted in.

4. INOVA-Tec

The INOVA-tec tool (JESUS, 2011; JESUS, 2007) is a methodology for measuring the degree of technological innovation. It provides different score criteria to indicators from different dimensions, establishing the overall degree of innovation.

INOVA-tec presents a spreadsheet which organises the indicators and dimensions, enabling the user to consider different levels of importance or magnitude of the parameters (JESUS, 2011). With this approach, innovation is measured through a more detailed approach, which enables greater contextualisation of the level of innovation.

The spreadsheet for evaluating the indicators carries out an analysis of the different dimensions (social, environmental, economic, institutional development, qualification, introduction to technology and unexpected incidents) which can suffer from the impacts of innovations, besides those dimensions inserted by an evaluator. These are essential, as they present specific indicators which are relevant to research and innovation. The method allows the evaluator to analyse the indicators considered relevant, taking into account different weighting factors and correlation factors linked to the evaluation context. The assessment of the given indicators and dimensions generates the Magnitude Index (JESUS, 2011; JESUS, 2007).

The INOVA-tec system is able to normalise the weighting factors, though without prioritising any dimensions. For each indicator presented, the system returns weights ranging from 1 to 3 for the indicators, within a range from -2 to +2. In turn, the correction factors have a wider range, varying from +1 to +5. The range of weighting factors establishes that indicators with a higher weight present a magnified impact. In case a given indicator is not significant to represent the level of innovation under analysis, this indicator can be ignored. Moreover, new relevant indicators can be inserted within the dimension of "Specific Indicators" (JESUS, 2011; JESUS, 2007).

Therefore, the Magnitude Index is calculated following the identification of the weighting factors, weight range and correction factors of the score of indicators, as well as gathering the relevant data. The Magnitude Index is calculated according to the following equations:

i) Equation 01: Indicator Score $_{a,g}$ x Weight of Indicator $_{a,g}$ x Value of Weight Range $_{a,g}$ + Σ (Correction Factor $_{a,g}$) = Total Weight of Indicator from the given dimension $_{a,g}$

ii) Equation 02: Total weight of the given dimension $_{a,g}$ = Σ (Total weight of Indicators from the given dimension $_{a,g}$) / Number of indicators from the given dimension $_{a,g}$

iii) Equation 03: Σ (Total weight of Dimensions A, B, C, D, E, F, G) / Number of Dimensions $_{a,g}$ = Magnitude Index (Overall Innovation Index)

The adaption of the INOVA-tec tool by including the indicators and scores presented by the Innovation Radar, as well as allocating weighting factors, weight ranges and correction factors enables the presentation of more contextualizable results, taking into account the reality of the MSEs analysed in the present work. A greater contextualisation of the results presented is possible as different scopes and opportunities of the

impacts of the actions developed is considered (Chart 3). The results presented by INOVA-tec rank the companies analysed as "Very Low Performance of Indicators", or up to 25%; "Low Performance of Indicators", or up to 50%; "Average performance of Indicators", or up to 75%; and "High Performance of Indicators", above 75% of the maximum possible score.

Chart 3. Adaption of INOVA-tec (JESUS, 2011) with the addition on new dimensions, indicators, scores, weight range and correction factors.

Dimension	Indicators	Score	Weight of indicator	Weight range	Correction factor
A - Offering	- Products - Daring	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Product from the same value chain +2 – Product from a new value chain
B - Platform	- Production System	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Eventually / Temporary +2 – Systematically / Permanent
C - Brand	- Brand - Brand leverage	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Eventually / Tm +2 – Systematically / Permanent +1 – Municipal +2 – State level +3 – Regional +4 – National +5 – International
D - Customers	- Identification of needs - Identification of markets - Use of customers' expressions	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Eventually / Temporary +2 – Systematically / Permanent +1 – Product

					from the same value chain +2 – Product from a new value chain +1 – Class A/B +2 – Class C/D +3 – Class E
E - Solutions	- Complementary solutions - Resource integration	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Same chain +2 – New chain +1 – Eventually +2 – Systematically
F – Relationship	- Facilities and amenities - Computerisation	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Temporary +2 – Permanent +1 – Eventually +2 – Systematically
G – Value capture	- Use of existing resources - Use of opportunities for interaction	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Temporary +2 – Permanent +1 – Eventually +2 – Systematically
H - Processes	- Process improvement - Management systems - Certifications - Management software - Environmental aspects - Waste management	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null -1 – Absence of ethical behaviour +1 – Eventually +2 – Systematically +2 – Socio-environmental project +2 – Support to community and technical associations
I - Organisation	- Reorganisation - Partnerships	1, 3 or 5	2 – significative for the value	-1 – deteriorates/decreases	0 – indifferent / null

	- External vision - Competitive strategy		chain 1 – not significative for the value chain	/null 1 – indifferent / stable +2 – improves/increases	+1 – Eventually +2 – Systemically +1 – Temporary +2 – Permanent +1 – Municipal +2 – State Level +3 – Regional +4 – National +5 – International
J – Supply Chain	- Supply chain	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Eventually / Temporary +2 – Systemically / Permanent +1 – Municipal +2 – State level +3 – Regional +4 – National +5 – International
K - Presence	- Points of sale - New markets	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Eventually / Temporary +2 – Systemically / Permanent +1 – Municipal +2 – State level +3 – Regional +4 – National +5 – International
L - Networking	- Dialogue with the customer	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Indirect +2 – Direct +1 – Eventually / Temporary +2 – Systemically / Permanent

M – Innovative Ambience	- External sources of knowledge I - External sources of knowledge II - External sources of knowledge III - External sources of knowledge IV - Technological daring - Innovative funding - Collections of ideas	1, 3 or 5	2 – significative for the value chain 1 – not significative for the value chain	-1 – deteriorates/decreases /null 1 – indifferent / stable +2 – improves/increases	0 – indifferent / null +1 – Indirect +2 – Direct +1 – Eventually / Temporary +2 – Systemically / Permanent +1 – Municipal +2 – State level +3 – Regional +4 – National +5 – International +1 – up to 10% of employees +2 – >10% of employees

Source: Authors' own compilation (2020) adapted from Sawhney (2006), Bachmann and Destefani (2008) and Jesus (2011).

5. Methodology

The present work is characterised as an exploratory, descriptive, empirical and comparative study. This study analysed the application of two different tools for measuring the degree of innovation in two Micro and Small enterprises (MSEs). The tools used for measuring the degree of innovation were the Innovation Radar (BACHMANN; DESTEFANI, 2008) and an adapted INOVA-tec approach (JESUS, 2011; JESUS, 2007).

Both tools were applied on two retail companies from the textile and clothing industry, located in the Brazilian State of Sergipe. The diagnosis was carried out on-site, directly with the companies' owners, in the year of 2019.

Aiming at drawing a more precise comparative analysis of the results, the following criteria were adopted: i) Value chain: textile and clothing industry; ii) Segment: retail; iii) Location: City of Aracaju, Brazilian State of Sergipe; iv) Background with the application of an Innovation Management process.

The adaptions carried out in INOVA-tec (JESUS, 2011; JESUS, 2007) were aimed at replicating the same dimensions and indicators which comprise the Innovation Radar (BACHMANN; DESTEFANI, 2008). However, the weighting factors, weight ranges, corrections factors and data handling process were based on the INOVA-tec tool itself (JESUS, 2011; JESUS, 2007).

6. Results and Discussions

Similar results were obtained when measuring the degree of innovation of companies using the Innovation Radar (BACHMANN; DESTEFANI, 2008). However, certain differences were verified in the results from

the analysis of the degree of innovation when using INOVA-tec (JESUS, 2011; JESUS, 2007).

The results from the Innovation Radar methodology (Table 1) highlight that the companies analysed in the present work were ranked according to the same degree of innovation, being characterised as "Little Innovative Companies", that is, the companies innovated little or did not innovate at all in the last 3 (three) years.

Table 1 – Results of the analysis of the degree of innovation of retail companies from the textile and clothing industry located in the city of Aracaju (Brazil) from the application of the Innovation Radar

Dimension	Indicators	Weight of indicator	Company A		Company B	
			Score of indicator	Score of Dimension	Score of indicator	Score of Dimension
A - Offering	- Products	1	1	1	5	4
	- Daring	1	1		3	
B - Platform	- Production System	1	3	3	3	3
C - Brand	- Brand	1	3	4	3	4
	- Brand leverage	1	5		5	
D - Customers	- Identification of needs	1	3	3	3	3
	- Identification of markets	1	3		3	
	- Use of customers' expressions	1	3		3	
E - Solutions	- Complementary solutions	1	1	1	1	2
	- Resource integration	1	1		3	
F – Relationship	- Facilities and amenities	1	1	1	3	4
	- Computerisation	1	1		5	
G – Value capture	- Use of existing resources	1	1	1	1	1
	- Use of opportunities for interaction	1	1		1	
H - Processes	- Process improvement	1	3	1.3	5	1.7
	- Management systems	1	1		1	
	- Certifications	1	1		1	
	- Management software	1	1		1	
	- Environmental aspects	1	1		1	

	- Waste management					
I - Organisation	- Reorganisation - Partnerships - External vision - Competitive strategy	1 1 1 1	1 3 1 1	1.5	1 3 1 3	2
J – Supply Chain	- Supply chain	1 1	1	1	3	3
K - Presence	- Points of sale - New markets	1 1	3 5	4	3 1	2
L - Networking	- Dialogue with the customer	1	1	1	3	3
M – Innovative Ambience	- External sources of knowledge I - External sources of knowledge II - External sources of knowledge III - External sources of knowledge IV - Technological daring - Innovative funding - Collections of ideas	2 2 2 2 2 2 2	1 1 3 1 1 1 1	1.3	1 3 3 1 1 1 3	1.9
Degree of innovation			**2.0**		**2.8**	

Source: Field Research (2019).

Although the results obtained from the application of the Innovation Radar classify both of the companies analysed with the same degree of innovation, “Company B” presented higher scores in most of the dimensions considered. Moreover, greater differences were verified among the scores obtained for the offer and relationship dimensions. Nevertheless, “Company B” presented the best result only in the presence dimension.

One of the aspects that can be improved in the Innovation Radar Tool lies on the allocation of the different weighting factors and corrections factors for some indicators. This would avoid an overlap of innovation profiles, despite the fact that the final result is presented based on the average score of the dimensions analysed.

The results obtained in the present study are similar to the average degree of innovation of 82 obtained for another MSE from the textile and clothing industry, analysed by Néto and Teixeira (2011) in the Brazilian State of Sergipe in 2010. In this study, an average degree of innovation of 2.1 was obtained from the application of the Innovation Radar, with the highest scores being found by the indicators in the platform

and brand dimensions. On the other hand, the dimensions processes, value capture, supply chain and organisation led to the lowest scores.

Néto and Teixeira (2011) observed that the degree of innovation can be a guidance for actions that must be prioritised, aimed at promoting an innovation culture within a company. In line with this statement, Carvalho et al. (2015) consider that the Innovation Radar can support companies in defining strategies for innovation, thus contributing to achieve greater competitive advantage to a company by highlighting the dimensions which have been little explored and can constitute competitive advantages.

Regarding the analysis of the degree of innovation through the application of the adopted version of INOVA-tec, the results obtained ranked the companies according to different degrees of innovation, with a considerable difference between the scores obtained (Table 2). "Company A" was characterised as a company with a "Very low performance of the given indicators", with the sum of the weights of the dimensions equal to 67.71 points, corresponding to a degree of innovation (overall innovation index) of 5.20. In turn, "Company B" was classified as a company with a "Low performance of the given indicators", with a total score of 129.16 points, corresponding to a degree of innovation (overall innovation index) of 9.93, as pointed out in Tables 3 and 4.

According to Jesus (2011, 2007), INOVA-tec allows to balance the relevant parameters for a case-by-case assessment of the results. Therefore, the tool enables a more detailed process analysis, establishing more responsible innovations.

Table 2 – Results from the analysis of the degree of innovation of retail companies from the textile and clothing industry located in the city of Aracaju (Brazil), analysed by the INOVA-tec tool with adaptions

Dimension	Indicators	Score of indicators		Weight of indicator		Score range		Correction Factor		Final Score of Indicator	
		A	B	A	B	A	B	A	B	A	B
A - Offering	- Products	1	5	2	2	+1	+2	0	+1	2	21
	- Daring	1	3	2	2	+1	+2	0	+1	2	13
B - Platform	- Production System	3	3	2	2	+1	+1	0	0	6	6
C - Brand	- Brand	3	3	2	2	+1	+1	0	0	6	6
	- Brand leverage	5	5	2	2	+1	+1	+2 / +1	+2 / +3	13	15
D - Customers	- Identification of needs	3	3	2	2	+2	+2	+1 / +1	+1 / +1	14	14
	- Identification of markets	3	3	2	2	+2	+2		+1 / +2	15	13
	- Use of customers' expressions	3	3	2	2	+2	+2	+1 / +2	+2	13	14
								+1			
E - Solutions	- Complementary solutions	1	1	2	2	1	1	0	0	2	2
	- Resource integration	1	3	1	1	1	+2	0	+1 / +2	1	9
F – Relationship	- Facilities and amenities	1	3	2	2	1	+2	0	+2	2	14
		1	5	2	2	1	+2	0	+2	2	22

	- Computerisation										
G – Value capture	- Use of existing resources - Use of opportunities for interaction	1 1	1 1	1 1	1 1	1 1	1 1	0 0	0 0	1 1	1 1
H - Processes	- Process improvement - Management systems - Certifications - Management software - Environmental aspects - Waste management	3 1 1 1 1 1	5 1 1 1 1 1	2 2 1 2 1 1	2 2 1 2 1 1	+2 1 1 -1 1 1	+2 1 1 -1 1 1	+1 0 0 0 0 -1	+2 0 0 0 0 -1	13 2 1 -2 1 0	22 2 1 -2 1 0
I - Organisation	- Reorganisation - Partnerships - External vision - Competitive strategy	1 3 1 1	1 3 1 3	2 2 2 2	2 2 2 2	+1 +2 1 1	+1 +2 1 +2	0 +2 / +2 0 0	0 +2 / +2 0 +1 / +1	2 16 2 2	2 16 2 14
J – Supply Chain	- Supply chain	1	3	2	2	+1	+2	0	+3	2	15
K - Presence	- Points of sale - New markets	3 5	3 1	2 2	2 2	+2 +2	+2 1	+2 +1 / +1	+2 0	14 22	14 2
L - Networking	- Dialogue with the customer	1	3	2	2	+1	+2	0	+2 / +2	2	16
M – Innovative Ambience	- External sources of knowledge I - External sources of knowledge II - External sources of knowledge III - External sources of knowledge IV - Technological daring - Innovative funding - Collections of ideas	1 1 3 1 1 1 1	1 3 3 1 1 1 3	2 2 2 1 2 1 2	2 2 2 1 2 1 2	0 0 1 1 0 1 0	0 +2 +2 1 1 1 1	0 0 +1 / +3 0 0 0 0	0 +2 / +3 +1 / +3 0 0 0 0	0 0 10 1 0 1 0	0 17 15 1 2 1 6

Source: Field Research (2019).

Table 3 – Sum of the weight of the dimensions (maximum and minimum) and the magnitude index (maximum and minimum) of retail companies from the textile and clothing industry in the city of Aracaju (Brazil), analysed using the INOVA-tec tool

Sum of weight of indicators		Magnitude Index	
Maximum	**Minimum**	**Maximum**	**Minimum**
293.51	-9.23	22.58	-0.71

Source: Field Research (2019).

Table 4 – Maximum thresholds for the classification of the degree of innovation (overall innovation index) of retail companies from the textile and clothing industry located in the city of Aracaju (Brazil), analysed using the INOVA-tec tool

Type of Company	Range	Threshold	Company A	Company B
Very low performance of the given indicators	Range 1	Up to 5.64	5.20	
Low performance of the given indicators	Range 2	Up to 11.28		9.93
Average performance of the given indicators	Range 3	Up to 16,.93		
High performance of the given indicators	Range 4	Up to 22.58		

Source: Field Research (2019).

The results obtained show a certain feasibility of the application of the adopted version of INOVA-tec for measuring the degree of innovation of the SMEs analysed in the present work. The different results of the companies analysed by this adapted tool show to a more dynamic and innovative entrepreneurial behaviour of "Company B", which presents systematic methods, as well as a systematic vision of its management processes. In addition, the company has a more systematic approach in its relationship with customers, marketing and in the search for solution in external environments when compared with "Company A", mainly taking into account the geographical scope and permanent flow of actions, despite the same result obtained from the application of the Innovation Radar.

According to Cavalcanti et al. (2015), innovation metrics have been a topic of growing interest in studies on innovation economy, exploring the complex relationship between investment on innovation and funding of resources. Therefore, it is possible to examine innovation and the consequent actions which allow companies from the textile industry and other sectors to: i) carry out a progressive review on the innovation metrics which support the innovative capacity of an organisation; ii) seek greater understanding of the process of innovation for increasing an integrated, effective and precise innovation metric system for the company; iii) consider that current innovation metrics are established upon various dimensions which inform on the state of innovative development of a certain company. Accordingly, it enables greater focus on the development of the dimensions established, causing greater impact on the growth of the organisation within a certain market sector (CAVALCANTI et al., 2015).

In this regard, the application of the adapted version of INOVA-tec presented in this work demonstrated positive contributions for contextualising the measurement of dimensions which can cause greater impact on the growth of a certain organisation within a given market sector. Consequently, this growth can in fact contribute to the development of an integrated, effective and precise innovation metric system.

Silva et al. (2008) presented a model for analysing the level of technological innovation, by gathering different indicators and score criteria. Thirty (30) multiple-choice questions were developed, being subdivided into 5 different groups corresponding to indicators on technological innovation. Through this methodology, different weights were only attributed to the group of indicators in the dimensions "output indicators" and "impact of innovation". On the other hand, the indicators in the dimensions "input indicators", "forms of innovation" and "sources of innovation" did not receive different weighting factors, being non-contextualizable.

Similar to the present study, the approach proposed by Silva et al. (2008) also establishes different ranks for the profile of innovation corresponding to the maximum percentage scores related to the indicators and their respective weights. Accordingly, Silva et al. (2008) presented the following classification for the level of a company's technological innovation: i) Innovative – IN (from 80% to 100% of the maximum score); ii) Averagely Innovative – MIN (from 40% to 79.9% of the maximum score); and iii) Little Innovative – PIN (from 0% to 39% of the maximum score). Silva et al. (2008) verified that Brazilian companies classified as more intra-entrepreneurial and innovative reached an average score within the range from 80% to 100% of the maximum score.

7. Conclusions

The results obtained in the present study conclude that the adapted version of the INOVA-tec tool enables a contextualisation of the process for measuring the degree of innovation in MSEs. The adapted methodology considers different perspectives of the particularities faced within the value chain of the companies analysed, as well as different perceptions of the innovation actions implemented. Therefore, this approach assesses the relevance of indicators with regards to the give value chain or type of service offered, taking into account a specific time frame and geographical scope of the actions and their respective impacts. This given contextualisation is related to the innovation actions, which can present different weighting coefficients, weight ranges or correction factors. For instance, if they are significant for the respective value chain; if they are occasional, temporary or systematic; if the impacts of the actions are positive, stable or negative; if the geographical scope englobes a municipal, state, regional, national or international scope.

In this regard, considering these factors provides a greater range of analysis of the results, with wider categories, which are directly proportional to the weighting factors, score ranges and correction factors in the assessment of the given indicators.

Future studies can include a larger population and sample, besides enabling an analysing of the adapted INOVA-tec methodology in other economic sectors. Moreover, future research can explore a predictive analysis of the potential impact of the innovation actions in MSEs, which can contribute to establishing further selection criteria, prioritising inherent actions to the process of innovation management and sustainable development.

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The perceptions of graduate students regarding diversity and culture in the construction of teacher identities

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Abstract

The discussions presented in this article arose from action research carried out with students in a Master's Program in Education. The questions asked in the study were: How do graduate students in Education, future specialists in the area, view the concepts of diversity and culture and, furthermore, what perception do the students have regarding the influence of these concepts on the construction of a professional teacher identity? Aiming to address these doubts, a qualitative study was conducted by way of an online questionnaire, specifically developed for this study which was applied to 13 students in the Master´s program in Education. The answers obtained were analyzed with the IRAMUTEQ software package to assess the text data. The results show that the group under study believed that one of the greatest challenges to teaching, and thus to the construction of an identity, is how cultural diversity is dealt with in the school setting. Therefore, it is necessary to deconstruct conceptual standards regarding diversity, culture and teacher identities.

Keywords: teacher identities; diversity; culture; teacher training.

1. Introduction

The discussions presented in this article arose from action research carried out in a graduate course called "Special topics in education: identity, diversity and adversity in teacher training". The locus of the study was the Master's Program in Education, focusing on Social Education, duly authorized by the Coordination for the Improvement of Higher Education Personnel (CAPES) and the Ministry of Education (MEC). This

program aims to provide researchers, professors and managers solid knowledge in the area of Education, with a special focus on social education, addressing the various settings in which education takes place, to construct interfaces between formal and non-formal education, through the production of knowledge on educational processes, considering movements in society and their contradictions.

In this context, beginning with the formal introduction of graduate studies in Brazil in 1965, with the Sucupira Report (CES/CFE nº 977/65), *stricto sensu* graduate programs were organized to adjust to the concept of the university as an academically productive institution (Turnes, 2014).

Currently, more particularly in 2020, it is common to find in the scientific literature studies aimed at analyzing, qualifying, quantifying and classifying teacher training experiences, including curricular components of graduate programs (Veras et al., 2020), teacher training and experience in higher learning settings (Furlan et al., 2020), mapping of research conducted on basic education teaching (Scherer, 2020), and teacher qualification and the training of teacher researchers in *stricto sensu* graduate programs (Teixeira et al., 2020). It is important to point out that Graduate Programs initially sought to meet an urgent demand to prepare teachers for more significant academic participation.

In this regard, the questions that conducted this study may be stated as follows: how do graduate students in Education, future specialists in the area, view the concepts of diversity and culture and, furthermore, what are the perceptions of students regarding the influence these concepts have on the construction of a professional teaching identity?

In this context, we consider it important to reflect on how the concepts of culture and diversity are related in the construction of teacher identities, given that they may produce complex manifestations on various social levels, giving different senses and meanings to the activities of teachers and researchers. In addition, the relevance of this diagnosis of ideas may be justified if we consider the various facets and elements of the concept of teacher identity, of which diversity and culture are part, in either the individual constitution of the teacher or in a collective context, which are equally important in this construction. Thus, an understanding of how teachers and future teachers regard these issues is important to raise awareness regarding the role culture plays in constituting and understanding of what it is to be a teacher and their professional practice.

Identity may be understood a set of singular and exclusive characteristics which reveal how individuals understand themselves. These attributes are dialectically constructed, in both the individual and social domains. For Turner (1982), the social domain is related to the social identity, and is the process where an individual identifies with another in a socially categorized system, for example, in a profession. This social identification, which takes place on the collective plane, directly influences the constitution of self-identity, since the way a person is identified by others contributes to how he or she conceives him or herself.

In this regard, Dubar (2006) states that identity requires differentiation, but also entails generalizing. From this counter perspective, differentiation allows a person to be unique in relation to another, thus identity would be difference. In generalizing, the aim is to determine a point in common for a set of all differences. Here, it is assumed that "identification of and by the other" (Dubar, 2006, p. 9) is recognizing that individual and social identities are not opposites; they are intertwined.

In order to better understand the meaning of identity, it would be of interest to pinpoint the concept. Bauman (2005, p. 12), highlights the complexity of the concept, and believes that "it is fundamental to understand

the preeminent characteristics of a 'long transition' in order to identify social trends [...]". The author believes that with globalization, countless transformations take place at a rapid pace, particularly in relation to the construction of an identity, in a context which is called liquid modernity (BAUMAN, 2001). Thus, when we speak of identity, we must also highlight the temporariness of the construction.

Regarding the particular identity we aim to better understand, namely the identity of the teaching profession, Nóvoa (2000) affirms that this construction is intimately related to the training process, which is not confined exclusively to university training. This journey is also comprised of pre-professional learning, academic training, and professional experience *per se* (Tardif, 2002).

The teaching profession is one of the few that provides the opportunity of immersion in the future professional setting, before becoming a professional teacher, due to the years spent in school. Albeit this experience may be related to our perspective as students, from the outset we continuously construct ideas of school, teachers, students, teaching and learning. In many cases, the conceptions created during our first years of schooling are so strong and entrenched that if we were to become teachers, these ideas, and not our formal training, would be revealed in our professional practice. Thus, teacher identities start forming when our lives begin, either in school or from all other experience. Well before we enter the university or start teaching professionally, important traits of this identity gradually become part of our teaching repertoire. For example, Besutti, Redante and Favero (2017) were able to determine, for a group of university faculty, that the influence of family or memorable teachers determined the trajectory and the construction of their identities.

In Brazil, professional teachers are trained in higher learning contexts, and students either obtain a Teaching Degree in certain areas of study or graduate in Pedagogy. In the former, specific knowledge is acquired in certain areas or for a given school level in which the future teacher shall work, and Pedagogy training covers the fundamentals of educational science, didactics, and current teaching contexts, as well as both the theoretical and practical aspects of university level teaching. This period, as well as the pre-professional stage, reinforces or brings new elements to the construction of teacher identity. Dubar (2005) points out that university training has a significant impact on the construction of the professional teacher identity.

At the same time, professional experience equally contributes to the construction of teacher identity. This experience, no longer as a student but as a professional, makes important contributions to the construction of this identity.

Professional experience, in terms of teacher identity, passes through different moments of the teaching career. In fact, the expectations of teachers at the beginning of their career, from the moment they begin to up to 3 to 5 years of teaching (Tardif, 2002), are different than those at other moments in their professional careers. Initially, the recognition and consolidation, by others and by the teachers themselves, of being a teacher and being welcomed by the profession are important for the construction of a professional teacher identity. Also, teachers need to assimilate school contexts, work routines, interaction with other teachers, school management and other situations that are specific to the teaching activity.

Teachers develop professionally from the interaction between the subjective dimension (which corresponds to a teacher's self-image) and the objective dimension (which corresponds to the image others have or what is expected of you). These universes (subjective and objective) come face-to-face in the socializing process, where professionalism plays an important role in the construction of this identity (Dubar, 2005).

It is true that professional experience, added to the other moments of teacher training, progressively lead to the constitution of an identity which is provisional. Although certain elements of this identity may be consolidated, the social and historical context and the relations established over one's life make the professional teaching identity subject to reflection and change.

At this point we introduce to the discussion the production of cultural meaning and diversity in contemporary societies, as in the construction of teacher identity. Toward this end, we discuss the concepts of culture and diversity based on cultural studies, which are characterized by their interdisciplinary nature. The main authors here are Raymond Williams, Hoggart, and E.P. Thompson who, according to Hall (1996), were pioneers in addressing the complexity of the concept of culture.

For Moreira and Candau (2007), the meaning of the word culture has changed over time. In the 15th century, culture was associated with farming and livestock raising. In the 16th century, the notion of culture was studied from the perspective of the human mind, the cultivation of the mind, and only certain persons or societies were regarded as having a high degree of culture or civilization. In the 18th century, the classist nature of culture crystalized only for those European civilizations that were considered refined and learned. It was only in the 20th century that culture began including popular culture.

Culture is regarded as a web of meanings woven by humankind with a global meaning, which expands and guides peoples and continues as an endless web. Culture is forged by the systems of symbols of individuals in reciprocal interaction (Geertz, 1989).

From this perspective, the current shared notion is that culture is constituted by the history of a social group, manifested as "[...] an entire complex that includes the knowledge, beliefs, art, morals, laws, customs and any other capacity or habit acquired by individuals as members of a society" (Laraia, 2006, p. 25).

Thus, "culture is the source of meanings present in the daily life of individuals. It is the wider concept of culture that breaks with the notion of culture linked to artifacts by placing daily practices alongside the arts" (Rossi; Marrero; Paluan, 2013, p. 3).

We recognize culture as an active referential in the lives of individuals, as well as its discussion in the development of teachers and researchers as co-participating subjects in the process of systematizing scientific knowledge, and as creators and disseminators of diverse cultural knowledge. In this regard, Fourquin (1993, p. 14) affirms that "culture is a substantial part of education; its source and ultimate justification; education is nothing outside from or devoid of culture".

The concept of culture is also addressed based on a term to which it is frequently associated - identity (Cuche, 2002, p. 175), since, "currently, the main interrogations regarding identity frequently refer to the question of culture".

Explaining how meaning is attributed to terms such as difference and diversity is pertinent to understanding the role diversity and culture play in the construction of teacher identities. Regarding diversity, Urquiza et al. (2014) propose that the most comprehensive expression be "cultural diversity", meaning "that which refers to the multiple manifestations of a group or society through their cultural practices" (Urquiza et al., 2014, p. 9). The authors explain that although many individuals and even dictionaries regard difference and diversity as synonyms, the distinction between the terms is highly relevant, since diversity is not only limited to a comparison between an "I" and an "Other". According to Gomes (2003), the concept of diversity is inherent to the level of relations endowed with cultural, political and historical values.

The notion of difference regards a "relation of otherness", or between "Ego (I) and the Alter (the other)" (Urquiza et al., 2014, p. 11). The concept of difference entails contradictions, which are the conflicts between an "I", when recognizing an identity. "Furthermore, diversity is part of the human essence: difference is a human characteristic. And differences also help preserve our identity" (MARTIN; SEGALLA, 2018, p. 23). In this regard, we believe that diversity is a property of human identity, driven by difference.

In this context, Hall (2006) carried out studies on cultural identity in the early 1990s, and the concept of identity was regarded, in his words, as a "cultural identity, which directly influences the construction of a subject's identity". Based on this, Hall presents three moments in history marked by three different conceptions of identity: the illuminist subject, the sociological subject, and the post-modern subject. According to Hall (2006), post-modernity fuels internal conflicts in subjects, which need to be resolved, and this process was defined by the author as an "identity crisis".

In light of all the particularities regarding the concept of identity, particularly the identity of professional teachers, our aim was to investigate how graduate students regarded this issue, from the perspective of diversity and culture.

2. Material and methods

This study adopted a qualitative approach, based on action research (Tripp, 2005). We conducted a survey among students enrolled in a Master's course offered by the Graduate Program in Education. On the first day of class, the students were invited to take part in the study, highlighting its importance towards reflection and contributions during the remainder of the course.

Abiding by all the ethical aspects pertaining to research on human beings, the study applied an online questionnaire that addressed identity, teacher identity, diversity and culture. The questionnaire was applied to 13 students and the responses were analyzed by the IRAMUTEQ 0.7.2.0 program (*Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires*). This software is based on the R software allowing the comprehension of texts and the presentation of results in decreasing hierarchical order, statistics, Specificity Analysis and Factorial Correspondence Analysis - FCA, similarity analysis, and word clouds. Developed by Ratinaud and Marchand (2012), the IRAMUTEQ program allows for different types of statistical analyses of text corpora and individuals/words. Initially developed in French, this program began to be used in Portuguese in 2013. According to Camargo and Justo (2013), the IRAMUTEQ program produces different types of textual analyses, ranging from basic lexicography to multivariate analyses.

The responses of the graduate students underwent linguistic correction so as to optimize the data analysis by way of a content analysis technique, also considering the frequency of word repetition with the use of the software.

For the textual analysis of the questionnaires of this study, the IRAMUTEQ program was used for a specific type of data analysis that deals specifically with the analysis of the transcribed verbal material, i.e., the texts produced under different conditions such as written texts, interviews, documents, essays, etc. which are the sources traditionally used in Human and Social Science research (Nascimento; Menandro, 2006).

2. Results and Discussion

The results sample is comprised of the responses given by 13 graduate students between the ages of 21 and 49 (11 female and 2 male) with different academic backgrounds, as listed below:

Table 1. Initial background of participants

Subject	Background
Graduate Student 01	Bachelor's degree in Law
Graduate Student 02	Teaching Degree in Physical Education
Graduate Student 03	Teaching Degree in Physical Education
Graduate Student 04	Teaching Degree in Biology
Graduate Student 05	Teaching Degree in Geography
Graduate Student 06	Teaching Degree in Biology
Graduate Student 07	Education
Graduate Student 08	Teaching Degree in Physical Education
Graduate Student 09	Teaching Degree in History
Graduate Student 10	Teaching Degree in Letters Portuguese/Spanish
Graduate Student 11	Teaching Degree in Physical Education
Graduate Student 12	Teaching Degree in Letters
Graduate Student 13	Bachelor's degree in Administration

Source: study data.

It may be observed that the participants, who are enrolled in a course in the Graduate Program in Education, have degrees in various areas, including some who during their undergraduate studies had never been acquainted with aspects of teacher identity (Tardif, 2002). However, this does not allow us to infer that these graduate student did not have conceptions associated with teaching practice, nor with the concepts of diversity and culture.

In the questionnaire assessment, the software identified 84 segments of text. The total number of words used was 2,369 and, disregarding the repetitions, the words or forms were broken down into their roots, producing a total of 566 lemmas or words with the same lexical root.

In the analysis of the responses provided by the graduate students when asked to define "being a teacher", we observed 12 forms of text in 221 occurrences of words, 27 of which were active forms, with an average repetition of 4.6. We highlight the response of Graduate Student 5, who stated that a teacher should be "a professional whose mission is not only to convey knowledge but, above all, to contribute to the development of his or her students as critical citizens, aware of their role in society".

The statements that depict what the graduate students believed was needed to be a good teacher are presented in Figure 1 in a word cloud, showing the most frequent words highlighted in the center, namely 'knowledge', 'commitment', 'didactic', 'teach', and 'student'.

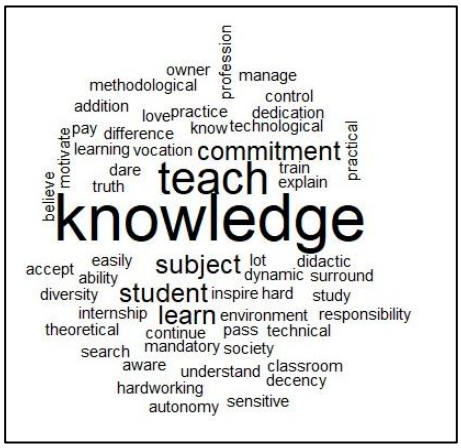

Figure 1. Word cloud "What is needed to be a teacher"

For the group under study, it was interesting to see the strong presence of the idea of the need for knowledge to be a teacher. This is an important trait in the constitution of the teacher identity, which breaks away from the common sense notion that being a teacher is a vocation or gift. In addition, there is the presence of the term "teach" corroborating that specific knowledge is intrinsic to the profession.

In the analysis of the responses regarding how the graduate students comprehended the concept of identity, the dendrogram in Figure 2 shows that the corpus was broken down into 3 divisions, two initial and then another. We considered words with a chi-square (X2) greater than 3.80, which reflects greater association of the TSs between the classes and stronger linkages (Camargo; Justo, 2013).

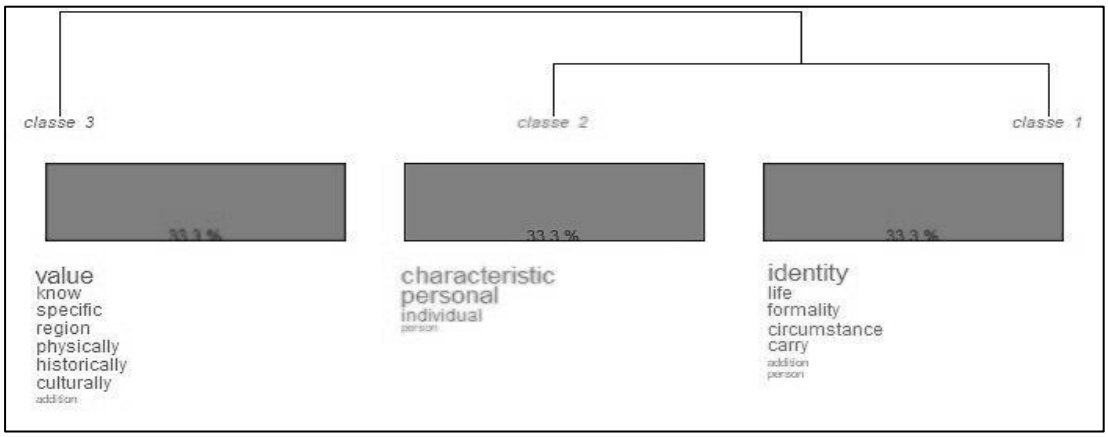

Figure 2. The conception of identity dendrogram

From these results, the classes were named as follows:

1) Identity from the cultural perspective, as a hybrid and flexible set of elements that form the cultural identity with the values of a people.

2) Identity from the social perspective; as a self-definition which is manifested and shared with members of a social group.

3) Identity from the psychological perspective, as the dynamic construction of one's being, ones self-awareness.

Hall (2006) proposes a definition called "cultural identity" as aspects of identity that arise from our

"belonging" to ethnic, racial, linguistic, and religious groups. The interlace between culture and identity can be heard in the statement of Graduate Student 10, who believed that the construction of identity "is linked to the culture an individual is part of".

Graduate Student 9 declared that "identity is the social form individuals see themselves as". This statement echoes the definition of identity from a social perspective and we thus perceive that "identity is never given, it is constructed and (re) constructed, with greater or lesser uncertainty, less or longer lasting" (Dubar, 2005, p. 104).

Ciampa (1987) addresses identity as a category of Social Psychology and regards identity as a metamorphosis in a continuous process of transformation, i.e., the provisional result of the intersection between one's individual history. This process may be noted in the words of Graduate Student 5, who stated that identity regarded "the particular characteristics of an individual. Our psychological and physical marks".

To further analyze the graduate students' perception of teacher identity we used the software's "Specificities and CFA" tool, using only the active forms of the words, selected by type, with a minimum frequency of 7. The words "professional" and "students" were the most frequently mentioned in the graduate student statements. Figure 3 illustrates the 3 groups of words distributed in the 4 quadrants.

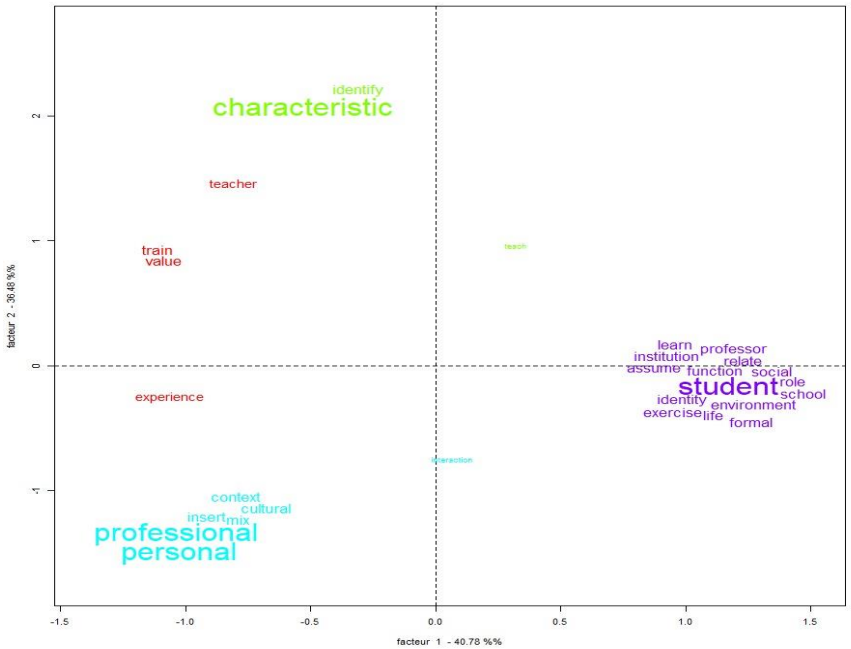

Figure 3. Specificities and FCA of teacher identities

This graph shows the forms on a plane, indicating the proximity of the groups of words in the text. However, it may be perceived that the group of words in the lower left quadrant are quite close to the words in the lower right quadrant, indicating that they appear more frequently and closer to each other in the graduate student statements. The following statements highlight this proximity: "The interaction of the teacher with the other students" (Graduate Student 11). "Teacher identities are generated from the principles and values that each professional carries, in other words, how they see themselves in their profession" (Graduate Student 4).

Figure 4 presents the similarity analysis and it is possible to identify that the large guiding axis of the graduate student statements on how diversity influences teacher identities is the word "culture". Thus, "for good or for bad, culture is now one of the most dynamic elements – and the most unpredictable – of historic change in the new millenium" (Moreira; Candau, 2007, p. 20).

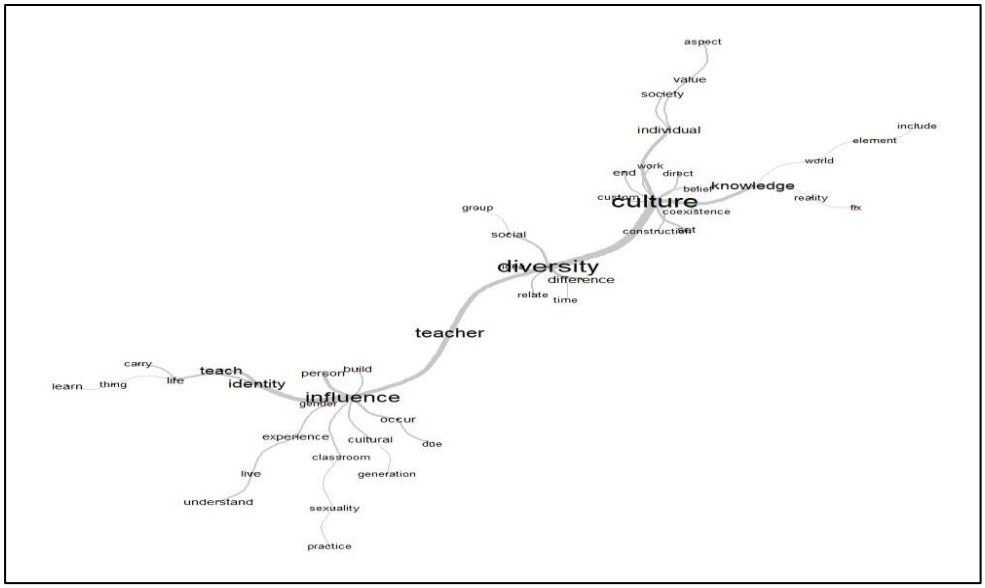

Figure 4. Similarity analysis of diversity in teacher identities

The corpus of text with the graduate students' perceptions regarding the challenges and possibilities in teacher training and in teaching practice were divided into 3 classes. The first class (29.4%) held that teaching practice expanded the possibilities of overall development, as may be seen in the statements "when we graduate and enter the classroom we are confronted with a totally different reality, with lots of challenges" (Graduate Student 10). The second class (35.3%) believed that the lack of recognition was the main challenge to teaching practice, as stated in "during teacher training and practice several challenges are faced, such as the lack of motivation and recognition" (Graduate Student 12). The third and last class (35.3%) highlighted that the learning process in teacher training may help overcome the challenges of teaching practice, as revealed by Graduate Student 8: "I believe in learning new possibilities that will help overcome the challenges of teaching practice".

Lastly, when questioned on diversity and identity in teacher training and practice, the dendrogram in Figure 5 shows that class 4 (21.4%) of the graduate students addressed the concept of "difference" when talking about diversity and identity in teacher training, and class 5 (21.4%) focused on the "student" when talking about teaching practice.

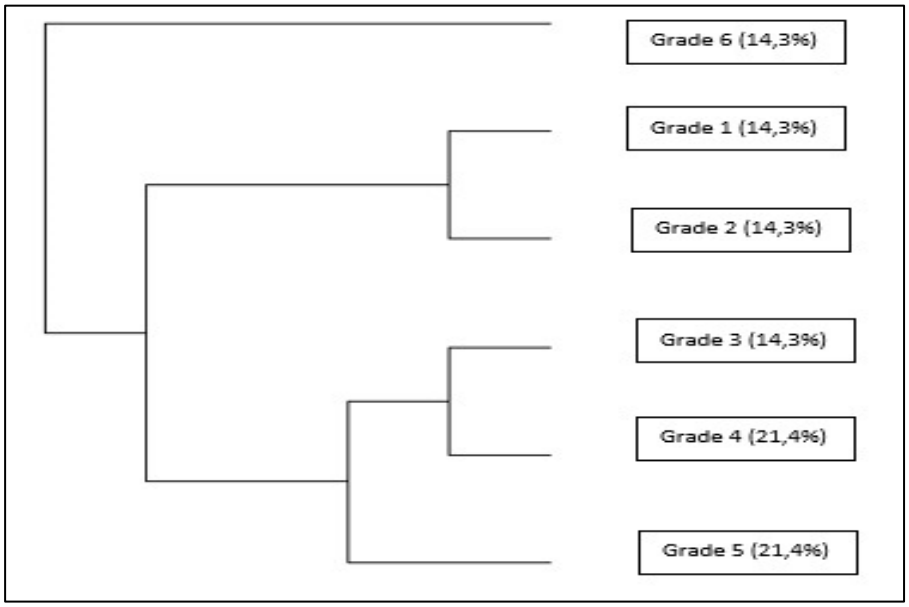

Figure 5. Dendrogram of diversity and identity in teacher training and practice

From this, it may inferred that the graduate students participating in the study believed that diversity is associated to dealing with the various needs of the students, as per the statement of Graduate Student 9: "many teachers do not know how to deal with the issue of diversity in the classroom, not for a lack of empathy or even for trying to make it work; the issue is that many do not have adequate knowledge of how to deal with different types of situation".

3. Conclusion

Knowing what future specialists in education think about teacher identities in a context of diversity and culture becomes relevant, since they are the subjects who will engage directly with teachers and managers of basic education, and indirectly in the training of other professionals. By knowing what they think, i.e., by being aware of their perceptions, better interventions may be organized and offered towards the initial and continuous training of teachers.

The group under study proved to be familiar with the concepts of identity and teacher identity, and manifested important traits regarding the teaching profession in their discourses. They stated that diversity in teacher training and teaching practice was related to culture, which is an important element to be considered in these domains. Furthermore, they highlighted the importance of teacher training that addresses the challenges of actual teaching with regard to dealing with cultural diversity in the classroom. The urgent need to deconstruct standard concepts of diversity, culture and teacher identities must also be pointed out. We conclude by proposing that future research consider the provisional characteristics of the issue when discussing the ample spectrum of human diversity.

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Psychological Exhaustion and Problematic Use of Drugs in The Nursing Team in A Hospital Environment

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ABSTRACT

Objective: *The objective of this study was to verify the relationship between problematic drug use and the occurrence of Burnout Syndrome among nursing professionals in a hospital environment. Methods: This is a study with a quantitative and exploratory approach. 416 professionals participated in the research. The data collection instrument was Sociodemographic and professional information; Alcohol, Smoking and Substance Involvement Screening Test; Alcohol Use DisordersIdentification Test - Consumption; Maslach Burnout Inventory. The level of significance (p value) was set at 0.05.* ***Results:*** *The consumption of tobacco and alcohol among workers was evidenced, being common to the practice of using alcohol in binge. There was a positive correlation between the use of alcohol and the occurrence of depersonalization and between the use of sedatives and depersonalization.* ***Conclusion:*** *It is essential that there are actions to minimize the occurrence of mental disorders in nursing workers.*

Keywords: Professional Burnout, Quality of Life, Team Nursing, Substance-Related Disorders, Mental Disorders

INTRODUCTION

The work routine is directly related to the health of workers, especially regarding the emergence of occupational diseases. In several studies, health professionals are indicated as a group potentially vulnerable to physical and mental illness [(1)].

Physical, emotional and mental wear and tear caused by work activity can cause apathy, discouragement, emotional hypersensitivity, anger, irritability, anxiety, depersonalization and inertia. As a consequence, there may be a drop in productivity, performance and worker satisfaction [(2)].

In this context, the need of workers and organizational goals suffer from conflicts arising from the reduction of the workforce, the intensified pace of work and its precariousness. Consequently, labor activity becomes stressful and triggers illness. [(3)]

The nursing professional category forms the largest individual professional group in the health workforce when assistants, technicians and nurses are considered, providing high risk for the development of stress and common mental disorders characterized by depressive symptoms and anxiety states. Substance abuse, aggression in the workplace and Burnout Syndrome are also commonly reported in the nursing occupational health literature [(4)].

Burnout Syndrome (BS) is an extreme mental clinical picture related to occupational stress and characterizes an important personal suffering manifested through psychosocial signs. [(5)].

Because of its characteristics, BS can lead health professionals to overuse psychotropic substances in general, but mainly due to the greater possibility of self-administration, since they have free access to these substances in the work environment [(6)] .

Health professionals face several types of difficulties and use medications as a possibility to facilitate the conduct of their daily lives. Thus, it is perceived, the trivialization of consumption, since professionals know the harm to health, family and work. Thus, it is necessary to discuss the use of medication by the nursing professional as a worker's health problem.[(6)]

In this context, investigating the occurrence of Burnout Syndrome in nursing professionals in the hospital environment is relevant because of the vulnerability in which these workers are exposed. Thus, it is expected that with the identification of professional burnout and its repercussions, it will help in the reflection about better working conditions and health, promoting debates about interventions in order to improve the health of the professionals and consequently benefit the quality of the assistance provided. And considering the influence of professional burnout on substance abuse can help to prevent consequences generated by excessive drug use.

OBJECTIVE

To verify the relationship between problematic drug use and the occurrence of Burnout Syndrome among nursing professionals in a hospital environment.

METHODS

Ethical aspects

The entire project follows CNS Resolution 466/12 regarding the ethical criteria for research involving human beings. The project was submitted for analysis by the UFU Ethics Committee.

Study design, period and location

It is a quantitative and exploratory approach study. The data collection was performed at the Hospital de Clínicas of the Federal University of Uberlândia between March and August 2016. This study followed the guidelines available in the STROBE instrument for observational studies.

Population or sample; inclusion and exclusion criteria

The population consisted of the nursing team at HCU-UFU, which was composed of 1,152 professionals. According to the stratified probabilistic sampling (considering a 95% confidence interval), the sample required for the study is 289 participants. 416 professionals participated in the research, the percentage obtained being 30.6% higher than the required sample.

To carry out this study were invited all nursing professionals in exercise at the University Clinic Federal Hospital of Uberlândia - MG, currently composed of 1,152 nursing professionals, 189 nurses and 963 nursing technicians and assistants. The study included subjects over 18 years of age who agreed to participate in the research, excluding subjects who did not respond to any item of the data collection instrument and professionals who were away from the service and / or on vacation.

Study protocol

The data collection instrument consisted the following questionnaires: Sociodemographic and professional information: this questionnaire included information on age, gender, marital status, religion, education and occupational situation with the purpose of characterizing the professionals participating in the survey.

The ASSIST (Alcohol, Smoking and SubstanceInvolvementScreening Test) - WHO was also used, and the questionnaire for tracking the use of alcohol, tobacco and other substances, recommended by the WHO, validated in Brazil.[7] The instrument was developed by researchers from different countries under the coordination of WHO and tested for reliability. ASSIST allows healthcare professionals to actively seek out problems arising from drug use. Its structure contains eight questions - on the use of nine classes of psychoactive substances (tobacco, alcohol, marijuana, cocaine, stimulants, sedatives, inhalants, hallucinogens and opiates) - that generate responses corresponding to scores. They also address the frequency of use, in life and in the last three months and various problems arising from use.[7]

As well as the AUDIT -C (Alcohol Use DisordersIdentification Test - Consumption): an instrument for screening alcohol use and associated problems, validated in Brazil[8]. This resource is used exclusively for the evaluation of alcohol use, evaluating several levels of consumption from non-use to probable dependence, besides the consumption in the last 12 months. It is composed by ten questions. AUDIT-C is a simpler version of AUDIT which consists of three questions to help in the identification of the pattern of

alcohol consumption in abusive or dependent.[9]

And finally the MBI (Maslach Burnout Inventory) was used to evaluate the syndrome itself.This instrument was first validated in Brazil in 1997.[10]It is a multifactorial instrument that has three versions, being that the versions MBI - Human Services Surveye MBI - EducatorsSurvey (destined to the professionals of the areas of health and education respectively) are constituted by 22 items each, distributed among the factors emotional exhaustion (9 items), depersonalization (5 items) and professional accomplishment (8 items). Each item follows a response scale that evaluates the occurrence of burnout related feelings. For each frequency of responses values are assigned, thus determining a score for each dimension of the syndrome. Burnout is identified when high values are obtained for emotional exhaustion and depersonalization, and low values for professional achievement. [11]

The collection instrument was delivered for self-filling and later returned to the team of researchers in an unidentified envelope, on an agreed upon date, together with the informed consent form.

Analysis of results and statistics

For the data analysis, a database was developed in the program StatisticalProgramof Social Science - SPSS - version 18 for Windows. The descriptive analysis of the data was presented in numbers, percentages, minimum and maximum values, means and standard deviation. The significance level (p value) was set at 0.05 for all variables. For the bivariate analysis of the data, the following non-parametric statistical tests were used: Wilcoxon test - to compare variables from two dependent samples, obtained through the pairing scheme; U Mann-Whitne test - to compare variables from two independent samples, obtained through the pairing scheme; Spearman post correlation coefficient - to evaluate the correlation between variables from two dependent samples.

RESULTS

A total of 416 nursing professionals from the HCU-UFU participated in the study, the majority of whom were female (85.2%), aged 50 years or older (39.7%). It is also noted that the predominant marital status is married/ living together(69.5%). The most frequent religion is Catholic (44.1%). In relation to schooling, the largest portion of the workers have a degree course (63.8%), followed by 34.2% who studied until high school and 2% who studied until elementary school (Table 1).

Table 1 - Sociodemographic characterization of nursing professionals at the University Clinic Federal Hospital of Uberlândia - MG, 2016 (n = 416)

Sociodemographic characteristics	N	%
SEX		
Female	350	85,2
Male	61	14,8
Did not answer	5	1,2
AGE RENGE		

20 to 29 years	36	8,7
30 to 39 years	131	31,5
40 to 49 yars	83	20,0
50 years or more	165	39,7
Did not answer	1	0,2
RELIGION		
Catholic	177	44,1
Evangelical	120	29,9
Spiritist	66	16,5
Others	38	9,5
Did not answer	15	3,6
MARITAL STATUS		
Married/living togheter	282	69,5
Single	114	28,1
Widower	10	2,5
Did not answer	10	2,4

N: total number of professionals

%: valid percentage, considering N as 100%

Table 2 indicates that the nursing team is composed of 49.3% nursing technicians, 28.5% nursing auxiliaries and 22.3% nurses. The sector with the greatest number of employees participating in the survey was the Maternal-infant (25.4%), followed by Surgical Hospitalization (14.7%) and Emergency Room (10.8%). It is identified that 40,6% work in the morning shift and 81,1% have only an employment bond. In relation to the time of exercise in nursing, 22.8% are employed in the area between 1 to 5 years, 19% between 11 to 15 years and 18% between 6 to 10 years.

Table 2 - Professional characteristics of nursing workers professionals at the University Clinic Federal Hospital of Uberlândia, Uberlândia - MG, 2016 (n = 416)

Professional characteristics	N	%
FUNTION		
Nursing assistant	115	28,5
Nursing Technician	199	49,3
Nurse	90	22,3
Did not answer	12	2,9
WORK SECTOR		
Maternal-child	104	25,4

Emergency Room	44	10,8
Ambulatory	36	8,8
Surgical Center	17	4,2
Adult and Coronary ICU	16	3,9
Clinical Hospitalization	37	9,0
Surgical Hospitalization	60	14,7
WORK SECTOR		
Materials and Sterilization	32	7,8
CEPEPE	4	1,0
Board of Directors	1	0,2
Others	58	14,2
Did not answer	7	1,7
WORK SHIFT		
Morning	169	40,6
Afternoon	123	29,6
Night	101	24,3
Did not answer	23	5,5
NUMBER OF EMPLOYMENT TIES		
1	227	81,1
2	48	17,1
3	3	1,1
4	2	0,7
Did not answer	136	32,7
EXERCISE TIME IN NURSING		
1 to 5 years	95	22,8
6 to 10 years	75	18,0
11 to 15 years	79	19,0
16 to 20 years	41	9,9
21 to 25 years	51	12,3
26 years or more	55	13,2
Did not answer	20	4,8

Table 3 shows that 6.7% of professionals have moderate risk of alcohol use or dependence. 36.1% ingest alcoholic beverages in binges. In relation to tobacco, 5.3% make moderate or dependent use and 5.7% use the other drugs mentioned. There was a considerable average of 19.53% of interviewees who did not present answers.

Table 3 - Risk of dependence on alcohol, tobacco and other drugs by nursing professionals at the University Clinic Federal Hospital of Uberlândia, Uberlândia - MG, 2016 (n = 416)

	None or low risk		Moderate risk of use Dependency		Did not answer	
	N	%	N	%	N	%
Alcohol	327	78,6	27	6,7	61	14,7
Alcohol use in *Binge*	266	63,9	150	36,1	-	-
Tobacco	316	76	22	5,3	78	18,8
Sedative	324	77,9	7	1,7	85	20,4
Cannabis	327	78,6	8	1,9	81	19,5
Cocaine, crack	333	80	2	0,5	81	19,5
Amphetamines	334	80,3	1	0,2	81	19,5
Inhalants	332	79,8	-	-	84	20,2
Hallucinogens	331	79,6	-	-	85	20,4
Opium	328	78,8	3	0,7	85	20,4
Others	322	77,4	3	0,7	91	21,9

Table 4 informs that 20.7% of the surveyed have a high level of emotional exhaustion, as well as 17.8% have a high level of depersonalization. Most professionals (63.9%) have a low or moderate level of professional achievement. The data show that 4.3% of the workers have Burnout Syndrome.

Table 4 - Characteristics of Burnout Syndrome among Nursing Professionals at the University Clinic Federal Hospital of Uberlândia, Uberlândia - MG, 2016 (n = 416)

	Emotional exhaustion		Depersonalization		Professional achievement	
	N	%	N	%	N	%
Low / moderate	242	58,2	288	69,2	266	63,9
High	86	20,7	74	17,8	75	18,0
Did not answer	88	21,2	54	13,0	75	18,0

The data present correlations between two drugs and a Burnout domain (Table 5). A positive correlation between alcohol use and depersonalization is identified (p=0.021) indicating that the higher the alcohol consumption the higher the depersonalization level. Similarly, there is a positive correlation between sedation and depersonalization (p=0.005) exposing that in larger amounts of sedation use a higher level of depersonalization is reported.

Table 5– Correlation between Burnout Syndrome and drug use among nursing professionals at the University Clinic Federal Hospital of Uberlândia, Uberlândia - MG, 2016 (n = 416)

		Emotional Exhaustion	Depersonalization	Professional achievement
Tobacco	Correlation coefficient	,057	,078	-,014
	P value	,343	,177	,818
Alcohol	Correlation coefficient	,093	,129	,057
	P value	,111	,021	,326
Sedative	Correlation coefficient	,113	,161	,024
	P value	,062	,005	,683
Cannabis	Correlation coefficient	,035	,048	,022
	P value	,566	,403	,713

DISCUSSION

Considering the results presented, the prevalence of women in the profession agrees with the literature since, nursing is a historically feminine profession being exercised exclusively by women until the middle of the 1970's, even the presence of men more and more frequent in the profession. However, in

the context of this study, considering the mental health of these professionals, studies show that women, besides facing the working day, also deal with the domestic day that has greater load for women than for men. This fact is related to inadequate health behaviors, making nursing teams vulnerable since they are composed mainly by women [12].

The nursing work force, as well as the one found in this study, is predominantly young[12]. Other researches corroborate with the fact, since they point that the average age of these workers is around 35 years[13].

A large part of the professionals are married (69.5%), similar to that observed in the literature [14]. Considering the research context, having a partner enables the sharing of work experiences, providing support for the confrontation of stressors and minimizing psychic suffering [15].

It is noteworthy that the sample was composed of 90 nurses and 314 technicians and auxiliaries. The study identified that these professionals, in their majority, have higher education than necessary to act in their respective positions [16]. According to the authors, access to higher education has expanded, but the offer of more qualified jobs has not expanded equivalently [16].Another scenario that should be considered is the search for better qualification for growth within one's own profession or the search for a new area of activity. The difference in the level of schooling in relation to the position held is worrying because it can contribute to low rates of professional achievement [16].

The set in study presents 6.7% of risk or dependence of alcohol use. The excessive consumption of alcohol is a reality present in society since it is a legal psychoactive substance. In general it is not considered a drug by the population given the social acceptance and advertisements about the product. Thus, alcohol is used as an escape from the suffering experienced in the work environment and is often associated with the consumption of other drugs [17].

A survey conducted with health professionals in a hospital environment shows that 35.4% are smokers, 38.2% consume alcoholic beverages regularly and 37.4% have already used other psychoactive substances [18], results similar to those presented in this study.

Considering these aspects, the literature reports that nurses use tobacco as a stimulant to improve mood, provide pleasure, improve service performance and relax in order to face the suffering they experience in hospitals, as well as consider it as an escape or forgetfulness from work [13].

The negative effects resulting from the consumption of substances affect the individual, his family and society. The damages include problems for the physical and mental health of the worker such as difficulty in memory and risk for chronic non-communicable diseases, besides causing work disorders such as absenteeism, conflict with colleagues, attention difficulties, impaired decision making and generating risk to the patient's safety [17].

In comparison with other studies, the data for the EE and DE dimensions are similar, a sample of 95 nursing technicians and 57 nurses revealing that the values of low professional achievement for each category were 25.5% and 24.6% respectively([19]).

A large portion of nursing professionals are not professionally "accomplished". The lack of professional recognition, low salaries and the excess of work that many times is not executed as predicted cause emsentiments of impotence, discomfort and anxiety. The professionals start to carry out their work activities with less effort and to carry out an assistance with less quality. Dissatisfaction is pointed out as

the main cause for the professional to give up his job [14].

As for the occurrence of Burnout Syndrome, the literature found similar data, with 19% and 28% of exhaustion in nurses [13-14].

Professional exhaustion is the result of a negative interaction with the workplace, the work team and the clients. Because it is the environment in which the worker spends most of his time, it is essential to be healthy in this area. The quality of life of the professional is directly related to the well-being and satisfaction at work [13].

The nursing professionals who work in the hospital context present symptoms of physical and mental exhaustion due to poor management of human resources and inputs for quality care[2].The stressful daily life of this environment requires psychological and emotional adaptation capacity, leading to professional exhaustion. Thus, the professionals make use of psychoactive substances to alleviate or deny the perception of suffering experienced in the work environment. [6].

Depersonalization is a way for workers to face discomfort and crisis situations[14]. The demonstration of cold and detached attitudes stems from the need to ensure emotional balance. There are few studies that relate depersonalization to drug use in professionals. Depersonalization or cynicism is a strategy to deal with labor demands and relates to alcohol abuse as a means to reduce stress[2].

Sedatives are also used as an artifice to improve work stress. The consumption of these substances results from the lack of autonomy, organizational support and fragile relationship of nurses with other colleagues at work[17]. The use is commonly performed without medical prescription due to the ease of access to these drugs by nursing professionals. Even if they know the risks of self-medication, they practice this habit to support the intense work day[20].

Contributions to the area of Nursing, Health or Public Policy

Thus, in view of the above, the results found and the discussions exposed in the literature, it is possible to notice that the main characteristics of the Burnout Syndrome are predictors for suicide risk, and the relationship between mental disorders and drug abuse increases such risk [4]. In view of this, it is perceived the importance of investigating the psychic health of professionals in order to avoid aggravation.

Study limitation

One limitation of this study was the little interest in worker participation when answering the research questionnaire. It is considered that the excuse is due to the great frequency in which professionals receive research questionnaires, for working in a university hospital, and to the fear of professional implications in face of the result of this study.

CONCLUSION

This research achieved its objectives by verifying the relationships between problematic drug use and the occurrence of Burnout Syndrome among nursing professionals. It was evidenced the consumption mainly of tobacco and alcohol among the workers, being common to the practice of alcohol use in binge.

The percentage found for high emotional exhaustion resembles the value obtained for high depersonalization. The high rate of low professional accomplishment was shown to be worrying. Most of the professionals are not satisfied with their positions.

In this study there was a positive correlation between alcohol use and depersonalization occurrence and between sedative use and depersonalization. More studies are needed to identify such relationships and their characteristics.

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Rheological Analysis of Asphalt Binders Modified with Hydrated Lime and Titanium Dioxide Nanoparticles

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Abstract

The significant increase in traffic on paved roads has accelerated the deterioration of asphalt coatings. Because of this, the use of additives to modify the properties of the asphalt binder has been studied in order to improve the performance in relation to, mainly, permanent deformations and fatigue life. This work evaluates the changes in the rheological properties of CAP 50/70 modified with fractionated particles of hydrated lime and titanium dioxide nanoparticles, obtained from the use of a ball mill. For this purpose, the CAP 50/70 was modified with the addition of fractionated lime particles in the contents of 3%, 5% and 7% by weight of the pure binder and with 3% of ground nano TiO2 (180 nm). The modified samples showed less loss of mass in the short term aging, proving to be an antioxidant alternative. In addition, it was found that the modified binders provided an increase in G (stiffness parameter) and, consequently, in the maximum Performance Grade (PG) temperature, allowing the use of the studied binders at higher temperatures. The binder modified with a content of 5% hydrated lime presented better results in the tests of permanent deformation (MSCR and LAS). The decrease in TiO2 granulometry increased the integrity of the binder and made it more sensitive to deformations under temperature variations, however, milled titanium dioxide showed a positive result in increasing the resistance of the asphalt binder to fatigue when compared to the binder with nano TiO2 220 nm. Finally, it was possible to establish that the addition of fractionated particles of hydrated lime to CAP 50/70 is a viable and effective technique that meets the requirements of DNIT for use in paving and that the incorporation of ground nano TiO2 (180 nm) attributed to the asphalt binder 50/70 higher working temperature in the field.*

Keywords: Asphalt binder. Hydrated Lime. Nanoparticles. Titanium dioxide.

1. Introduction

The progressive increase in the volume of traffic, excess loads and the requirement of maintenance have contributed to the premature degradation of asphalt pavements. Due to the magnitude and repeated application of loads, over the time, pathologies develop in the structure of the pavements. These degradations occur mainly in the formation of permanent deformations and fatigue cracks.

An alternative to promote an increase in the useful life of pavements is the addition of modifiers of asphalt binders that increase the resistance to fatigue and minimize permanent deformations. For this, techniques have been used to modify asphalt binders, polymers, fillers, fibers and recently nanomaterials, which have shown technical and economic viability for this purpose. (MARINHO FILHO, 2017).

Nanotechnology involves the manufacture of structures, devices and systems with new properties and functions due to arrangements of their atoms on the scale of 1 to 100 nanometers or less. Among the nanostructured materials are nanoparticles, nanocrystals, nanowires, nanofibers, nanotubes and nanocomposites.

Previous research has used nanomaterials as modifiers of asphalt binders with positive results in improving the rheological properties and resistance to oxidative aging of the binders. Among these nanomaterials are inorganic nanoparticles such as silicon dioxide, titanium dioxide and calcium carbonate (NAZARI; NADERI; NEJAD, 2018), nanosilica and nanozinc (HONG et al., 2020), carbon nanotubes

(MAMUM; ARFUZZAMAN, 2018), copper oxide (AMINI; HAYATI, 2020), nanoclay (MORTEZAEI et al., 2020), and titanium dioxide (MARINHO FILHO, 2017).

Behbahani, Hamedi e Gilani (2020) used hydrated nano lime as an asphalt binder modifier and an anti-pickling agent to improve the resistance of asphalt mixtures. The results indicated that the use of lime showed an increase in the tensile strength and fatigue life of the mixtures, as well as an increase in the polar, non-polar and basic components of the asphalt binders and a decrease in the acidic components.

You et al. (2018) evaluated the dispersion of hydrated nano lime particles on foamed asphalt with water through physical-chemical analysis using scanning electron microscopy (SEM) and X-ray diffraction tests. It was concluded that the presence of lime hardened the asphalt and decreased the potential for bonding, as well as increased resistance to cracking at low temperature. Diab et al. (2013) used hydrated lime and nano lime (with sizes of 50 nm and 100 nm, respectively) to analyze the difference that would be obtained in the rheological properties of the asphalt binder for hot mixtures. The lime nanoparticles were added to the asphalt binder in proportions of 5%, 10% and 20% (by weight) and studied in the Dynamic Shear Rheometer (DSR). The authors concluded that the application of hydrated lime with a content of 20% by weight of binder can be replaced by the addition of almost 5% (by weight) of nanoparticles of lime (50 nm).

Nazari et al. (2018) studied the addition of titanium dioxide and silicon dioxide in asphalt binders and found a gain in resistance to aging. Theivasanthi (2017) states that the reduction in the size of the nanoparticles improves the mechanical, photocatalytic characteristics and TiO2 band gap that can be exploited in several applications. Zhang, et al. (2015) studied the rheological characteristics of the asphalt binder modified with expanded vermiculite and nano TiO2 and its results indicated improvement in the binder's resistance to aging.

Marinho Filho (2017) researched the effects of the incorporation of 3%, 4% and 5% of nano TiO2 in the pure state on the rheological characteristics of the 50/70 and 55/75 asphalt binders. In general, their results showed that the incorporation of nano TiO2 was beneficial to resistance to aging, decreased Jnr and increased resistance to fatigue, with emphasis on the content of 3% for presenting better results than the others. In order to reduce the agglomeration of particles in the binder, the superficial modification of the nano TiO2 was carried out with 3 different agents (oleic acid, benzyl alcohol and oleylamine). The rheological results performed on the incorporated binder with 3% of superficially modified nano TiO2 presented even better results in increasing the working temperature, lower aging rates and greater integrity of the binder when subjected to the induced damage, supporting greater numbers of cycles until failure by fatigue.

Based on the above, this study aims to compare the addition of hydrated lime with milled titanium dioxide in the asphalt binder by means of rheological tests.

2. Materials and Methods

This topic describes the materials and procedures performed during the experimental phase of the research, performed in accordance with AASHTO and ASTM standards.

2.1 Materials

CAP 50/70 Petroleum Asphalt Cement granted by the Rocha Cavalcante processing mill, located in the city of Campina Grande - PB, was used in the research. The Hydrated Lime used in the study was manufactured by the company Cal Norte Nordeste S.A. The nanoparticles with the trade name TiO2 - titanium dioxide FR 767 in rutile crystalline form were acquired through the company InterBrasil.

The lime needed to go through a milling process to acquire nanoparticle dimensions and, for this purpose, the methodology used by Kavussi and Barghabany (2015) was used, milling in the same equipment and with the same ball-to-dust ratio (BPR).

The centrifugal crusher mill used in the process was the periquito (parakeet), located at the Materials Engineering Laboratory of the Federal University of Campina Grande. In the procedure, milling was performed in a 5:1 proportion of BPR, in which 200 g of lime and 1 kg of balls (large and small) were placed in the mill for a period of 50 minutes, without using a milling control agent.

The TiO2 nano agglomerates easily due to its high surface energy. For this reason, for an efficient milling it was necessary to perform the wet milling with the use of hexane as surfactant for the nano TiO2. The study by Gajovic et al. (2002) on grinding TiO2 and ZrO2 in the choice of milling time and weight ratio TiO2-balls, was used as a reference . The 1:10 TiO2-balls weight ratio was used, totaling 100g of TiO2 nano and 30 ceramic balls of different diameters (1 kg). The milling time of 50 minutes performed in two stages of 25 minutes each, the interruption after 25 minutes was used to check the nano TiO2 agglomeration and it was observed that after the first 25 minutes the nano TiO2 was agglomerated. To continue the milling, a new TiO2 solution was made with hexane and milling was continued for another 25 minutes. At the end of the milling, the nano TiO2 was placed in an oven at 200 ° C to volatilize the excess hexane and dry the material. After the milling process, the particle size analysis was performed by laser diffraction of the nano TiO2.m.

2.1.1 Asphalt Binder

Table 1 shows the characteristics of the binders used before and after aging.

Table 1 - Properties of the asphaltic binder

Test	Limits	Result	Standard
Penetration 0.1 mm (100g, 5s, 25ºC)	50-70	54	ASTM D5:2019
Softening Point (ºC)	≥ 46	52	ASTM D36:2014
Rotational Viscosity (cP)	≥ 274 ≥ 112 57-285	430,00 (135°C) 219,50 (150°C) 83,00 (177°C)	ASTM D4402:2015
Residue Tests After RTFOT			ASTM D2872:2012
Mass Variation (%)	≤ 0,5	0,12	-
Softening Point Increase (ºC)	≤ 8,0	4,5	ASTM D36:2014
Retained Penetration (%)	≤ 55	74,34	ASTM D5:2019

The values obtained in the physical characterization tests of the asphalt binder before and after aging, were within the minimum and maximum limits required by the DNIT 095/2006 - EM standard in the penetration classification for the Petroleum Asphalt Cement CAP 50/70.

2.1.2 Lime

Table 2 presents the product specifications provided by the manufacturer.

Table 2 - Physical-chemical characteristics and lime granulometry used in the research

Physical-Chemical Characteristics	
Molecular weight	79,09
Percentage	> 90%
Melting point	510 °C
Relative density	2,24 g/cm³ a 20° C
Solubility in water	0,13 g/100ml de água a 17,8°C
Retention in # 325	≤ 1,5%
Granulometria	
D10	0,47 µm
D50	4,28 µm
D90	30,84 µm
Average diameter	9,87 µm

Source: Cal Norte Nordeste S.A

2.1.3 TiO2 nanoparticles

Table 3 presents the product specifications provided by the company. The TiO2 nano had an effective diameter in the range of 220 nm and a purity of about 90% (MARINHO FILHO, 2017).

Table 3 - Characterization of Nano TIO2 provided by InterBrasil

Item	**Specification**	**Result**
TiO_2	≥93	93.9
Whiteness (comparison with pattern)	Approximate	Passed on
Lighting Power (Reynolds Number)	≥ 1800	1940
R (%)	≥ 98	98,9
105 ºC Volatile	≤ 0,8	0,4
Water soluble matter (%)	≤ 0,5	-
pH	6,5 ~ 8,5	7,5
Oil absorption (g/100g)	≤ 21	20
Finesa % (45µ resíduo de peneira)	≤ 0,05	0,01

	Dispersibility (%)	≥ 5,75	6,25
	Resistivity (Ω.m)	≥ 80	261
Color	L	≥ 98	98,4
	B	≤ 2,4	2,06

Source: InterBrasil

This material is considerably used in the plastics and paints industries and must present certain characteristics for its use to be successful, such as lighting power, brightness, fineness and dispersibility. A avaliação realizada pela empresa determinou que o material enquadra-se nas especificações do padrão de qualidade internacional.

2.2 Methods

The experimental research program was performed in two stages: the first consists of the process of mixing the asphalt binder with the pre-established levels of the modifiers and the second stage corresponds to the analysis of the physical and rheological properties of the modified binders.

2.2.1 Mixing Procedure

The levels of lime used were based on the research by Saha and Nilufar (2010). According to the authors, the addition of particulate materials, with a percentage between 1 and 5% by weight, can improve the physical, mechanical and rheological properties of asphalt binders. Therefore, it was decided to incorporate the fractionated lime particles in the contents of 3, 5 and 7%, in addition to the reference binder, without incorporating the particles. The 7% content was determined as an additional study in order to analyze whether the addition has a positive effect on the rheological properties of the asphalt binder. The TiO2 content used was 3% based on the research carried out by Marinho Filho (2017) who concluded that among the levels of 3%, 4% and 5%, the content 3% obtained better results in the rheological tests performed.

The pure asphalt binder was placed in a mechanical mixer and heated to a temperature of 150 ± 5ºC. After the temperature stabilized, the modifiers were added to the binder, separately, and the mixtures were agitated by the propellers of the device at 2000 rpm for 90 minutes in order to ensure the homogeneity of the mixtures, slowly incorporating the percentage of each pre-established content in the binder.

2.2.2 Rheological Tests

The rheological properties of the modified asphalt binders were obtained using the DSR Discovery Hybrid Rheometer (DHR-1) at the Pavement Engineering Laboratory at the Federal University of Campina Grande. The FASTTRACK software, developed by TA Instruments, was used to perform the rheological tests

The PG (Performance Grade) test was performed on asphalt binders modified with fractionated lime and TiO2 nanoparticles (180 nm effective diameter) before and after aging in an RTFO greenhouse. For this purpose, binder samples were molded with geometry of 25 mm in diameter and 1 mm spacing between plates. It was performed with an initial temperature of 46 °C with a temperature increase of 6 °C, where the parameter G */senδ was verified at each temperature step. The values of G */senδ should not be less

than 1.00 kPa for un aged binders and 2.20 kPa for asphalt binders aged in an RTFO greenhouse. The test is interrupted when the minimum values established for G */senδ are not reached. The software generates a report at the end of each test.

The MSCR (Multiple Stress Creep Recovery) was performed at two voltage levels 0.1 kPa and 3.2 kPa with 10 cycles at each voltage level. The temperature adopted for the performance of tests was that of PG because this is the limiting temperature for the good functioning of the binder according to the parameter G*/senδ analyzed. The charging and rest times, established as a rule, are 1 second and 9 seconds respectively for each cycle. It was performed with samples aged in the short term (RTFO) and uses the same geometry of 25 mm in diameter and 1 mm of distance between the plates, the same geometry used in the PG test.

The LAS (Linear Amplitude Sweep) test can be performed after the sample is aged in the short and long term. This work was performed only for samples aged in the short term. A geometry of 8 mm in diameter and 2 mm spacing between plates is used. Initially, the geometry was heated to 64 °C to ensure the sample adhered to the geometry. The test temperature used was 25 ° C based on the studies by Nascimento (2015) and Marinho Filho (2017). The procedure has two steps: frequency scanning from 0.2 to 30 Hz, with 0.1% deformation; and amplitude scanning, with the application of small torques at a frequency of 10 Hz. The loading is increased so that the deformation varies from 0 to 30%. Every 10 cycles each value of applied shear stress is recorded, as well as the values of phase angle and complex module (MARINHO FILHO, 2017).

3. Results

3.1 Milling

The granulometric analysis by laser diffraction was performed in order to check whether the hydrated lime particles reached diameters on a manometric scale, as well as the effective diameter of the TiO2 nano. Table 4 presents the granulometric analysis of lime by laser diffraction in liquid medium.

Table 4 - Granulometric analysis of cumulative percentages

	Hydrated lime	**Ground hydrated lime**
Diameter by 10%	0,47 µm	0,45 µm
Diameter by 50%	4,28 µm	2,29 µm
Diameter by 90%	30,84 µm	14,53 µm
Average diameter	9,87 µm	5,08 µm

According to Table 4, it can be inferred that after milling there was a decrease in the average diameter of 48.53% of the hydrated lime particles. However, a material is inserted on the manometric scale when its particles have a granulometry between 1 and 100 nm (nanometers) or less. Therefore, the ball mill milling process did not result in the production of nanoparticles.

Some factors may have contributed to this result. The non-use of the grinding control agent may have caused the particles to agglomerate, preventing fragmentation into smaller diameters. Another source of

error to be considered is the milling time. Possibly, the time established for the procedure was not able to achieve the expected objectives. Despite this, the fractional particles obtained were used in the study as an additive to the asphalt binder for the analysis of rheological behavior.

Figure 1 presents the grain size distribution of nano TiO2, before and after milling, obtaining a positive result in reducing the particle size of the material, with a reduction in the effective diameter from 220 nm to 180 nm.

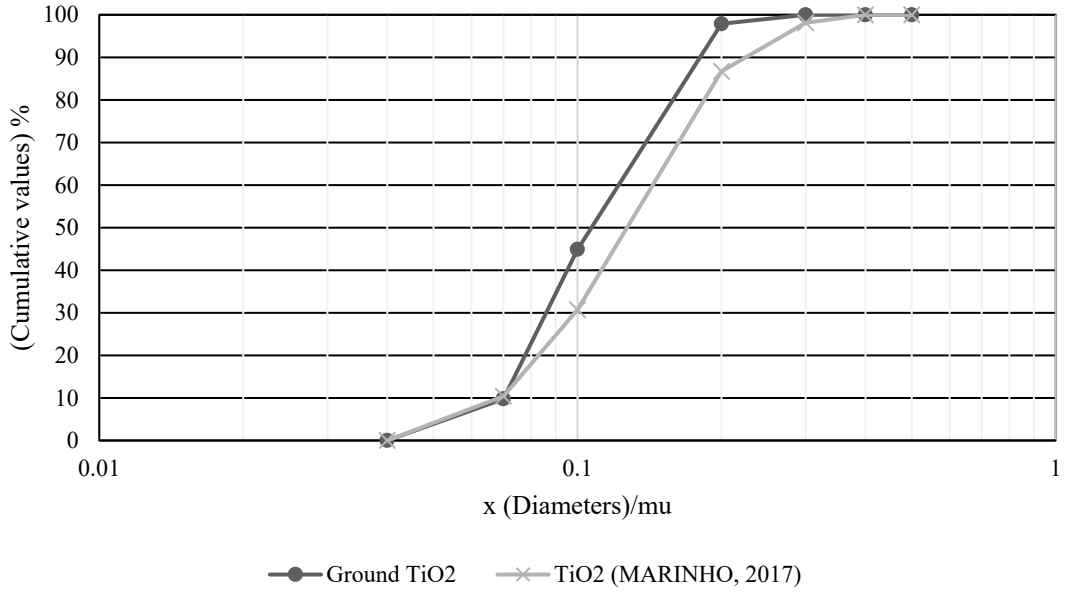

Figure 1 - Particle size analysis of TiO2 nanoparticles

3.2 Physical properties of pure and modified asphalt binders

3.2.1 Penetration Test

Figure 2 shows the results of the Penetration test for pure and modified binders with fractionated particles of hydrated lime and ground titanium dioxide nanoparticles, as well as before and after RTFO.

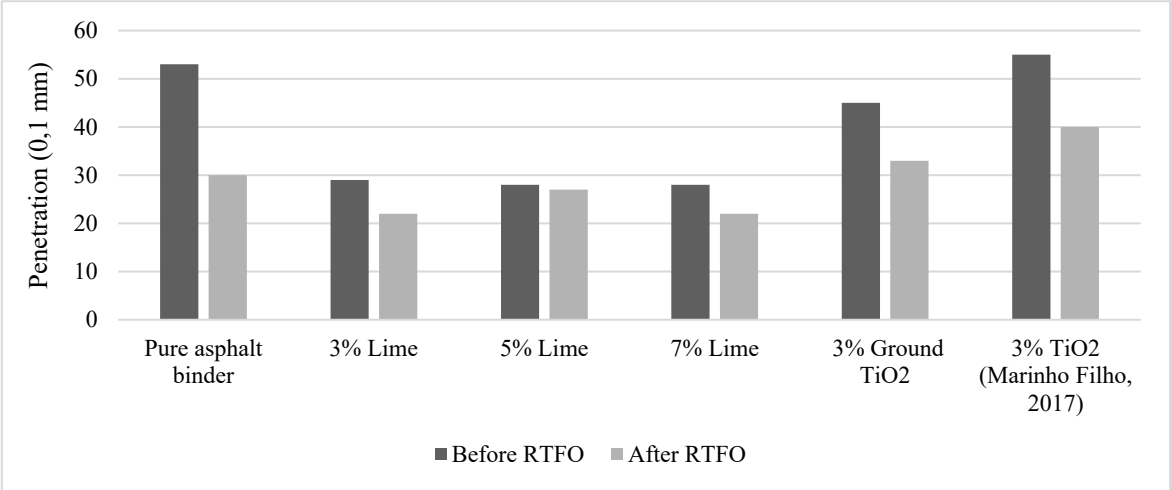

Figure 2 - Penetration Test for asphalt binders

It is noted that there was a significant decrease in the penetration values of the asphalt binders

modified with the hydrated lime and with the ground titanium dioxide, in relation to the pure binder, showing an increase in the stiffness of the material with the addition of the modifiers. The penetration results for the titanium dioxide studied by Marinho Filho (2017) was quite similar to that of the pure binder.

Jahromi (2009), Ali et al. (2016), Sun et al. (2016) and Shafabakhsh and Ani (2015) raised that it is common to decrease penetration as fractionated particles are added to asphalt binders. According to resolution 19 of the National Petroleum Agency - ANP (2005), the classification range for the penetration values of CAP 50/70 binders is the interval between 50 and 70, where all the modified binders evaluated in this study did not reach the minimum value.

After the RTFO, there was a reduction in the penetration values, which is a recurrent feature of the binder aging. However, it can be noted that the addition in the content of 3% of TiO2 presented greater penetration among the modified binders analyzed, proving to be less rigid in relation to the other contents.

Figure 3 presents the values, in percentage, of the retained penetration (penetration ratio after and before aging). This data is important to verify the sensitivity of the binder to aging and for that purpose, ANP Resolution 19/2005 defines a minimum of 55% for this parameter. The closer to 100%, the smaller the change in the penetration value to aging, that is, the lower sensitivity to oxidation. Therefore, the modified binder with a 5% lime content showed the best result with a retained penetration of 96.4%.

All retained penetration values of the modified binders were higher than that of the pure binder. Therefore, the addition of fractionated particles from the modifiers contributed positively to the sensitivity of the binder, making it less susceptible to oxidation.

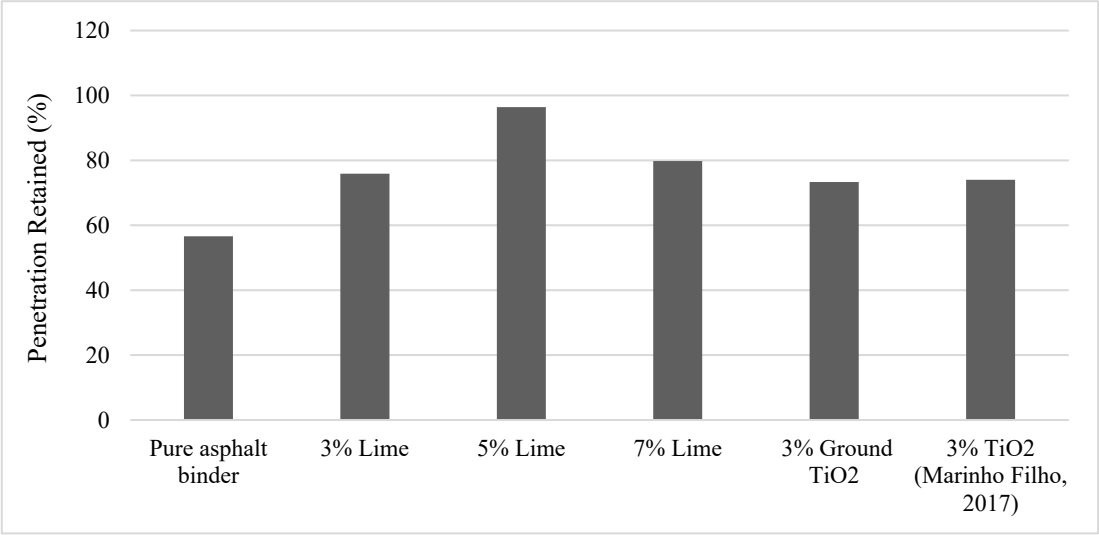

Figure 3 - Retained penetration ratio for CAP 50/70

3.2.2 Softening Point Test

The softening point is related to maintaining the properties of the binder at high temperatures and increasing the resistance to permanent deformation. This parameter was obtained from the average of the two test temperatures. Figure 4 presents the results of the softening point tests, when using pure binder and samples modified with fractionated particles of hydrated lime and titanium dioxide, as well as before and after RTFO.

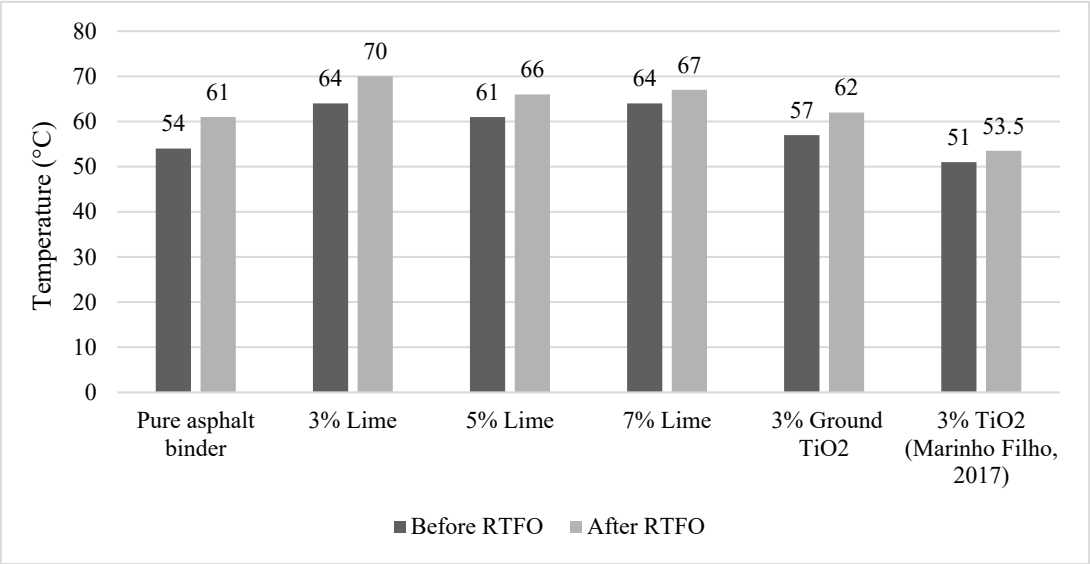

Figure 4 - Softening Point Values of CAP 50/70 samples

The ANP Resolution nº 19/2005 establishes a minimum temperature of 46 °C for the softening point in the normal condition, and thus, it appears that all binders have met this limit.

An increase is noted in the softening point in relation to the pure binder for all modified binders, in which the maximum temperature increase reaches approximately 10 °C, except for the one studied by Marinho Filho (2017). Among the levels used for the modification, the addition of 3% of TiO2 showed less value.

Figure 5 shows the variation of the softening points for the studied ligand (compared before and after the RTFO procedure). The DNIT 095/2006 Standard – EM determines that for CAP 50/70 the maximum softening point increase is 8 ºC. Among the results presented, it appears that the variations of all the modified ligands were lower than that of the pure ligand (7 ºC), probably caused by the addition of the modifiers.

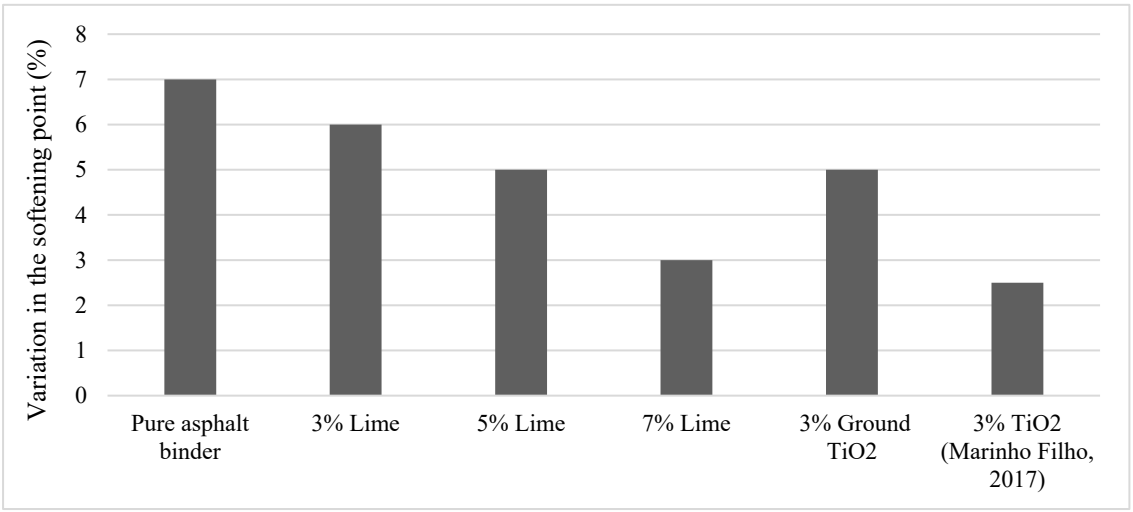

Figure 5 - Variation of softening points

The reduction in the softening point may be an indicative of less aging of the asphalt binder, since the softening point is related to the material's stiffness. The asphalt binders after the aging procedure are

more rigid, and, therefore, have increases in softening point values.

The index of thermal susceptibility (ITS) is another parameter that can be analyzed from the results obtained from penetration and softening point. The ANP resolution (2005) establishes a range for the ITS values, ranging from -1.5 to +0.7 for binders without additions. Most asphalt binders have an IST between -1.5 and 0. Values greater than +1 represent oxidized binders, little sensitive to high temperatures and brittle at lower temperatures, while values less than -2 indicate binders that are very susceptible to temperature variations (BERNUCCI et al., 2006).

Table 5 shows the indices of thermal susceptibility for pure and modified binders. The data obtained are within the ranges established by the ANP and demonstrate that the binder modified with TiO2 studied by Marinho Filho (2017) has greater susceptibility than the other binders, however, the modified binders in this research have less susceptibility when compared to the pure binder.

Table 5 - Thermal susceptibility indexes of the ligand

	Pure asphalt binder	**3% Lime**	**5% Lime**	**7% Lime**	**3% Ground TiO2**	**3% TiO2 (MARINHO FILHO, 2017)**
Thermal Susceptibility Index	-0,36	0,59	-0,02	0,54	-0,45	-0,79

The binders with contents of 3% and 7% showed values close to the upper limit, characterizing them as binders with a greater possibility of becoming brittle. The addition of 5% fractionated particles of hydrated lime, for this analysis, presented a better result, as it kept the binder in a range closer to zero, which indicates that it became less susceptible to the effect of variation of temperature, an indispensable fact to guarantee the good performance of the pavement in the field.

3.2.3 Rotational Viscosity

Figure 6 shows the viscosity versus temperature graphs for the samples produced with the binder modified with particles of hydrated lime and titanium dioxide.

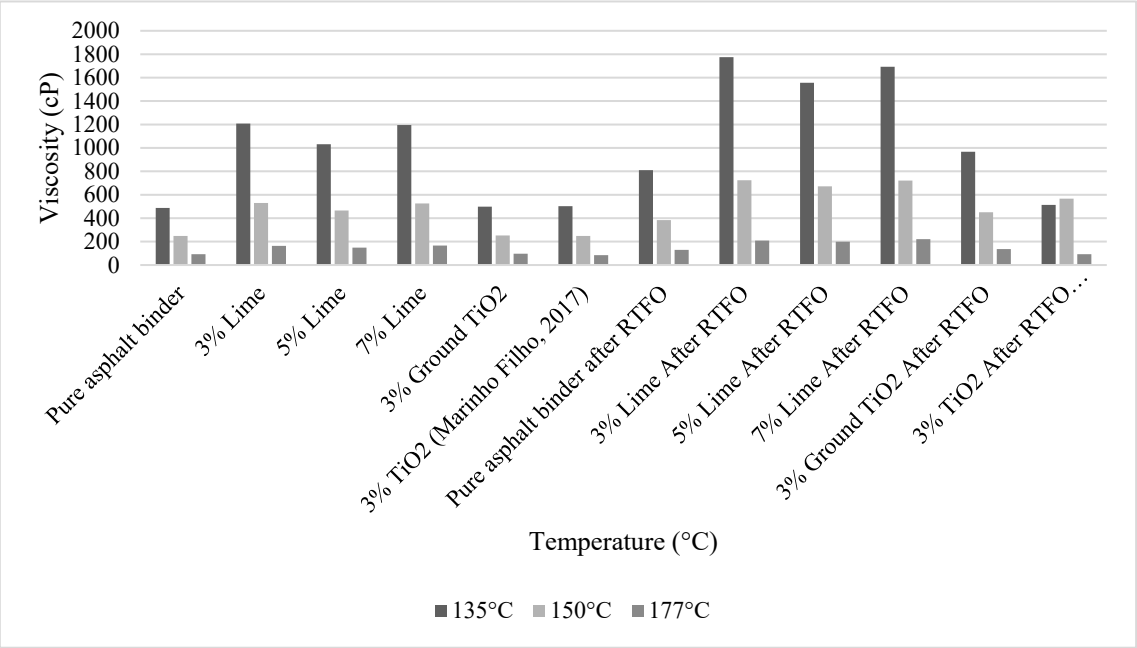

Figure 6 - Rotational Viscosity of modified CAP 50/70

The viscosity values of the pure binder, and consequently those modified by the addition of fractionated lime particles and titanium dioxide nanoparticles, assist the minimum values (274 cP - 135 °C and 112 cP - 150 °C) and range (57 to 285 cP - 177 °C) of the specification with their respective temperatures, according to ANP Resolution No. 19/2005.

In all levels there was an increase in viscosity, therefore all curves are above the pure ligand curve, except for the mixture analyzed by Marinho Filho (2007), which presented lower values. Analyzing the results, it is observed that the mixtures with 3% of TiO2 showed lower viscosity.

3.2.4 Short-term aging procedure (RTFO)

Figure 7 shows the results of the mass variations of the binders modified with fractionated particles of hydrated lime and titanium dioxide nanoparticles after performing the procedure in RTFO. The asphalt binders are in accordance with DNIT-095/2006-EM, which recommends mass variations of less than 0.5%.

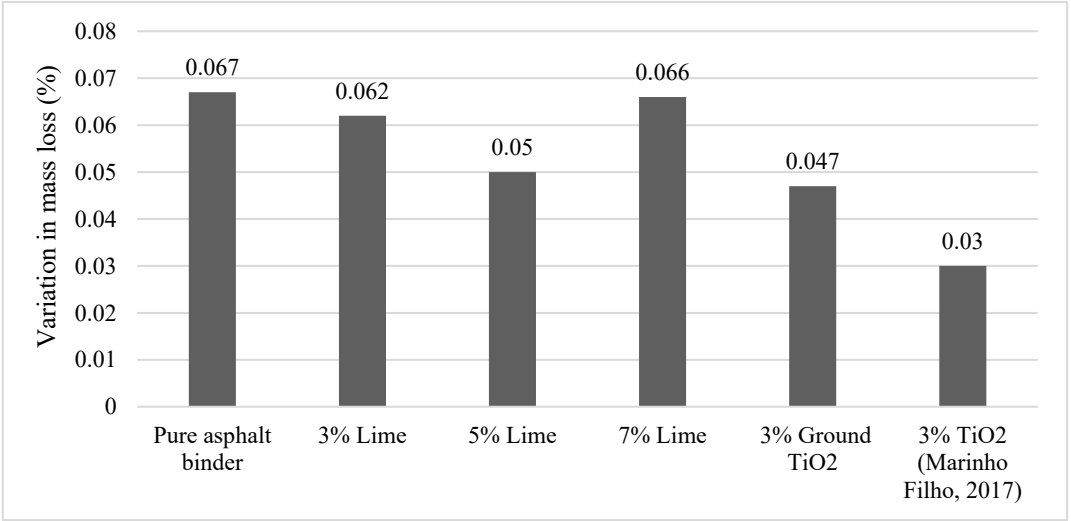

Figure 7 - Loss of mass of binders submitted to aging in RTFO greenhouse

When the binder is subjected to the aging process, it loses mass as there is a volatilization of the components that give it viscoelastic properties. In this way, the lower the mass loss, the greater the resistance to permanent deformations and the fatigue of the pavement. Analyzing the results, it appears that the mixtures that showed less loss of mass were those modified with a content of 3% titanium dioxide.

3.3 Performance Grade (PG)

The PG test was performed on an asphalt binder modified with TiO2 nanoparticles of 180 nm in effective diameter and with hydrated lime in the levels of 3%, 5% and 7%, before and after aging in an RTFO greenhouse. Figure 8 shows the PG temperatures (°C) for pure and modified binders.

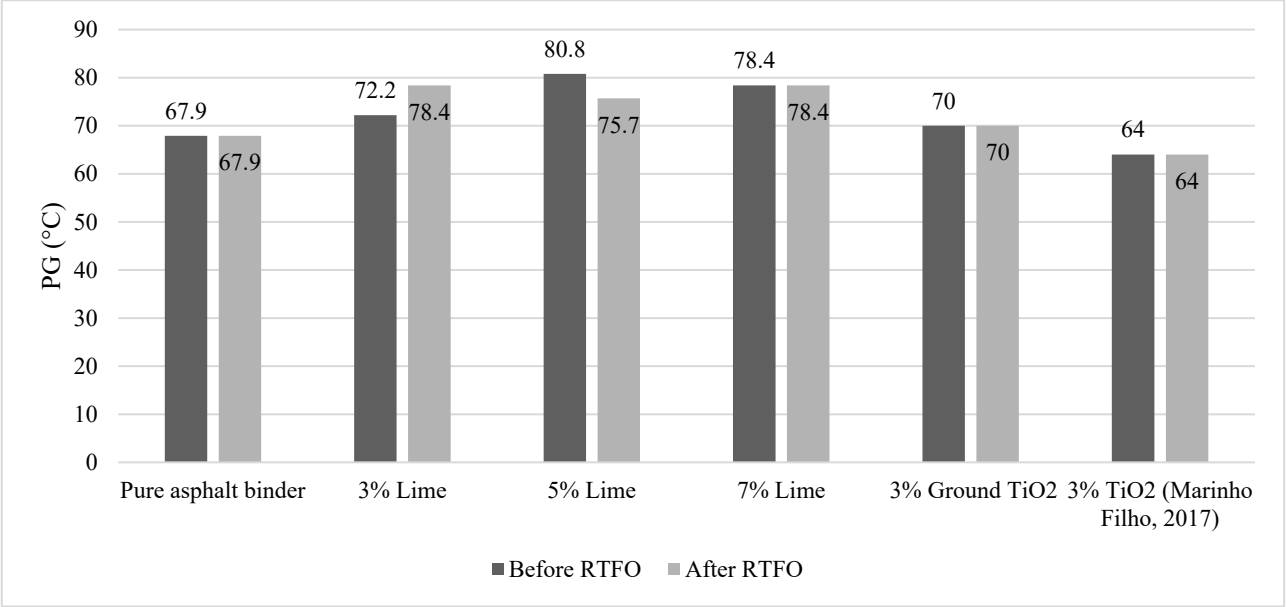

Figure 8 - Performance Grade for asphalt binders

It is noted that the addition of the modifiers analyzed in this research provided an increase in the maximum temperature of PG, highlighting the modified binders with lime that showed higher temperatures, especially the content of 5% of lime. This increase is interpreted by the increase in the Complex Module (G*), greater than the increase in senδ. The parameter G* corresponds to the stiffness and it is understood that there was an increase in viscosity in the modified samples allowing the achievement of a good Degree of Performance (PG).

The reduction in granulometry of the nano TiO2 was beneficial in increasing the binder failure temperature before and after aging in an RTFO oven compared to the pure binder and the nano modified TiO2 220 nm binder, studied by Marinho Filho (2017).

3.4 Test for multiple stress creep recovery (MSCR)

The test for multiple stress creep recovery (MSCR) allows to obtain the level of traffic supported by the binder and the percentage of binder recovery when subjected to tension variations. The higher the Jnr value, the material becomes more susceptible to permanent deformation. On the other hand, lower values of Jnr indicate resistance of the binder to this effect.

Figure 9 shows the Non-Recoverable Compliance values of the pure and binders modified with Cal and TiO2, with the application of a voltage of 0.1 kPa and 3.2 kPa.

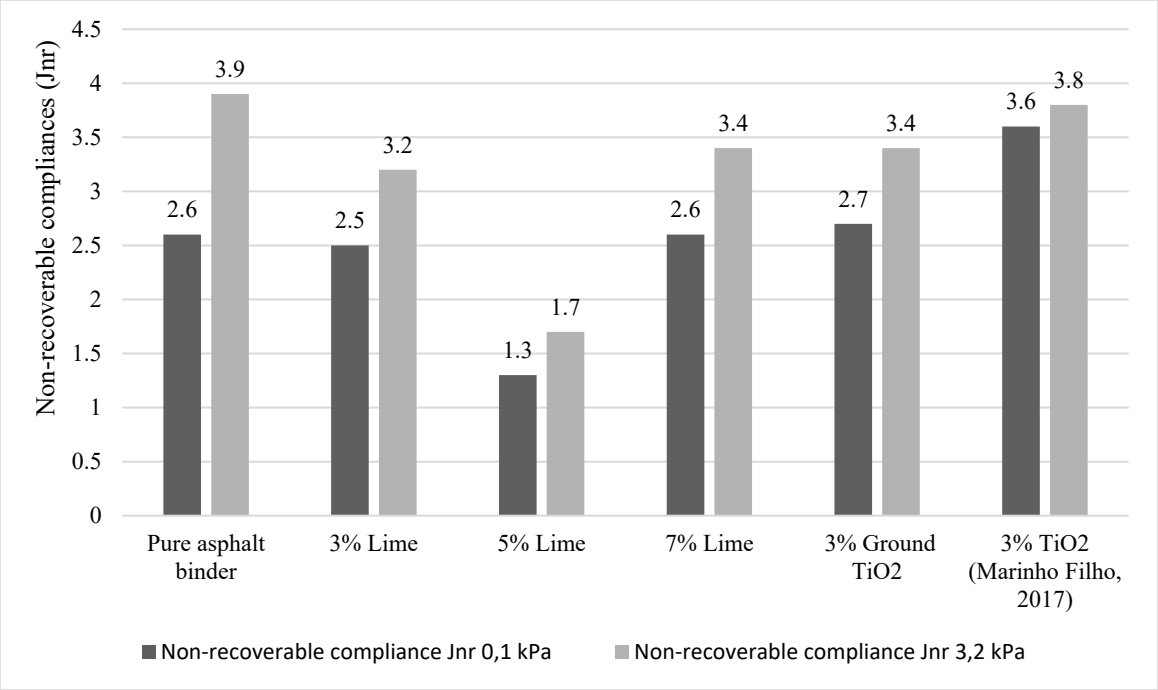

Figure 9 – Non-recoverable compliances from pure and modified binders

From the analysis of the Jnr values, shown in Figure 9, it can be noted that, with the application of the tension of 0.1 kPa and 3.2 kPa, the modified binder with lime in the content of 5% presents lower values for non-recoverable compliance when compared to the others, meaning to be the least susceptible to permanent deformation.

The non-recoverable compliance of the modified binder by 3% nano TiO2 180 nm is less than that of the pure binder at 3.2 kPa and that of the binder used by Marinho Filho (2017) modified by nano TiO2 220 nm at both 0.1 kPa such as 3.2 kPa. These results indicate that the decrease in the TiO2 granulometry for incorporation into the asphalt binder, compared to the binder used by Marinho Filho (2017), decreased the susceptibility to permanent deformations, as well as when compared to the pure binder.

According to AASHTO M320 (2016) it is possible to make the relationship between the values obtained for Jnr at 3.2kPa and the traffic class to which the binder is located. Table 6 presents this classification.

Table 6 - Pavement loading level classification based on Jnr values

Property	Jnr (1/kpa)	Type of traffic	Number of strides on a standard axis
Jnr at 3.2 kPa at maximum temperature of PG	2,0 – 4,0	Standard (S)	<10 Millions
	1,0 – 2,0	Heavy (H)	>10 Millions
	0,5 – 1,0	Very heavy (V)	>30 Millions
	0 – 0,5	Extremely Heavy (E)	>100 Millions

Source: AASHTO M320 (2016)

The pure binder is classified to support standard traffic (S), as well as the lime modified binders in the contents of 3% and 7% and the binders modified with 3% TiO2, as they have Jnr between 2.0 (1/kPa) and 4 (1/kPa). It is noteworthy that the binder with a 5% lime content was the only one to present a value between the limits of 1.0 (1/kPa) and 2.0 (1/kPa) and, therefore, classified to withstand heavy traffic (H), being the least susceptible to permanent deformation among the modified samples analyzed.

Another parameter analyzed in the MSCR test is elastic recovery. According to SHWA (2016) for binders with high Jnr, in other words, binders that have a high non-recoverable band, there is no specified minimum elastic recovery. The percentage of MSCR recovery (%) can identify and quantify the effect of the additive on the binder. An increase in the percentage values of this parameter results in the improvement of a modification of the binder to maintain elastic characteristics at high levels of traffic. Figure 10 shows the elastic recovery values for the binders modified with lime and titanium dioxide (TiO2).

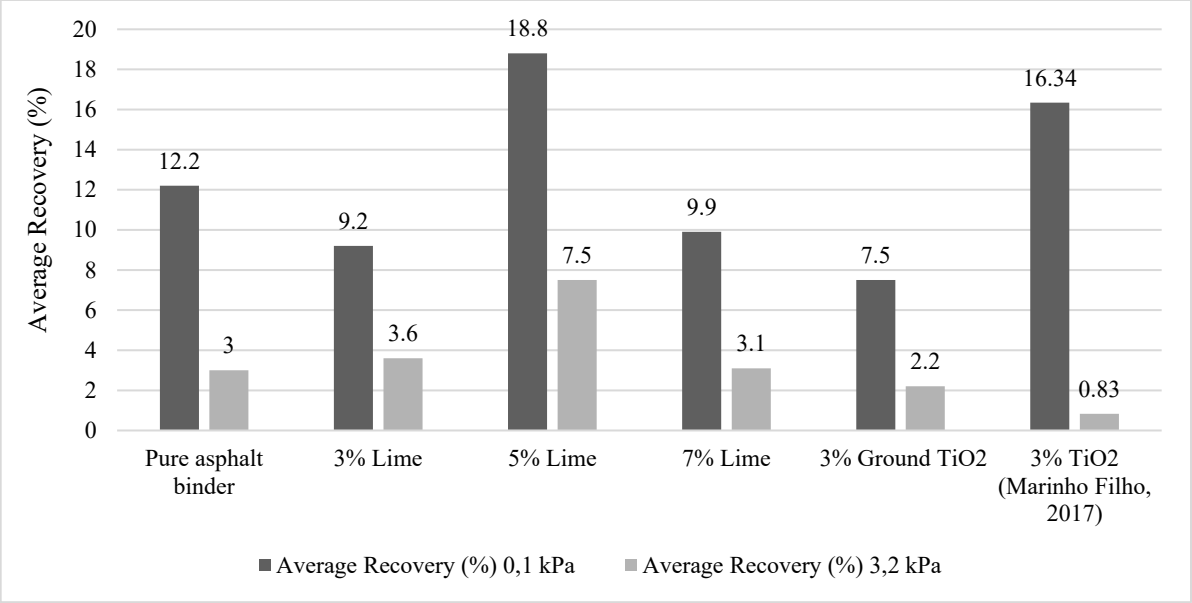

Figure 10 - Elastic recovery at 0.1 kPa and 3.2 kPa for pure and modified binders

The addition of lime promoted an increase in the recovery percentage of the material at the tension level of 3.2 kPa for all the samples, where the sample with 5% of lime showed the highest value. The increase in the elastic recovery of the mixture sample with 7% of modifier lime, at this level of tension, is insignificant because it presents a result similar to the pure binder.

In view of the analysis of the parameters of non-recoverable compliance and percentage of elastic recovery, the binder that presented the best results in relation to susceptibility to deformation and elastic recovery was the mixture with the addition of 5% of hydrated lime particles, presenting the ability to maintain its elastic characteristics at high traffic levels.

The milled titanium dioxide presented the lowest elastic recovery value when compared to the other studied binders, including the TiO2 nano analyzed by Marinho Filho (2017).

3.5 Linear Amplitude Sweep (LAS)

The linear amplitude sweep test is deterministic in ascertaining the fatigue life of asphalt binders. As a

result, it presents two parameters: A and B. The A parameter, obtained by the amplitude sweep, is related to the variation of the material integrity due to the accumulated damage. Higher A values mean that the sample maintained its initial integrity. The B parameter, given by the frequency sweep, is related to the sensitivity to deformations. Figure 11 shows the variability of A and B parameters in the resistance to damage obtained through the linear amplitude sweep test for samples with CAP 50/70 modified with fractionated particles of hydrated lime and titanium dioxide.

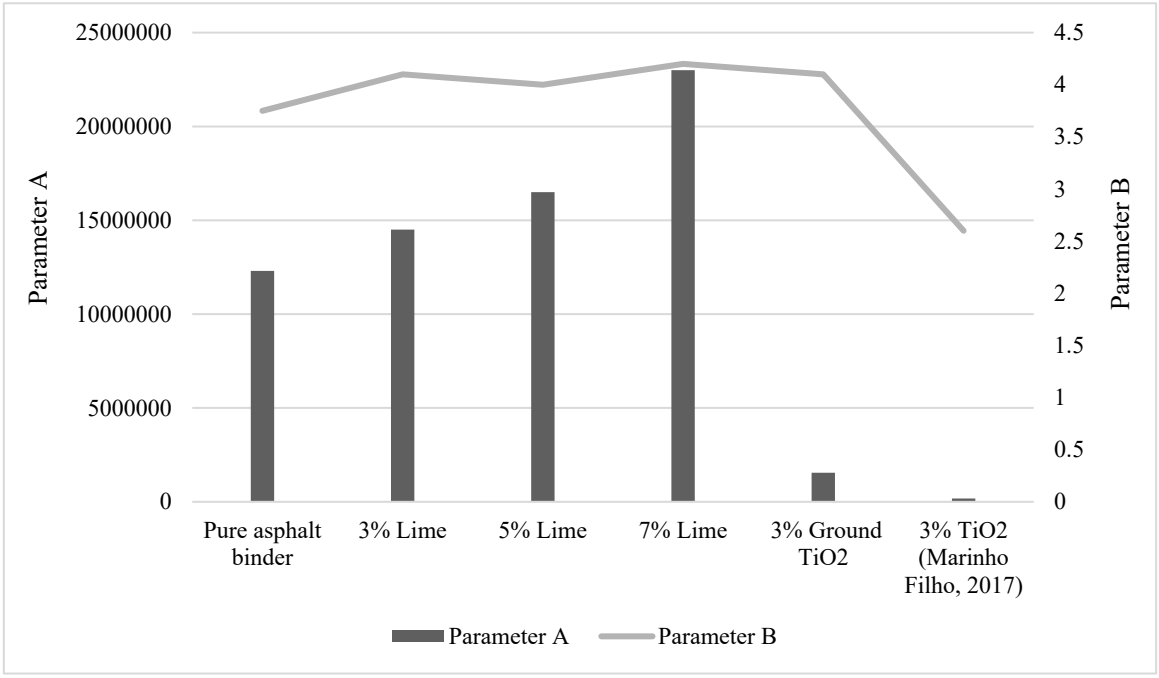

Figure 11 - Parameters A and B for pure binders modified with lime and TiO2

It can be observed in Figure 5 that there was an increase in the values of A parameter with the addition of fractionated lime particles in relation to the pure binder. In this way, the material that maintained the highest sample integrity was the modified binder with 7% of lime. In comparison to the pure binder, an increase of 87% in this parameter was obtained. The other levels obtained increases of 18% for the content of 3% of lime and 34% for the content of 5% of lime. The modified binders with titanium dioxide presented strong decreases in the A parameter when compared to the pure ligand and those modified with lime, the nano TiO2 220 nm being of lower value.

The B parameter, analyzed by means of the inclinations of the line shown, presents that among the modified binders, samples of modified binders with 3% TiO2 were more sensitive to deformation levels, which is not desired for asphalt binders. The sample with 5% hydrated lime showed the best result, with a lower inclination of the line. The analysis of the two parameters indicates that the decrease in the particle size of the nano TiO2 increased the integrity of the binder and made it more sensitive to deformations under temperature variations.

Figure 12 presents the fatigue life graph (Nf) as a function of the amplitude of deformation for asphalt binders in order to observe the effect of adding modifiers on the studied asphalt binder. Sobreiro (2014) apud Marinho Filho (2017) explains that the fatigue life indicates the volume of traffic that the

material would support due to the deformation applied, while the deformation is related to the conditions in which the materials could be submitted in terms of the structure of the pavement.

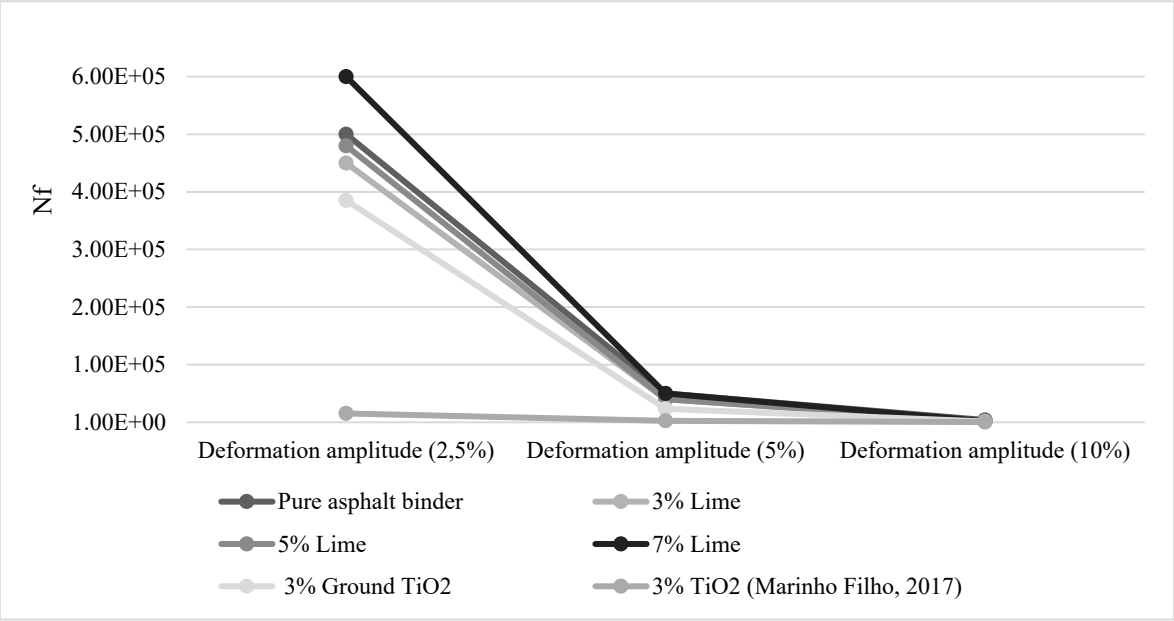

Figure 12 - Estimation of fatigue life of pure and modified binders

Based on Figure 12, it can be seen that the binder with 7% hydrated lime has the highest fatigue life estimates among all the analyzed binders. The Nf value of the sample modified with 3% milled titanium dioxide (180 nm) is greater than that of the modified ligand with 3% of TiO2 220 nm analyzed by Marinho Filho (2017), indicating that the decrease in the granulometry of the nano TiO2 proved to be positive in increasing the resistance of the asphalt binder to fatigue.

4. Conclusion

The milling process by the ball mill under the performed conditions (50 minutes long and without using surfactant) did not result in particles on a manometric scale for hydrated lime and the process with the use of hexane as a surfactant in the grinding of TiO2 is not advisable for not present significant improvements in the rheological characteristics of the asphalt binder.

The milling using a different surfactant and with a more expressive reduction in granulometry can still be used to study the influence of the size of TiO2 nanoparticles on the rheological properties of asphalt binders.

The modified binders showed better physical performance when compared to the pure binder. The mixture with 5% fractionated lime particles presented less susceptibility to oxidation and to the effect of temperature variation. The modified binder with 3% nano TiO2 presented lower viscosity and less loss of mass compared to other mixtures.

The rheological tests showed an increase in the performance level of modified binders with lime and nano TiO2 180 nm before and after aging in an RTFO greenhouse, obtaining higher failure temperatures.

The modified binder with a content of 7% hydrated lime showed better resistance to fatigue among

the mixtures analyzed. Among the contents of hydrated lime studied and the use of milled titanium dioxide, the content of 5% of lime showed a lower value of Jnr, being classified to withstand heavy traffic and the other mixtures only for standard traffic.

The binders modified with hydrated lime showed higher values of the A parameter, indicating that the sample maintained its initial integrity. The decrease in the granulometry of nano TiO2 increased the integrity of the binder and made it more sensitive to deformations under temperature variations when compared to nano TiO2 220 nm. As for parameter B, the modified binder with a content of 5% hydrated lime presented less inclination and less susceptibility to permanent deformation, therefore, this mixture is the most suitable for use due to the good performance in all tests conducted.

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Informational Flow Mapping in The Context of Fertilizer Importation Logistic Operations in The Port of Paranaguá, Paraná, Brazil

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Abstract

Due to the relevant growth of fertilizer importation in Brazil and the great incentive for its use in agribusiness, this study aimed to present the sharing of information from the perspective of the informational flow mapping of fertilizer importation in Brazil using the Port of Paranaguá, as example, seeking to verify the importation chain from the origin to the final destination, using the observation method since it could emphasize the research and thus show the complete mapping of this informational chain. The study was carried out in companies which work in the fertilizer importation and storage sector in the Port of Paranaguá, Paraná (Brazil).

Keywords: Strategic information management; Informational flow; Fertilizer import.

1. Introduction

The world business context has been marked in recent decades by the advancement of management models

supported by new technologies, which consequently leads to an exponential increase in competitiveness. In this sense, it is natural for companies to look for ways to survive and stand out in this scenario.

One of the biggest focuses in this highly competitive environment has been the increasing amount of information that is disseminated all the time, on different areas and with the use of various information and communication technologies (ICTs), making the business world immersed in a very informational context. Many authors corroborate that we are experiencing the "Information Society" or "Knowledge Society" (CASTELLS, 1999; MORIN, 1991; CHOO, 2003; DAVENPORT and PRUSAK, 1998; NONAKA AND TAKEUSHI, 2008; VALENTIM, 2007).

From this perspective, companies are using information as an input more intensely than in other decades, and this can represent both a risk and an important strategic tool. In this last case, it is argued that informational mapping can be an important tool for analyzing the situation of a company related to relevant information, considering that it is able to clearly indicate each step, point out gaps and establish diagnoses. In this sense, the present study aimed to map the information flow in the framework of the logistics operations in a fertilizer importation company that operates at the Port of Paranaguá, Paraná State, Brazil. This study sought to map the existing information flow in all stages of the logistical process in order to understand the steps, offering an informational panorama able to support strategies for the company as well as new studies.

It is understood that the information flow mapping may be able to contribute to the optimization of the logistics operation, considering the intensity of the fertilizer flow in Paranaguá, as well as the competitiveness on a global scale, which promotes an environment where operations need a lot of discretion regarding timing and efficiency in the processes. Thus, this research sought to understand the information flows in this process by mapping and analyzing each point in order to identify which information is actually relevant from the importer to the arrival at the farm, which would be the final stage of the process, and how the port, warehouse and carrier act in this context.

2. Theoretical reference

2.1 Business informational flow

Considering the organizational perspective, it is argued that information is one of the most important inputs, being present in everything the company does. As it is an important input responsible for both communication and strategic support, it is extremely important that companies pay close attention to the ways in which information is used.

McGee and Prusak (1994) emphasize that in the companies, information can be compared and is becoming an asset as important as others, such as capital, properties, human resources and material goods, considering that all of these need to be managed.

In this sense, many companies already recognize the importance of understanding the information flow as one of the most important resources of the company in order to be able to stay in the competitive environment where they are inserted, because it is through the information flow that the organization is able to efficiently map which are the information that should be used as an aid tool and what information should be used as a strategy tool. From the information flow mapping, the company can have a more

effective overview of its processes and thus build knowledge about the internal and external environments and on its management.

For the organization to achieve its goals, it is essential that the chain elements of the company's process are in line, thus minimizing losses due to the transfer of discordant and inconsistent information during the process, especially in critical interfaces, such as cross-functional ones (Correia and Almeida, 2002).

It is important to mention that the implementation of the information flow analysis approach in the organizations involves the need to know and understand the stages of processes that are often done routinely, and the speed with which such processes are carried out often does not allow an return analysis based on time, implements, people, systems, among others thing involved in the processes.

From this perspective, Correia and Almeida (2002) also add that the information from these flows is often improperly originated, processed, used and destined, which reduces the efficiency of the processes.

The information flows are guided, among other aspects, by the organizational communication, considering that they are understood as a result of the formal and informal interaction process among sectors and individuals in a given organizational context (Valentim and Zwaretch, 2006).

Regarding formal and informal flows, Lopes (2010, p. 30) defines:

> Formal flows are resulted from the company's structure, that is, routines and elements applied to the productive activities, being related to the company's organizational chart. In this case, the recorded information runs through the company's formal systems, such as: corporate portals, intranets, reports, records, documents containing rules and codes, among others. And in the form not registered there are formalized meetings, courses and events, but not registered in any type of support. As for informal flows, these can arise spontaneously, during a meeting or even in conversations between employees, being related to the intellectual structure of each individual working in the company. It is noteworthy that informal flows, in general, take the unregistered form, considering they are non-formalized dialogues and interactions among subjects and, therefore, not registered in supports (Lopes, 2010, p.30).

In order to make it possible to manage these informational flows, whether formal or informal, it is essential that the company establishes and conducts integrated actions aiming at prospecting, selecting, filtering, processing and disseminating all information including documents and databases, produced internally and externally to the organization until individual recognition of the different individuals and actions existing in the organization (Valetim, 2002).

In this context, it can be argued that business informational flows are part of the entire business context. It is essential that the company knows and understands this flow and knows how to use it as a strategic tool.

2.2 Exportation logistics

The industrialization process in Brazil took place at the beginning of 1940, and from this decade on, the government encouraged the fertilizer factories. Brazil uses about 6% of all fertilizer commercialized in the world, in addition it can be listed that 70% of all fertilizer in Brazil is imported, being dependent on the world supply, using the means of transportation by road, rail and waterway modals.

2.2.1 Logistics solution

The inter-modality of the logistics process is the way to obtain lower costs in cargo transportation. Inter-modality is obtained from a succession of stages, characterized by the use of more than one modal for cargo transportation. The first phase is the movement, characterized only by the use of more than one modal. In the second one, there is an improvement in the efficiency of integration between the modals such as the use of containers and instruments for the transfer of cargo between one modal to another (this is defined as the moment of multimodality, which is the current phase of the Brazilian scenario (Neto, 2014).

2.2.2 Port of Paranguá

The port of Paranaguá last year has been in first place in terms of fertilizers importation, being one of the main products handled in Paranaguá, with 20% of all product handled. The strongest point of Paranaguá is the efficiency and practicality of the discharge, fulfilling goals established by APPA and other regulatory agencies. In a future projection, the Port of Paranaguá intends to handle around 9 million tons in 2030.

2.2.3 Importance of information in the context of logistics operations for exportation

The flow of information is very important, not only in logistics operations, but in all segments. Information in logistics has an emphasis on a dynamic environment, with constant changes and in Paranaguá, the flow of information among all those involved is very relevant for the success of the high volume of fertilizers handled. Besides de competitiveness, the companies work as stakeholders, partners in handling, always seeking the union in favor of the continuous growth of the Port of Paranaguá. This exchange of information between regulatory agencies and companies, makes port to have greater efficiency in unloading and a better logistics flow.

All information is shared with everyone who is part of the logistics chain operations so that the port has corrections and adjustments that impact on improvement and efficiency. Therefore, what is observed is that this information is more important than the operational capacity of the agents involved. With this information, several alternatives and changes can be applied and maximize attitudes, which positively impacts the logistical success and good final results to the Port of Paranaguá.

3. Methodological procedures

This study is presented with an essentially qualitative typology, having been supported by the participant observation research. As for participant observation, May (2001), argues that the great advantage is that the researcher can establish a relationship with the investigated ones, because the observer participates in the process which he is researching, allowing a deeper interpretation of the context.

In order to achieve the objectives, it was also used a case study, which can be understood as:

> [...] a method that covers everything - with the planning logic incorporating specific approaches to data collection and data analysis. In that sense, the case study is neither a tactic for data collection nor merely a feature of planning itself, but a comprehensive research strategy (YIN, 2001).

3.1 Characterization company

As this study is about importation, it was not used a specific company, it was chosen the Port of Paranaguá, one of the main fertilizer entrance places in Brazil, being responsible for about 30% of all fertilizer imported and it also distributes the fertilizer to other regions of Brazil such as Southeast and Midwest. In this way, the Port of Paranaguá has great relevance for the flow of this product importation, which has enabled the researchers to analyze some points such as: the ships arrival management, the spaces for mooring management, whether there is space for the products landing and whether they already have the means to deliver them to the final consumer, all of these points are very relevant in structuring the mapping.

4. Results presentation and discussion

This paper sought to map, from the perspective of informational flow management, which are the main points inherent to logistical processes in the context of the fertilizer importation sector, considering the beginning of the process, that is the importer, until the arrival at the final customer, pointing out the main strategic information related to each stage of the logistics process. In this sense, the presentation was categorized according to the structure of the observation script that sought to identify each logistical step and the relevant information generated, the following categories and subcategories bellow:

Category 1: Purchase specification

Subcategories 1: as for the producer, as for the product, as for the mean of transportation, as for the terms, as for climatic issues, as for the price.

Category 2: Importation monitoring

Subcategories 2: as for the time of ship departure, as for the route, as for the quality control of the product in the course, as for the arrival at the destination.

Category 3: Arrival at the Port terminal

Subcategories 3: as for the choice of the terminal, as for the ships programming, as for the control of the Port internal logistics, as for storage.

Category 4: Transportation and the choice of modal for shipment to the buyer

Subcategories 4: as for the railway modal, as for the road modal, as for the costs.

It is also noteworthy that both registered information (documents) and unregistered information (based on observation) were considered, so this way it was also possible to identify the document flow of the processes. Next, the categories, subcategories and the respective information that make up the information mapping are presented.

4.1 Category 1: Purchase specification

4.1.1 As for the producer

The countries from which Brazil imports the most vary according to each type of fertilizer, and in most cases, in order to be able to import fertilizers, it is necessary to have an authorization document for importing fertilizers, inoculants and correctives, which can be done by individuals or companies, and it is need to require for an authorization with import license, invoice, analysis certificate and cargo knowledge.

Between January and June 2019, Urea was most imported from Algeria (21%), Russia (16%) and Qatar (12%), Ammonium Nitrate come in a greater quantity from Russia (72%), Ammonium Sulphate came mainly from China (64%) and Belgium (18%), MAP had a great demand from Morocco (22%), Russia (20%), and USA (17%), whereas the main DAP countries were the USA (71 %) and Saudi Arabia (15%), while Potassium Chloride was most imported from Canada (32%) and Russia (26%).

4.1.2 As for the product

There is a large amount of fertilizers that are imported into Brazil, such as Urea (used to replace this nutrient in fertilizers), Single Superphosphate (SSP, is widely used in soybean crops), Triple Super Phosphate (TSP, has a high concentration of phosphorus), Ammonium Sulfate (widely used in several crops and can be used for its replacement), Potassium Chloride (KCI, main supplier of potassium, widely found in NPK in Brazil), Diammonium Phosphate (DAP, widely used for concentrated fertilizers and is a great fertilizer for wheat and corn), Monoammonium Phosphate (MAP, widely used by the industries for fertilizer mixtures but can also be used in its pure form) and Ammonium Nitrate (it is an efficient and fast nitrogen fertilizer but has some restrictions).

4.1.3 As for the mean of transportation

The imported fertilizers are generally sourced from countries in Europe, Asia and North America, so the method usually used is waterway one, the ships bring to Brazilian ports and after the arrival at the port, the products are delivered to the factories by trucks or trains.

4.1.4 As for the terms

The time for the arrival of the fertilizer at the port varies in several aspects, such as if the product is already ready, if it was packaged correctly, in which container it will be placed, which will be your ship, in which port it will be loaded, which will be the modal to be delivered to the destination, how it will be placed in the truck or train, how the fertilizer will be removed from the container or if it will arrive at the destination inside the container. Therefore, everything must be defined in advance so that it is possible to safely predict the arrival of the product.

4.1.5 As for climatic issues

The climatic conditions are a very important factor to be considered because the product must be well packed and the container must not have any damage, as in case of rain the product can be wet and damaged. The climate is not something that directly affects fertilizer, because if the harvest is not in a good season, as lack of rain it can directly affect agriculture and reduce the demand for the product, thus reducing the desire to import (Thomazella, 2019).

4.1.6 As for the price

Brazil is a big consumer of fertilizers and as there are no taxes on fertilizer importation, it is more convenient to buy from countries on other continents than to buy from the states in Brazil, due to high taxes on Brazilian logistics. Thus, according to Fontanari and Pereira (2019) in February 2019, the fertilizers

with the highest price are MAP (425.8 USD), potassium chloride (355.0 USD) and TSP (332.5 USD).

4.2 Category 2: Importation monitoring

4.2.1 As for the time of ship departure

In Paranaguá Bay – PR it was observed that the average size of the ships varies between 199 and 214m, with an average of 60 thousand tons per ship and the time for unloading and loading is done under agreements between suppliers and importers, varying from 3 to 10 days on average. The entire process between arrival, mooring and departure is measured according to the lineup that each port makes available, thus the daily average regarding the time of ship departure can be visible to make the data effective.

Weather conditions must also be taken into account during the period in which the ship is operated.

4.2.2 As for the route

The average time of the route is measured considering the route on which the ship will sail. This route is carried out under the orders of the captain therefore, the route is pre-established by the course of the route before the ship leaves until its final destination. However, the ship's route can be altered by external factors defined by the captain, such as weather or supply factors.

4.2.3 As for the quality control of the product in the course

The quality control of the product is carried out during the ship loading procedure at the origin, and during the unloading of the ship at the destination, that is, during the journey, quality control is not carried out, however the control is carried out before the ship is loaded and during the unloading process. For such verification, professionals and companies specialized in quality control of the loaded products are designated, this investigation aims to have products with excellence, as there are products that cannot be influenced by other agents, such as humidity, for example.

In order to avoid this kind of problem, some data about the ship is carried out, such as age, material, flag and which were the last loads carried.

For products loaded in the Port of Paranaguá, for example, the quality control is carried out right after the arrival of a loaded truck in the city, so that there is no contamination of the product in the storage, this means that the cargo of a contaminated truck is not mixed with the other cargoes that will be loaded in the ship.

4.2.4 As for the arrival at the destination

After the entire loading process and choosing the route, the unloading process is carried out, being coordinated by the ship's captain. Reports are generated with notifications related to the ship's conditions, its positioning and arrival forecasts so that then the average time of the journey can be predicted and if the ship will be able to reach its destination on the scheduled date.

Upon arrival at the destination, the captain sends a communication called NOR (Notice of readiness) that complements the NOA (Notice of Arrival) which basically includes the notification that the captain is informing that the ship has arrived at the port anchorage and that it is already ready and willingness to carry out the stipulated operation. This document is very importance for all parties involved, as it is based on it

that premiums or fines will be stipulated for the delay or not in the operation.

4.3 Category 3: Arrival at the Port terminal

4.3.1 As for the choice of the terminal

The ports of Paraná totaled an amount equivalent to US$ 1.4 billion in landings until the middle of 2019, representing 34% more than the previous year. With these data it is noted that the Port of Paranaguá receives the amount that represents 30% of all fertilizer imported by Brazil, characterizing this port as the main importer port of Brazil.

It can be evidenced that there is a total of 299 tons landed per hour, and for that purpose the Port of Paranaguá has great efficiency and a structure, highly prepared to receive this enormous amount of cargo. The landings present the types of direct landings (by trucks) and landings by dalas (carriers) that are directly connected to warehouses, improving the flow and speed of the products transportation. The warehouses that receive fertilizers are close to the port, thus avoiding major bottlenecks.

It was possible to verify during the observation, based on daily documents and analyzes, that over the years Paranaguá has expanded in the territorial context, with the Port of Paranaguá becoming more modern, however the city did not follow the tendency of the port growth regarding the structure, which has generated some bottlenecks in the landings due to the proximity of the warehouses. It happens because with the exponential growth of the port, the flow of landings increased considerably and, consequently, the flow of trucks also, which generates huge queues in periods of great peaks, causing disturbances in the region and complications in the landings.

4.3.2 As for the ships programming

The programming of fertilizer ships is done with data provided by dispatchers, shipping agencies and port operators that daily enter data using the Paranaguá and Antonina Ports Association (APPA) system. Dispatchers make the documents clearance, such as the Bill of Lading, called BL's, at the APPA and IRS (Internal Revenue Service).

These documents make up the ships' documentation, they are managed by a maritime agency that does all the processing, such as: the negotiation with the importer, selling the option of fast landing in Paranaguá after every deal that occurs in the Fertilizer Meeting that takes place at APPA. However, when ships go to the meeting, they must be duly cleared by APPA and IRS (Internal Revenue Service), documentation that is the responsibility of the Port Operator which does the operational management, landing and logistics to the warehouses of the importer's choice. Thereafter, the port operator daily inserts in the APPAWEB system the distribution of the ship, specifying the product, the importer and where the product will be landed. The control of this distribution is supervised by APPA. After 100% released by the agencies, the maritime agents participate in weekly meetings at APPA in order to know which ships will be "next". It was possible to observe all the criteria used in the meetings, such as which ships are preferred and which are not. The moorings are elaborated by APPA using a daily LINE UP.

4.3.3 As for the control of the Port internal logistics

It was possible to follow in real time everything that happens in the internal logistics of the port, knowing

which ships are moored, their arrival and departure times, which agencies and operators were working on the ships, the way of all products (if it is importation or exportation), all of this was possible using the Graphic Map that is made available on the official APPA website. It is a good option for future importers that are looking to analyze the times and deadlines for landing their products. It is also possible to access data about the number of trucks that can enter the port range.

4.3.4 As for storage

The Port of Paranaguá, in relation to fertilizers specifically, does not work with internal storage in the port area. All landings are carried out by direct unloading or carriers, due to the fact that the port does not have an extensive physical area, in addition to the fact that all warehouses are located around the port, which facilitates the logistics of the importer since it will be easier to move this cargo to the producers. All fertilizers that are landed in Paranaguá serve producers in Paraná, in addition to the states of Mato Grosso, Mato Grosso do Sul, Goiás, São Paulo and Minas Gerais.

4.4 Category 4: Transportation and the choice of modal for shipment to the buyer

4.4.1 As for the railway modal

According to the Brazilian National Land Transportation Agency (ANTT), the railway modal is characterized by the ability to transport large volumes efficiently, especially when traveling medium and long distances. The railway modal is the most secure, with the lowest accident rate and the lowest incidence of theft and robbery. Among the typical loads of the railway modal are fertilizers, which are the object of this study. Brazil has the largest railway system in Latin America in terms of transported cargo, reaching 162.2 billion tons per usable kilometer.

Paraná has 2,400 km of railroads and ANTT is the regulatory agency and being divided into two concessions:

• 2,039 km concessioned to América Latina Logística (ALL).

•248.5 km concessioned to the Government of Paraná State, being managed and operated by Estrada de Ferro Paraná Oeste S.A. - FERROESTE.

4.4.2 As for the road modal

The road transportation is responsible for transporting 58% of all the country's cargo on federal highways. According to Rodrigues (2003), federal highways are divided into five types of “BR’s” that cross the country:

• BR Radial - start in Brasília, numbered from 1 to 100;

• BR Longitudinal - North-South direction, numbered 101 to 200;

• BR Transversal - East-West direction, numbered 201 to 300;

• BR Diagonal - diagonal direction, numbered 301 to 400;

• BR Connection - join the previous ones, numbered 401 to 500.

Transportation by road, despite being the main modal in the country, has insufficient legislation and several problems linked to it, such as theft and deviation of cargo that generate losses of US$ 32 million per year on average.

4.4.3 As for the costs

The road modal, although being responsible for carrying more than half of the cargo transported in the country, has relatively higher costs when compared to the railway modal.

According to the Department of Research and Economic Studies of Bradesco (DEPEC, 2011), the railway modal cost from R$ 15.00 to R$ 26.00 per 1000 ton/km, while the road modal cost from R$ 35.00 to R$ 45.00 per ton/km.

5. Final Considerations

The aim of this paper was to describe and analyze the informational flow of the logistical operations management of fertilizers importation, with the perspective of the criteria used to carry out the stages of importation from the origin to the arrival at the final destination. For such analysis, a mapping of the information flow was carried out regarding the stages that permeate and that are important to these processes, using participatory observation based on a previously established script as a method.

The chosen environment for the research and case study was the Port of Paranaguá, which has great importance in the fertilizer importation logistics sector in Brazil, being considered the port that handles the largest volume of fertilizers in the country.

In relation to the logistical process, the central axis of this paper, it includes characteristic elements of a structured information flow, that is, the flow of information is highly efficient in supporting the processes carried out. The informational flow when it is well structured provides good communication, a fundamental item when it happens in an environment with a diversity of agents acting.

It could also be observed that there are improvements in the Port of Paranaguá, these improvements brought greater efficiency in the logistical processes of fertilizers importation, as well as in the generation of relevant information and document management. Such improvements are related to technological advances, especially in relation to updates to the port informational flow management system, thus obtaining better process results.

The sharing of information in the fertilizer importation process was considered as one of the main agents in the quality management of the Port informational flow, which makes it possible to identify problems in a timely manner, as well as to create solutions.

Therefore, the dissemination of information within the port logistics process is one of the main contributing agents for the improvement and efficiency of the processes. In this regard, it could be seen that the adequate dissemination of information among agents makes the optimized informational flow one of the main organizational tools in the search for excellence in this context.

In view of the observed aspects, it is concluded that the informational flow mapping can be considered as one of the main organizational tools related to the diagnosis of processes. It is noted that due to its numerous possibilities in relation to the broad visualization of the stages, it is possible to collect information, analyze documents, access data and build holistic knowledge in order to diagnose and create solutions and improvements.

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Shopping Centers and Confrontation with Product Life Cycle

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Abstract

This article presents initially the evolution of the shopping center as a product, from its starting configuration as a supply center focused on territorial planning to its configuration as a real estate product. Thus was observed that the product's condition took it to a confrontation with a cycle, laid out in phases that go from introduction to decline. In this case, cycle confrontation will not free ventures from entering the phase of decline, implying in great impacts on cities and their inhabitants, as well as on the several agents involved with this type of enterprise. Therefore, the work points out a concern with relation to the types of ventures that will be developed which cannot be exempted from a holistic view of urban economy.

Keywords: Shopping center, Consumption, Product life cycle

1. Introduction

Exchange, as a basis for commerce, brings from its origins issues such as supply for survival and sociability as a way to maintain cordial relations among peoples (VARGAS, 2007)

Thus, from the obligation of giving, receiving, and repaying in archaic societies (MAUSS, 1974; *apud* VARGAS, 2007), exchange will open the way for commerce, when it includes the intention of monetary profit. However, as mentioned by Mauss, it must be remembered that there never was a natural economy, since interest has always been present in the act of exchange. What changes, in this sense, is the intention of extra gain (profit).

The formation of capital from mercantile and financial profit will enter the production system as it incorporates the most varied products in its process of accumulation. This way the concept of basic

necessities will be amplified over the centuries, especially from the 19th Century on, when industrial expansion began to require diversification of merchandise and markets as a way to maintain its profit rate.

Marx considers this an inherent process to capitalist society, in which men produce much more than what is enough for their needs, which generates a production surplus which tends to be appropriated by the expanding capital. On the other hand, if production is consumption, for the expansion of capital it becomes necessary to expand consumption through surplus consumption. It is observed from this that production is no longer based on man's natural demand, but needs to create new demands so as to stimulate the creation of new usage values, which will intrinsically convert to exchange values (MARX, 1979).

In the 20th Century the consolidation of the industrialization process implicated an exponential growth in the number of launched projects, which resulted in an expansion of markets far beyond those verified when the production process was handmade.

Thus was configured the "society of consumption" imagetically tied to the fordist[1] production process.

After the 1970's this expansion in consumption would happen fundamentally by product disposability and fragility, an attitude which would be evidenced in the advent of flexible production based on customization and constant innovation, when consumption expands beyond products and begins to embrace other aspects such as services and the consumption of experiences and sensations (LIPIETZ, 1986; HARVEY, 1993).

Returning to Marx's considerations (1979) in viewing the maintenance of profit margins, capitalist production will be supported on two principles: (i) markets must be enlarged so as to include a greater number of people; and (ii) the time for consumption must diminish, that is, the principle of obsolescence makes recirculation of merchandise faster, thus artificially amplifying demand.

Such enunciated principles would still be supported and magnified by the marketing and retail sciences, which would gain strength after the 1950's, by studying the several behavioral aspects of consumers, trying to transform desires into needs.

From there, products would be subjected to a life cycle, constituted by phases, from introduction to decline.

One of the first authors to identify this cycle was Vernon (1966), who inferred that a specific product was composed of a useful life composed of three phases: (i) introduction of the product; (ii) maturation; and (iii) standardization. Each of these phases also corresponds to a profit cycle, which marked out for investors as to how, where or when to stop investing. Afterwards, Davidson (1971) completed the cycle, inserting additionally a phase of decline. Thus, the product cycle can be summarized by:

(i) Introduction phase: A product's introduction phase is marked by uncertainty with relation to the product's acceptance. In this case the product's characteristics are still not able to be standardized, which results in great variations to the final product. This phase is also marked by imprecision in

[1] The term *fordism* was created to designate the production and consumption expansion process also characterized by innovation in technological processes, followed by population growth, advancement in the marketing and retail sciences, in addition to increments in the transportation sector, notably by the disseminated use of the automobile. This process was accompanied by governmental policies aiming at market regulation, as well as growth in government spending with pension systems, known as the Social Welfare State. Fordism's "golden" period coincides with WW II's post-war, when, especially in the US, there is great expansion in consumption, followed by income growth and a brutal growth in birth rates (SCHLESINGER, 1988).

consumer market dimensioning, which in principle would concur towards the small number of circulating products and the high degree of differentiation among them.

(ii) Maturation phase: The number of producers grows, as product diversification also grows in the struggle to define a hegemonic model. The initial diversification will give way to a movement in direction to product standardization, which will benefit the company or group whose product is the winner in the "introduction" battle. This group will deter the monopoly of innovation for a determined period of time. Vernon (1966) still explains that with greater production stability grows the usefulness of cost projections and the importance of controlling them in an efficient manner.

(iii) Standardization phase. This is the moment the product reaches its clímax. Consumption is massified and production scale is optimized, thus evidencing a deepening of the previous phase's characteristics of product maturation. Despite this relative stability of the product and of the consumer market, specification of the input required for production will go through great changes. The relative importance of capital and labor factors grow while the technology factor declines. The need for work linked to knowledge decreases while that linked to production grows, as well as the importance for improvement of incorporated technology in equipment (VERNON, 1966).

(iv) Decline phase. The product's profit margins fall. New products are beginning its substitution. Thus, market interest in the "old" product declines. Production tends to be abandoned or transferred to lesser developed countries, where it will still be able to generate profit.

The speed of the cycle's phases will vary according to the product involved. However, even with the variations, the tendency will always be towards constant growth in speed of the referred cycle. Thus, two standards can be established for the 20th Century. The first is the speed of the fordist period cycle and the second of the flexible production model.

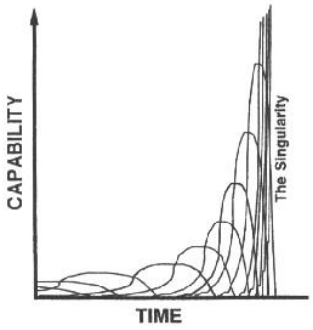
In the fordist model, the cycle's speed was stable, tending to stagnate for long periods in the standardization phase. In the flexible accumulation model, however, speed will be exponential, with progressive shortening of the product's phases. On the other hand, even though shorter, in this period profit margins will become progressively higher, although ephemeral, as demonstrated in Tom Meckendre's graphic.

Thus is observed that the life cycle will be an inherent process to the product, be it produced by the electronic, phonographic, or real estate industries. In this sense, shopping centers will not be free from this process as they are constituted as a real estate product.

2. The shopping center as a (real estate) product.

The association between mercantile and real estate capitals goes back to the Parisian Galleries of the 19th Century, which were already thought out as a real estate product, bringing rental income to their owners. In the 20th Century the planned shopping Center would have its origin in the territorial planning, meant to meet population demand for supplies. This was the case with the garden cities designed by Ebenezer Howard, such as Letchworth in 1906.

Graphic 2. Product life cycle.



Source: adapted from Sevcenko, 2001

Later on, in the 1920's, North American real estate businessmen embraced the idea of planning for commerce, from then on with profit as the objective. The idea consisted in maximizing public appeal through placement of attractions, as well as a correctly combined store mix. Moreover, planning of operations, action control, and submission of the storeowner to proper behavioral codes formulated by the controller are highlighted; the focus on customer satisfaction becomes more important than the storeowners' interests (VARGAS, 2001).

Furthermore, in the beginning of the evolution of shopping centers, the role of the real estate entrepreneur was sometimes played by the retailer, as is the case with department stores, which were the first to build regional shopping centers. However, as the product became standardized, mercantile capital was gradually withdrawn from the scene towards dominance of real estate capital, supported by financial capital.

Thus, the shopping Center came to be seen as a profitable product, so real estate operations became, for businessmen, hegemonic in relation to commerce. This configuration as a product will place it in the direction of product life cycle, marked by constant decadence of what becomes old and ascension of what is new.

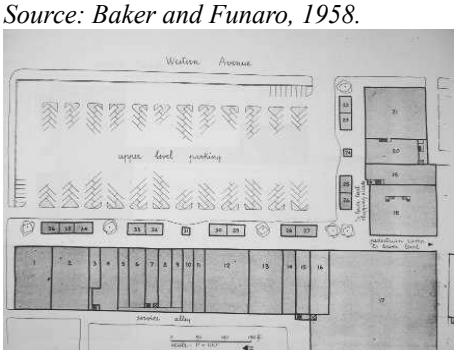
3. The shopping center product cycle

3.1. Introduction Phase (1927 – 1950)

The initial moment of this phase is the construction of the Country Club District by J. C. Nichols, a real estate businessman, to whom was attributed the creation of the term "shopping center", in 1927, to designate these planned undertakings aimed at the motorized population. However, as there is no standardization of dominant typologies, this real estate product will share space with another two other forms of similar origin: the supermarket and the drive-in type equipment, inaugurating the *one stop shopping* context. In reference to these typologies is noted that they arise as the motorized population in the USA advances, making the downtown-suburb connecting axes attractive to commerce. Even so, the store blocks still tried to turn their shop windows towards the street, showing that traditional commerce was still the main reference (Figs. 1 and 2).

Fig. 1. ***The Country Club District****. 1926 Project.*
Source: http:// www.digitalpast.com.

Fig. 2. The Evergreen *in Chicago, 1948. Stores turned toward the street.*
Source: Baker and Funaro, 1958.



3.2. The Maturation Phase (1950-1956)

The product maturation phase has a clear process of standardization, highlighted by great competition that begins to establish itself and by the search for monopoly in innovation.

Due to this aspect of innovation, the studies that precede construction of a shopping center become more accurate, based on several theories placed by scholars whose specialties go from geography to economy, passing through marketing.

In this sense, the importance of science grows, during this period represented by the several emerging sciences such as that of retail, Christaller's and Reilly's locational theories, environmental perception with the Chicago school, among several other studies that contributed towards the formulation of a shopping center science whose apex was the determination of a strategic location which made possible the potentialization of the unit as a whole (KELLY, 1956). Thus arises the regional shopping Center, whose expenditures on technology and involved risks discourage small investors. The control phase then begins, in which aspects such as consumer habits, circulation, target public, income, and future competition possibilities are considered. The concept of *anchorage* and *tenant mix* are refined.

There is not one defined typology, but two: the first is the Linear (*strip*) model, with stores laid out towards an internal corridor (fig. 3), and the second, the cluster, whose stores form internal courts and offer the possibility of a circular route (fig. 4). It must be noted that the shopping corridor (*mall*) is still not covered and the shopping center is not air conditioned.

Fig. 3 NorthGate Shopping Mall*: strip model.*
Fonte: http://www.Historylink.org.

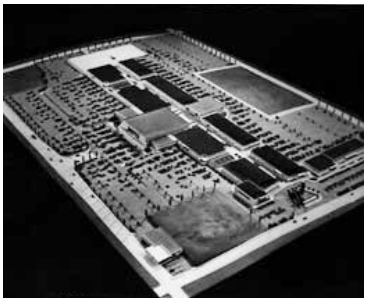


Fig. 4. Northland Shopping Mall*. Cluster Model.*
Source: Gruen Associates Archive.

3.3. Standardization Phase (1957 – 1980).

This phase has as its mark the opening of the Southdale Center in Edina (Fig. 5), a suburb of Minneapolis, in 1957. This shopping center is the image of the standard shopping center: a great closed box set within great parking areas. Its project contemplated in terms of innovation the closing of the mall and its air conditioning, which made it possible to deploy this model in the entire world. In relation to product cycle is noted that investments in technology decrease, the product has a clear and dominant formula which can be followed. Victor Gruen himself, the author of this project, had a simplified formula which he always repeated to investors, as a passport to earn money (HARDWICK, 2004). Even though accurate viability studies persisted, the simplified formula obtained great success by modifying shopping habits and converting shopping centers into consumer temples.

Thus, the standardization phase inaugurates the dominant, low risk model, encouraging real estate investors to dedicate themselves to this genre, as was the case with James Rouse, Taubmann or De Bartholo, all of them founders of great real estate companies specialized in the construction and control of shopping centers.

To Hardwick (2004) even a verb was created to designate the formula and attitude of its creator, Victor Gruen. "To Gruenize"[2] meant to see great possibilities in shopping centers, including as important elements for the revitalization of degraded downtown areas. This was done in several North American cities at the end of the 60's, such as Rochester, where extensive downtown areas were demolished to nestle shopping centers. Later on, these programs were abandoned due to their lack of success, but the standardized formula for suburbs remained intact until the beginning of the 80's, when it gave out signs of exhaustion and entrance into a phase of decline.

3.4. Product Diversification.

Healey and Ilbery (1989) note that at the first sign of entry into a phase of decline the market tends to try to postpone its fall through product diversification. In this sense, one may complete the product cycle by adding a new phase immediately before decline, the product diversification phase, which also answers for a conversion from the product cycle to the profit cycle, the understanding that the product is subject to obsolescence but that profit has to be maintained.

This diversification movement is also motivated by the decadence of the fordist model and the emergence of the flexible model, focused no longer on standardization of the consumer market, but on understanding the flows that lead toward consumer customization, substantiated by diversified forms of living and life styles. In this model, according to Harvey (1993), consumption migrates from durable goods to services, and also to consumption of sensations and experiences.

One of the first undertakings to contemplate this stance was Quincy and Faneuil Market Place in Boston, installed within old markets, preserving their history and configured in a different place, which ended up inaugurating the idea of place consumption. Also in the 70's, diversification lead to the emergence of other formats, such as *outlet centers* and the recovery of multiuse undertakings.

However, for the traditional suburban model, the *enclosed mall*, the answer to the attempt to maintain profit margins was the *entertainment center*, a model in which the attraction for the public was

[2]

strongly based on entertainment equipment. The dimensions of this type of equipment at the end of the 80's reached levels never before observed, as was the case with West Edmonton Mall in Canada or the Mall of America (Fig. 6), shopping centers which, according to their advertisement, would take close to 84 hours to complete a visit to all their stores.[3].

Fig.5. Southdale Center*: standardization.*
Source: Gruen Associates Archive.

Fig.6. Mall of America*.*
Source: Gruen Associates Archive.

On the other hand, great complexes began to require greater financial contributions, compromising a greater number of agents towards the profit cycle. Thus is noted that application of this capital, of financial origin (Banks, Pension Funds, Insurance Companies, Real Estate Investment Trusts) tends to the creation of new areas of centrality, aiming at rapidly maximizing monetary gains. In this way this profit cycle prompted a loss of support for shopping centers in the United States, accelerating the product life cycle and taking some shopping centers to enter the declining phase in the product life cycle.

3.5. The Phase of Decline

Even though the *entertainment centers* model was characterized as a search for elasticity in the product standardization phase, the several shopping centers produced by the *enclosed mall* standard have inexorably entered the phase of decline in the product life cycle, marked by accented decline of profit margins and gradual substitution of the product by a more innovative one.

It is estimated that in the United States existed 3,800 dead shopping centers in 1999[4]. Most of them are of the *enclosed mall* type. This number is highly significant if we consider that in the United States the totality of shopping centers with area over 40,000 sq. m. (gross rentable area) includes close to 6,500 ventures. An examination of these shopping centers makes it clear that the main category that was struck is that of the great regional centers from the 50's, the 60's, and the 70's.

The phenomenon recently acquired importance, with several publications focusing on the subject and even a website dedicated to documenting these dead shopping centers.[5] There, on exhibit, line up a total of 221 well documented shopping centers with closed doors, mostly from the 50's to the 70's.

Some became icons of a generation, such as the Northland Shopping Center (Figs. 7 and 8) in 1999. Located in Jeannings, Missouri, its project – undertaken by the office of Victor Gruen in 1955 – became

[3] http://www.mallofamerica.com.
[4] This number inclues those with high vacancy rates. CALTHORP, Peter. Quoted by Grifth, Victória. Americans abandon shoppings. In: Gazeta Mercantil, November 3,1999, p.2.
[5] http://www.deadmalls.com .

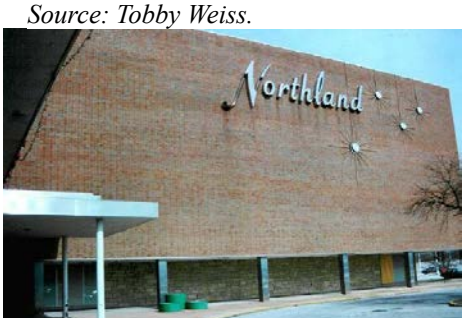
known for its modernist lines and sophisticated appearance, standing as reference for other ventures of the same type.

This succession of shutdowns brought up an issue: what to do with these enterprises? Their spatial conception makes it difficult to turn them into other activities. These locations were even described as *greyfields* in a relation to the term *brownfield*, used for contaminated industrial areas[6]. Albeit the difficulties presented, the real estate sector has been able to reutilize these spaces and convert them, in several cases together with government and community, including resorting to competitions of ideas, such as the competition put forth in Los Angeles searching for solutions for *Greyfields*[7]. In the case of the Westgate Mall in Cleveland – another dead giant – a discussion is going on in the sense of adapting it into facilities for a university.

The numbers expressed above demonstrate clearly the closure of a cycle for this real estate product, whose introductory phase goes back to Nichols in 1927. In confronting decline, entrepreneurs will try other business forms aiming at maintaining their profit rates. Product diversification, as was seen, will be symptomatic in this transference from product cycle into profit cycle.

***Fig.7. The deactivated Northland Center**, before demolition.*
Source: Tobby Weiss.

***Fig.8. The deactivated Northland Center**, before demolition.*
Source: Tobby Weiss.



4. Conclusions

In analyzing the evolution of shopping centers it can be noted that one of the most relevant issues was its conversion into a real estate product, removing the shop owner from its planning and decision making. This way, configured as a product, it followed the production-consumption relationship inherent to merchandise. The confrontation with a product life cycle was, therefore, inevitable. However, the widening of this relationship occurred in passing from the fordist accumulation system to the flexible system, with a rapid acceleration in its product life cycle, followed by its own conversion to temple of consumption, a place where merchandise circulates within its own condition as merchandise, disposable and quickly obsolescent. However, the highly inertial character represented by the enormous built complexes does not promptly admit ephemerality.

The reflection that these findings and analyses offer us point to a preoccupation with relation to the types of ventures that will be developed, which cannot dispense a holistic view of urban economy. These

[6] Price Waterhouse Coopers. Quoted by: MAX, Sarah. Malls: the death of an American icon. In: CNN Money, 24/07/2003. www.money.cnn.com/2003/07/02/pf/yourhome/deadmalls. See also the book from the New Urbanism Congress: Greyfields into goldfields.
[7] http://www.laforum.org/deadmalls.

undertakings must be able to consider not only short term interests of real estate groups, but also of investors (owners), consumers and the city, since these buildings have an inertial character that does not promptly admit the ephemerality and disposability which the consumer society is used to imprinting on the products that constitute it.

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Analysis of COVID-19 pandemic trends and its impact on the health system of the main urban centers of Minas Gerais, Brazil.

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Abstract

***Objectives**: In this study, related to COVID-19, we characterized the epidemiologic, trends and the impact of new coronavirus on the health systems of the main urban centers in Minas Gerais, Brazil. **Methods**: A retrospective time series encompassing data associated with COVID-19 disease, from March to July of 2020, were approached for verifying the trends of social distancing rate and number of daily deaths by means of Mann-Kendall test. The Binomial test was performed to analyzing the differences between percentages of two periods (before and after pandemic) with the goal to measure the impact of disease on health systems. **Results**: Although the social distancing rates for the main urban centers of Minas Gerais presented declining trend along the time series, Juiz de Fora had the best rate and, consequently, flattened the epidemic curve for new cases of the disease, besides of to notify the lowest number of deaths (Mann-Kendall [Belo Horizonte]: -0.77, p<0.001; Mann-Kendall [Juiz de Fora]: -0.74, p<0.001; Mann-Kendall [Uberlandia]: 0.29, p<0.001). The number of oncologic treatments in Belo Horizonte (April 2019 vs April 2020= -41.5%; p<0.001) and clinical treatments in Uberlandia (March 2019 vs March 2020= -51.7%; p<0.0001) have reduced drastically before and after pandemic. **Conclusions**: Therefore, the implementation of a higher social distancing rate could flatten the epidemic curve avoiding an increase in deaths number and to reduce the impact of COVID-19 on health systems preventing the collapse of them.*

Keywords: coronavirus disease 2019; Pandemics; Health Systems; Brazil.

1. Introduction

The infection caused by severe acute respiratory syndrome coronavirus-2 (*SARS-CoV-2*) emerged in Wuhan, China, at the end of December 2019, as a pneumonia outbreak and disseminated to other continents [1].
The transmission from this disease occurs primarily by the airway, on the other hand, the extra-lungs airway should be considered, seeing that the viral RNA was detected in faecal samples from disease cases [2].
Regarding the disease incubation period, the interval between the infection and onset symptoms, varied from 5.1 to 11.5 days, according to a study developed with 181 patients [3].
In relation to the symptoms, the clinical spectrum from the disease is complex, ranging from mild symptoms to major pneumonia. Thus, the main disease symptoms reported were fever, cough, rhinorrhea, headache, diarrhea and dyspnea as the most prevalent [4,5].
There are some factors which promote the viral transmission in the community taking into account the *SARS-CoV-2* persistence in plastic and metal surfaces for 72 hours and the viability in aerosol came to 3 hours [6]. However, mathematic models by means of adjusted incidence rate ratios (IRRs) pointed that, social distancing measures were associated with reductions of 29% in the COVID-19 incidence and 35% in the mortality of this disease [7].
The lethality for age group was 4.6% from 60 to 69 years old, increasing to 9.8% for those from 70 to 79 and achieving 18% in those with 80 years old or more [8].
Brazil presents a lethality rate of 3.20% (113.358/3.532.330) changing as the numbers of deaths and confirmed cases range, indicating a rapid advance of the disease and continuous increase in the hospitalization rate [9]. It represented, in several states of the country, the health systems collapse such as occurred in Ceara state, where 45 days after the notification of the first COVID-19 case, 80.5% of intensive care unit (ICU) beds were overcrowded [10]. In Minas Gerais state, in the main cities from the Central region, South of state and Triangulo Mineiro, the average of ICU occupancy rate was 87.19%.
The information related to the new cases, mortalities, social distancing rate and ICU occupancy are important to the health authorities for the pandemic containment and elaboration of plans for short and long terms.
The purpose of this study is to compare epidemiologic data, trends associated to disease and the impact on the health system of the main urban centers in Minas Gerais, Brazil.

2. Methods

2.1. Study and sample type

This is a retrospective observational study encompassing a time series analysis based on information related to COVID-19 infection, from March to July of 2020 involving 3 urban centers of Minas Gerais State – Brazil. The sample were formed of patient's data that were infected by the new coronavirus and, mainly, deaths records.

2.2 Secondary data/variables

The main epidemiological and demographic variables used in this study were: total deaths, confirmed cases, mortality rate, social distancing rate, comorbidity presence, sex, skin phenotype, age group. The secondary

data associated with care procedures used to this study belongs to Minas Gerais State Health Secretary; Municipal Departments of Health of Belo Horizonte, Juiz de Fora and Uberlandia, besides of records of Computer Department of the Brazilian Unified Health System (Datasus) that summarizes data of hospital information system (HIS/SIH) and authorization forms for hospital admittance (AIH) for Unified Health (SUS). All data were collected from 22 march to 15 July, 2020, that is, from the beginning of pandemic time to the likely peak of the epidemic announced by the government of Minas Gerais.

2.3 Inclusion and exclusion criteria

The study included only data patients affected by COVID-19 that were taken from public domain sites, from 22 March to 15 July 2020 published on official websites of the aforementioned public agencies. Secondary data, before or after the mentioned period of collection did not make part of this tabulation.

2.4 Statistical analysis

The Mann-Kendall test was utilized to verifying the existence of trend along the time series related to social distancing and count of deaths. The binomial test was used to verify the differences between percentages of two periods (before and after pandemic) regarding frequency of to authorization forms for hospital admittance (clinical and surgical care).

The analysis was carried out using the software GraphPad Prism 4.04 (GraphPad Software, Inc., San Diego, CA) and Action Stat, trial version (Estatcamp, São Carlos, SP). The null and alternative hypotheses were tested at a significance level of 5% (0.05).

2.5 Ethical approval

This study does not require appreciation by the Ethics Committee on Human Researches due to the data to be presented in the public domain disclosed by Departments of Health managed by public agencies.

3. Results

3.1. Clinical and epidemiological characterization

The current study characterized the clinical and epidemiological profiles of those patients who had their death associated to COVID-19 in the major urban centers in Minas Gerais. According to table 1, there was a difference among mortality rates when the percentages of the cities were compared, Belo Horizonte and Juiz de Fora ($p=0.0095$); Belo Horizonte and Uberlandia ($p=0.0011$); Juiz de Fora e Uberlandia ($p<0.0001$). Furthermore, in the table 1, it was observed the high percentage of comorbidity among those individuals that died due to COVID-19 infection in one of the 3 urban centers described in this study (Belo Horizonte: 91%, 291/320; Juiz de Fora: 92.4%, 82/89; Uberlandia: 87.5%, 150/171; $p=0.1697$) without statistic difference among the proportions.

In relation to sex, among the deaths caused by COVID-19, the male was more affected in Belo Horizonte (54%; 173/320) and Uberlandia (61.2%; 54/171) as compared with female sex, that consequently predominated in Juiz de Fora with 51.9% of (46/89) of total being infected. There was no difference among the proportions of deaths between male and female (W: 2.74; $p=0.2540$).

The death cases for *SARS-CoV-2* infection in white skin people were predominant in the towns of Juiz de Fora (54.4%;48/89) and Uberlandia (44.1%;75/171). On the other hand, in Belo Horizonte brown individuals (44.1%; 75/171) prevailed among those who died due to this same pathogen (Table 1).
Concerning the age group most affected, in Belo Horizonte, the age group from 80 to 89 years old totalized 24.9% (80/320) from the total amount of deaths. The same occurred in Juiz de Fora (29.2%; 26/89). In Uberlandia the highest percentage of deaths were among those who were from 70 to 79 years old representing 25.7% of cases. There was no association among the age group evaluated per city (W: 19.64; p< 0.1419).

Table 1- Clinical and epidemiological characterization associated with deaths caused by COVID-19 infection from 22 March to 15 July 2020 in the Main Urban Centers of MG.

	Belo Horizonte		**Juiz de Fora**		**Uberlandia**		G–test / *Binomial test	
	n	**%**	**n**	**%**	**n**	%	W	*p-value*
Mortality								*(BH vs JF) 0.0095
Total of deaths	320		89		171			
Confirmed cases	13559		2778		9834			*(BH vs Udi) 0.0011
Fatality rate		2.4		3.2		1.7		*(JF vs Udi) < 0.0001
Comobidity								
Yes	291	91	82	92.4	150	87.5	3.55	0.1697
No	17	5.3	5	5.1	17	9.9		
Not declared	12	3.7	2	2.5	4	2.6		
Sex								
Male	173	54.0	43	48.1	54	61.2	2.74	0.2540
Female	147	46.0	46	51.9	35	38.8		
Phenotype Skin								
White	92	28.8	48	54.4	75	44.1		
Brown	133	41.5	10	11.4	65	38.2		
Black	33	10.3	11	12.7	16	9.2	47.54	< 0.0001
Yellow	3	0.9	0	0	1	0.7		
Not declared	59	18.5	19	21.5	14	7.9		
Age Group								
20 - 29	0	0	1	1.3	0	0		
30 - 39	7	2.2	1	1.3	7	3.9		
40 - 49	21	6.6	4	5	15	8.6		
50 - 59	41	12.9	13	15	17	9.9		
60 - 69	75	23.3	8	8.9	35	20.4	19.64	0.1419
70 - 79	74	23.2	26	29.2	44	25.7		
80 - 89	80	24.9	26	29.2	36	21.1		
≥ 90	22	6,9	9	10.1	18	10.4		

3.2. Trends analysis

Even though the social distancing rates in Juiz de Fora were superior than others urban centers in Minas

Gerais throughout the time series, there were a declining trends in these rates of the 3 urban centers (Mann-Kendall [Belo Horizonte]: -0.77, p< 0.001; Mann-Kendall [Juiz de Fora]: -0.74, p< 0.001; Mann-Kendall [Uberlandia]: 0.29, p< 0.001) (figure 1A). The social distancing rates in these three urban centers started on 1st April and reported percentages lower or equal to 50% (figure 1A).

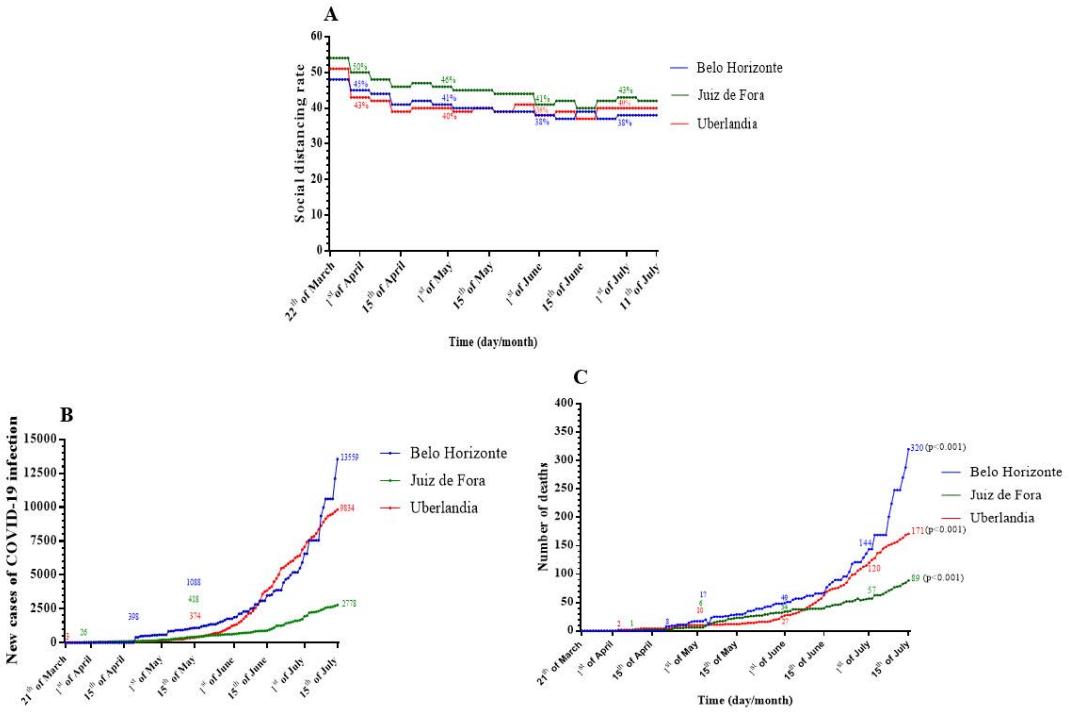

Figure 1 (A) – Social distancing rates from March 22th to July 11th of 2020 in the main urban centers of Minas Gerais indicating declining trends over the time series in Belo Horizonte (Mann-Kendall; -0.77, p< 0.001); Juiz de Fora (Mann-Kendall: -0.74, p< 0.001) and Uberlandia (Mann-Kendall: -0.29, p< 0.001). (B) The number of new cases from 21 March to 15 July on 2020 in the main centers in Minas Gerais pointing to high trends during the time series in Belo Horizonte (Mann-Kendall; 0.96, p< 0.001); Juiz de Fora (Mann-Kendall: 0.97, p< 0.001) and Uberlandia (Mann-Kendall: 0.98, p< 0.001). (C) The number of deaths from 21 March to 15 July 2020 in the main urban centers of Minas Gerais indicating increase tendency during the time series in Belo Horizonte (Mann-Kendall; 0.96, p<0.001); Juiz de Fora (Mann-Kendall: 0.97, p<0.001) and Uberlandia (Mann-Kendall: 0.98, p<0.001).

In Uberlandia, as shown in figure 1B, there was a fast increase in progressive phase of the epidemic curve, when compared with Belo Horizonte and Juiz de Fora, emphasized by the high percentage change in the number of cases. On the other hand, the epidemic curve of COVID-19 in Juiz de Fora flattened, showed by the lower percentage change in the mentioned period (Figure 1B). The epidemic curve showed a rising trend in the three urban centers (Mann-Kendall [Belo Horizonte]: 0.96, p< 0.001; Mann-Kendall [Juiz de Fora]: 0.99, p< 0.001; Mann-Kendall [Uberlandia]: 1, p< 0.001) (Figure 1B).

The figure 1C showed that the cumulative number of deaths from 21st March to 8th July in Belo Horizonte, Juiz de Fora and Uberlandia. There was a high increase on the number cases in those 3 cities and increasing trends (Mann-Kendall [Belo Horizonte]: 0.96, p< 0.001; Mann-Kendall [Juiz de Fora]: 0.97, p< 0.001;

Mann-Kendall [Uberlandia]: 0.98, p< 0.001) such as showed in figure 1C. It was possible to notice that in Juiz de Fora the curve was flattened for the new cases of the disease, and consequently, the curve regarding to the number of deaths was also flattened, on that period in which was filed 89 deaths among the 2778 infected (lethality rate: 3.2).

3.3 Impact of COVID-19 infection on Health Systems

By means of analysis of authorization forms for hospital admittance (AIH) for Unified Health (SUS), the impact of coronavirus pandemic on health systems of the main 3 urban centers of Minas Gerais were assessed comparing the same period of 2020 with 2019 as shown in table 2.

The oncologic treatment, in Belo Horizonte, presented on March, April and May 2020 a reduced number of attendances when compared with the same previous period in 2019 (March 2019 vs March 2020= -28.5%; p= 0.0998 / April 2019 vs April 2020= -41.5%; p< 0.0001/ March 2019 vs March 2020= -73.8%; p< 0.8219) (table 2).

The surgeries of the Digestive Systems had a progressive decline during the quoted period, Mach, April and May 2020, as compared with previous same period in 2019 (March 2019 vs March 2020= -40.5%; p< 0.0001/ April 2019 vs April 2020= -77%; p<0.0001/ March 2019 vs March 2020= -79.8%; p<0.0001) (table2).

The orthopaedic and genitourinary surgeries there were results similar according to the table 2.

With regard to the pandemic impact on Juiz de Fora health system, the digest system surgeries have reduced on March, April and May 2020 (pandemic period) when compared with the same months on 2019 (March 2019 vs March 2020= -10.6%; p= 0.3026 / April 2019 vs April 2020= -80.7%; p< 0.0001/ March 2019 vs March 2020= -86.1%; p < 0.0001) (table 2). In relation to the genitourinary tract surgeries, on April and May the data were similar to the digest system surgery (table 2).

In respect of Uberlandia, it was possible to observe a progressive reduction in the frequency of authorization forms for hospital admittance (AFHA/AIH) for the clinical treatments on March, April and May 2020 when compared with the same period of 2019 (March 2019 versus March 2020= -7.8%; p= 0.4432 / April 2019 versus April 2020= -38.4%; p< 0.0001/ March 2019 versus March 2020= -51.7%; p< 0.0001) (table 2).

Furthermore, it is important to emphasize that the obstetric surgery on March 2020 increased 7.7% (p=0.0841) when compared with March 2019. On the other side, on April and May 2020, the surgery amount decreased to 37.5% (p=0.0467) and 55.2% (p=0.0347) respectively, when compared with the same months of 2019 (table 2).

Table 2. Procedures group according to authorization form for hospital admittance (AFHA/AIH) that was handled during March, April, and May in 2019 (non-pandemic period) and the same period in 2020 (pandemic period) in those major urban centers in Minas Gerais

Procedures Group	Amount of authorization form for hospital admittance (AIH) – Belo Horizonte												May 2020 / May 2019		April 2020 / April 2019		March 2020 / March 2019	
	2019 (non-pandemic period)						2020 (Pandemic period)											
	March		April		May		March		April		May							
	n	%	n	%	n	%	n	%	n	%	n	%	*Per.Var.*	*p-value*	*Per.Var.*	*p-value*	*Per.Var.*	*p-value*
Clinical Treatment	8103	36	8885	38	9159	37	6275	36	4199	39	2211	35	-22.6	0.3712	-52.7	0.0131	-75.9	0.0002
Oncologic Treatment	1314	6	1199	5	1201	5	939	5	702	7	315	5	-28.5	0.0998	-41.5	< 0.0001	-73.8	0.8219
Circulatory system surgery	790	3	808	3	891	4	597	3	333	3	252	4	-24.4	0.7437	-58.8	0.117	-71.7	0.2019
Digestive system surgery	1417	6	1454	6	1406	6	843	5	334	3	284	4	-40.5	< 0.001	-77	< 0.0001	-79.8	< 0.0001
Musculoskeletal system surgery	2088	9	2107	9	2233	9	1636	9	983	9	833	13	-21.6	0.45	-53.3	0.5203	-62.7	< 0.0001
Genitourinary system surgery	954	4	992	4	1048	4	621	4	234	2	419	7	-34.9	0.0014	-76.4	< 0.0001	-60	< 0.0001
Obstetric surgery	891	4	921	4	878	4	737	4	507	5	153	2	-17.3	0.1099	-45	0.0005	-82.6	< 0.0001
Other procedures	7175	32	7270	24	7656	24	5745	24	3477	21	1863	24	-24.1	0.6674	-59.4	< 0.0001	-74.9	0.2689
Total number of procedures	**22732**	100	**23636**	100	**24472**	100	**17393**	100	**10769**	100	**6330**	100	-23.5	-	-54.4	-	-74.1	-
Amount of authorization form for hospital admittance (AFHA/AIH) – Juiz de Fora													*Per.Var.*	*p-value*	*Per.Var.*	*p-value*	*Per.Var.*	*p-value*
Clinical Treatment	1538	39	1557	37	1782	39	1107	35	706	36	348	27	-28	< 0.0001	-54.7	0.236	-80.5	< 0.0001
Oncologic Treatment	239	6	294	7	279	6	286	9	231	12	141	11	19.7	< 0.0001	-21.4	< 0.0001	-49.5	< 0.0001
Circulatory system surgery	164	4	170	4	178	4	118	4	45	2	45	4	-28	0.3026	-73.5	0.0003	-74.7	0.5343
Digestive system surgery	189	5	249	6	273	6	169	5	48	2	38	3	-10.6	0.3026	-80.7	< 0.0001	-86.1	< 0.0001
Musculoskeletal system surgery	328	8	335	8	405	9	226	7	142	7	138	11	-31.1	0.0464	-57.6	0.2517	-65.9	0.0357
Genitourinary system surgery	156	4	177	4	210	5	171	5	33	2	29	2	9.6	0.0055	-81.4	< 0.0001	-86.2	0.0002
Obstetric surgery	270	7	245	6	240	5	258	8	227	11	138	11	-4.4	0.0531	-7.3	< 0.0001	-42.5	< 0.0001
Other procedures	1047	27	1161	28	1196	26	860	27	550	28	400	31	-24.9	0.1113	-65	< 0.0001	-73.1	0.5466
Total number of procedures	**3931**	100	**4188**	**100**	**4563**	**100**	**3195**	**100**	**1982**	**100**	**1277**	**100**	-18.7	-	-52.7	-	-72	-
Amount of authorization form for hospital admittance (AFHA/AIH) – Uberlandia													*Per.Var.*	*p-value*	*Per.Var.*	*p-value*	*Per.Var.*	*p-value*

Clinical Treatment	1594	38	1737	39	1743	37	1470	37	1070	45	841	49	-7.8	0.4432	-38.4	< 0.0001	-51.7	< 0.0001
Oncologic Treatment	98	2	103	2	118	3	120	3	68	3	37	2	22.4	0.0508	-34	0.1512	-68.6	0.4101
Circulatory system surgery	154	4	179	4	208	4	123	3	48	2	13	1	-20.1	0.1629	-73.2	< 0.0001	-93.8	< 0.0001
Digestive system surgery	212	5	204	5	237	5	230	6	66	3	40	2	8.5	0.1286	-67.6	0.0003	-83.1	< 0.0001
Musculoskeletal system surgery	349	8	375	8	409	9	335	8	188	8	103	6	-4	0.8041	-49.9	0.5263	-74.8	0.0004
Genitourinary system surgery	211	5	246	5	257	6	157	4	17	1	16	1	-25.6	0.0213	-93.1	< 0.0001	-93.8	< 0.0001
Obstetric surgery	299	7	339	8	319	7	322	8	212	9	143	8	7.7	0.0841	-37.5	0.0467	-55.2	0.0347
Other procedures	1265	24	1308	29	1451	24	1266	32	740	22	514	30	-5.2	0.89	-49.2	0.375	-67.2	0.037
Total number of procedures	**4182**	**100**	**4491**	**100**	**4649**	**100**	**3942**	**100**	**2377**	**92**	**1699**	**100**	-5.7	-	-47.1		-63.5	-

Legend: Per.Var.: percentage variation

4. Discussion

4.1. Clinical and epidemiological Characterization

It was observed in those three cities, a high percentage of deaths on those individuals infected by COVID-19 and affected by comorbidities, what is in accordance with some studies that pointed diabetes and hypertension as some medical conditions associated with worst prognosis and mortality [11, 12]. In this study, the male sex prevailed among those who was infected and died in 2 urban centers. This result may be associated with the high levels of gene expression of Angiotensin-converting enzyme-2 (ACE 2) receptor in male sex. This receptor have favoured *SARS-CoV-2* and *SARS-CoV* infections [13, 14]. Moreover, immunological factors as low expression of CD200 receptor in women have promoted effective viral clearance due to increased production of type I interferon [15].

Even though the white skin prevailed in 2 urban centers, the brown skin was more susceptible to coronavirus infection in Belo Horizonte. A previous evidence quoted different results, since that black skin individuals had higher risk of being infected by *SARS-CoV-2* when compared with white patients [16]. In relation to age group, this study found a higher percentage of death in elderly independent on the location. This fact is associated with the presence of comorbidities in this group and immunocenescence, seeing that the number of B lymphocytes competent reduces over the years, turn elderly into people more susceptible to infections [17, 18, 19]

4.2 Trends analysis

Although it was observed an increasing trend on the number of new cases during the time series in those three urban centers in Minas Gerais, in Belo Horizonte and Uberlandia there were a gradual increase on the number cases in a short period when compared to Juiz de Fora which registered a flattening on the curve. This difference may be explained by the low social distancing rates in Belo Horizonte and Uberlandia as occurred in other countries. Places which implemented social distancing earlier, experienced a reduction on the COVID-19 new cases, on the hospitalization and the deaths number related to the disease, essential to flatter the cases curve, especially in the absence of vaccines and treatments [20, 21]

The 3 and 4 alert levels were implemented in the urban centers. However, the social distancing rates did not achieve 50% in those places, what promoted the increase on the case number, and consequently, on the death numbers. Different countries in the world as Germany, France, Italy and Chine took 2 weeks to register the decline on the death cases, after the reduction on the new cases associated with an effective social distancing measures. On the contrary, the United States took 4.5 weeks to the number of deaths to decline after implementation of a high level of social distancing [22]

4.3 Impact of COVID-19 infection on Health Systems

We assessed the pandemic impact on the health system in relation to de main procedures performed in the tertiary level in those major urban centers. We emphasized that in Belo Horizonte there were a sharp decline of frequency of attendance and procedures related to the oncologic treatment. This fact corroborates with the scenario seen in United Kingdom, where the chemotherapy procedures have reduced in 60% at the local hospitals [23]. Besides that, the deaths caused by breast and colorectal cancer increased in 9.6% and 16.6% respectively, according to a British survey, because of delay in diagnostic related to the COVID impact in that health system [24]. A study reported that elective surgeries should be restricted to favour the measures of treatment of COVID-19, except for oncologic surgeries, for instance, individuals who need pass for stratification based on priority 1, in order to avoid deaths from oncologic patients [25].

The results showed, in these 3 urban centers, that surgeries of digestive, orthopaedic and genitourinary system and the others which has been suspended, probably are associated to non-urgency classification. Such situation was estimated in studies, pointing to cancellation of elective surgeries due to the COVID-19 impact on the health system, requiring strategic plans for restoring the surgical activities [26]. By providing emergency surgery restriction, the American College of Surgeons, the Royal College of Surgeons of England, Royal College of Surgeons in Ireland and others elaborated an emergency general surgical procedures list that should be priority during the pandemic period, such as intestinal ischemia, incarcerated

hernias, appendectomy with perforation and others, what explain the reduction on the digestive system surgeries and other specialties during this period [27].

We emphasized that new coronavirus pandemic tested the health system of many countries such as United States (US) where prevails privatization of health, the low coverage of population in relation to the public assistance services (Medicare; Medicaid and others) and private systems with or without profit motives. Furthermore, the Brazilian universal health care system showed to be vulnerable amid COVID-19 pandemic presenting structural problems associated to inappropriate financing and unequal allocation of resources [28, 29]. The direct impact of the COVID-19 pandemic on the health system in US and Brazil conduct to 205.208 and 142.161 deaths, respectively, related to the emergency disease [30].

Notwithstanding in Brazil the units of the federation and municipalities have presented contingency plans for response to COVID-19, almost all of them without details about the disease. The Special Committees on Covid-19 Response from these cities and others in Brazil were formed of infectologist doctors, directors and presidents of health institutions, procurators and members of the education area. It would be so important to include others members from different professions for discussing strategies in sectors which could collaborate with the health sector on the implementation of effective social distancing measures, such as economist, administrator, psychologist, traffic engineer for the traffic, geographer, nurse and physical educator. We highlighted that Leadership is primordial during pandemic periods as occurred in countries such as Germany and New Zealand where there were a commended leadership for the action in a timely manner, even though others factors have influenced in the reduction of the deaths [31].

5. Conclusions

Therefore, we conclude that the social distancing rate may flatten the epidemic curve, such as occurred in one of cities assessed in this study, and consequently, avoid an increase in deaths number and to reduce the impact of COVID-19 on health systems preventing the collapse of them.

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Application of Energy Efficiency in A Company Through A Photovoltaic Energy System on Grid

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Abstract

Energy consumption is a major factor in relation to an organization's costs and expenses, determining the need to apply methods that can minimize or reduce these expenses as much as possible. Having these factors in context, the present work aims to present the technical feasibility of implementing a project that uses solar energy through the on-grid solar system to supply the energy demand of a company. The methodology used was the descriptive, in which several data were collected and documentations were analyzed that supported and justified the elaboration of a photovoltaic project and development of the budget and analysis of the costs of a solar energy system. Through the results obtained, it was possible to arrive at a solar project that would be able to establish the necessary power for the company for a cost of R $ 20,916.96 and a payback of 5 years and 5 months. Thus, it is possible to conclude that the photovoltaic system is viable in its use and application, not only because of the advantages associated with the environment, but taking into account its self-sustainability over time and with a useful life of up to 25 years.

Key words: Energy; commercial building; efficiency.

INTRODUCTION

Commercial buildings through their business activities are responsible for the highest energy demand in Brazil and in most other countries. Some research on energy efficiency shows that this practice is essential for economy and sustainability. In Brazil alone, there are more than 100 thousand smaller companies, which do not have incentives or energy saving practices when compared to medium and large companies,

demonstrating the importance of this practice as a factor for business optimization (MARQUES et. al., 2007).

Commercial buildings through business activities are responsible for 36% of global energy consumption (CHOI; EOM; MCCLORY, 2018). In Brazil, energy consumption was 80.9 Mtoe in 2018, corresponding to 31.6% of final consumption (EPE, 2019). In terms of electricity, in the same year, the sector consumed a total of 200.9 TWh, equivalent to 37.5% of the total electricity consumed nationally (EPE, 2019).

In addition to its growth, the energy sector moves huge economic figures every year, around 1.5 trillion dollars. Global investment in renewable energies reached $ 288.9 billion in 2018, exceeding financial support for the generation of energy from fossil fuels (UN BRASIL, 2019). With this factor in context, the energy options based on characteristic natural resources are being discontinued and the use of the current circumstance is no longer conceivable, due to the depletion of these raw materials in current reserves, in addition to the ecological effects and impacts.

The verified problematization that generated the question that guided this work, what are the practicable techniques in relation to renewable energies in commercial buildings to optimize the expenditure of electricity?

Therefore, based on the entire context presented, the objective of this research is to present the technical feasibility of implementing a project that uses solar energy through the on-grid solar system to supply a company's energy demand.

THEORETICAL REFERENCE

Energy Efficiency: Among the productive resources used in companies, electricity is an important resource for almost all activities in the productive system. Therefore, investing in the efficient use of electric energy brings a series of benefits both for the company and for the country and its end users (CASTRO, 2015).

Thus, energy efficiency is shown as the relationship between the amount of final energy used and the amount of a good produced or service performed (EPE, 2018). By saving energy, the need to build new generating plants and associated electrical systems is being postponed, making resources available for other areas and contributing to the preservation of nature.

Energy efficiency, as an instrument for energy conservation, comes close to the needs of the Brazilian citizen, who, as he becomes aware of its importance for the country's economy, for the environment and, therefore, for the whole society, begins to use resources in a sustainable way. With this purpose, it is necessary that systems, methodologies, technologies, materials and equipment, be known by technical professionals, mainly those of engineering and architecture, who are directly connected to the technicality involved with this theme (MARQUES; et al., 2007).

Energy efficiency is a performance indicator and one of the most important requirements for economic environments. Currently, electricity consumption is equivalent to about 44% of the national account consumption. Since Brazil is a developing country, this consumption tends to increase (SIMÃO, 2014).

The reduction in energy consumption can be achieved by eliminating unnecessary consumption, compensating for losses, functional improvements in existing equipment and using equipment with optimized performance (SÁ, 2010).

To achieve better energy efficiency in a given company or process, it is necessary to reduce energy losses and consumption and achieve the same results in production and / or services through the rational use of human, material and economic resources with measures to combat waste of energy, in addition to the modernization of industrial systems or processes (CAPELLI, 2013).

According to Mathias (2014), disputes between companies for competitiveness and profitability have become increasingly intense. In this scenario, it is important to develop methods to reduce inefficiencies and waste in the production processes.

Energy efficiency is recognized as one of the most important means to increase the competitiveness of the business sector, in particular for small and medium-sized companies, where energy efficiency measures are not implemented correctly (MATHIAS, 2014).

Photovoltaic Solar Energy: According to Goldenberg and Lucon (2007), solar photovoltaic energy is that generated through the direct conversion of solar radiation into electricity, through the use of a technology determined as a photovoltaic module, which makes the practice of the photoelectric or photovoltaic effect. The solar radiation reaching the Earth's surface is determined by two different types, according to Pinho and Galdino (2014), being: Diffuse radiation, which comes from all directions and dispersed by the molecules present in the atmosphere; Direct radiation, which comes directly from the Sun. Therefore, solar radiation is interpreted as the radiant energy transmitted by the sun in the form of electromagnetic radiation, through various wave frequencies. And its irradiation is the quantity related to the amount of incident solar radiation for each m², with its peak at noon solar (PINHO; GALDINO, 2014).

Types of Photovoltaic Systems: According to Pereira and Oliveira (2011), there are two photovoltaic systems that can be used today: a) Autonomous or isolated systems (OFF GRID); b) Systems connected to the electrical network (ON GRID).

According to Câmara (2011), autonomous systems are those that do not depend on the electricity network for operation, their use is therefore very much focused on areas in remote locations that do not need the electricity infrastructure. Two types of isolated systems can be used, with storage and without storage. The first is determined from the charging of electric vehicle batteries for lighting and even to supply some portable devices (VILLALVA; GAZOLI, 2012). And the second type, does not use storage instruments and directly supplies electrical equipment, being the most economically viable (PEREIRA; OLIVEIRA, 2011).

The photovoltaic systems connected to the electric grid, are called On-Grid or Grid-Tie systems, it is the type of system that operates in parallel with the electric grid. Unlike autonomous systems, the devices do not have energy storage, and all the surplus energy is increased in the electrical network, thus generating credits for the system owner (CAMARGO, 2017).

MATERIALS AND METHODS

As initially contextualized, the objective of the research is to implement a photovoltaic energy system on grid in the company. The purpose is to reduce the costs incurred with electricity, in addition to having an asset that can sustain itself in the future by implementing energy efficiency in the company.

Thus, in order to qualify the present research, the development of the application of a photovoltaic system in a company will be presented, addressing the context already presented, resulting in the analysis of the financial viability of the project based on the evaluation of the return on investment in the photovoltaic system. Thus, the procedures for project development were:

a) Survey of the company's energy demand, through the electricity bill.
b) Determination of geographic data, to record the city's insolation data for the study in question, from the survey of CRESESB data.
c) Then, according to Villalva and Gazoli (2012), it is possible to obtain the installation angle for photovoltaic panels using geographic data.
d) Present the photovoltaic module, according to the manufacturer and its material, demonstrating the feasibility of your choice based on its energy efficiency.
e) Demonstrate the inverter to be used, with the objective of converting the electric current, using the dimensioned system as a reference.
f) Quantify costs and demonstrate the budget for the project developed, based on the prices presented by the equipment manufacturers detailed previously.
g) As a viability determination, the payback will be calculated, and thus the return time necessary for the system to self-sustain will be evaluated.

From this information, it is possible to conclude and associate the objectives proposed by this research and the results obtained.

RESULTS AND DISCUSSIONS

The first step to obtain the necessary results is to establish the necessary energy demand for the photovoltaic system. Therefore, the electric energy bill for the analyzed company was used and through it the energy consumption was raised to supply the power that will be used as a parameter by the photovoltaic system. Figure 1 shows the electric consumption history of the account used as a reference.

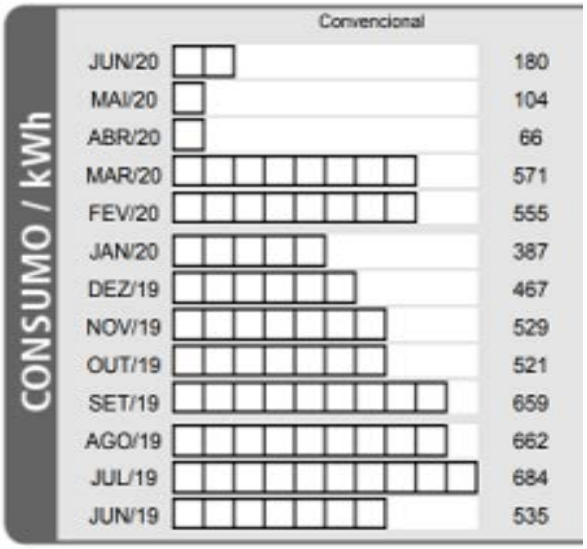


Fig. 1. Electricity consumption of the company

Source: Own Author (2020).

Analyzing Figure 1, the company's largest energy consumption in a year is 684 kWh, therefore, this value will be used as a measure for dimensioning the photovoltaic system, so that it can guarantee that the company is served in its electrical potential. In this way, the conversion of this quantity was carried out to result in the electrical power used by the company based on its daily 8 am operation from Monday to Saturday.

$$ENERGY = POWER\ X\ TIME$$
$$684\ kWh = POWER\ X\ 192h$$
$$POWER = 3{,}562\ kW\ ou\ 3562\ W$$

Therefore, for the operation of the determined company it is necessary to have a solar system project that can generate at least 3.562 kW, thus meeting the loads measured by the electrical equipment and guaranteeing the effectiveness of the consumption of the electrical system.

Geographic Data of the Solar System:

Then using a geographic tool such as Google Maps, it is possible to obtain the geographic coordinates of the city, determined as an object of study of the research, which from its use was realized that the municipality of Rio de Janeiro is located at Latitude 22º 54 '10 "S and Longitude 43º 12' 27" W.

From the geographic data of latitude and longitude, and the use of the database with the insolation values, for the development of CRESESB photovoltaic systems, it was determined that the average solar irradiation value for an angle equal to latitude is 5 , 07 Kwh / m²dia, for the panel inclined at 18º N it is 5.07 Kwh / m²dia and for the smaller insolation with 22º the value of 5.06 Kwh / m²dia is obtained, Table 1 shows the results obtained.

Table 1 - Average daily solar radiation for the city of Rio de Janeiro - RJ.

Angle	Inclination	Average daily solar radiation of the month [kWh/m2.day]													
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average	Delta
Horizontal Plane	0° N	6,12	6,44	5,40	4,56	3,92	3,63	3,75	4,35	4,86	4,96	4,99	5,89	**4,90**	**2,81**
Angle equals latitude	20° N	5,56	6,14	5,51	5,04	4,67	4,50	4,56	4,97	5,11	4,84	4,63	5,30	**5,07**	**1,64**
Highest annual average	18° N	5,64	6,20	5,52	5,02	4,61	4,43	4,50	4,93	5,10	4,87	4,68	5,37	**5,07**	**1,76**
Highest monthly minimum	22° N	5,48	6,09	5,50	5,07	4,72	4,57	4,62	5,01	5,11	4,80	4,57	5,22	**5,06**	**1,52**

Source: CRESESB (2020).

Based on the results of solar irradiation, the value determined for use is 5.07Kwh / m²dia with a 1.64 delta, with the highest insolation value and the smallest possible variation.

Next, another fundamental parameter determined by the project is obtained, which is the installation angle for photovoltaic panels. Table 2 then details the relationship between the latitude and the slope of the plate.

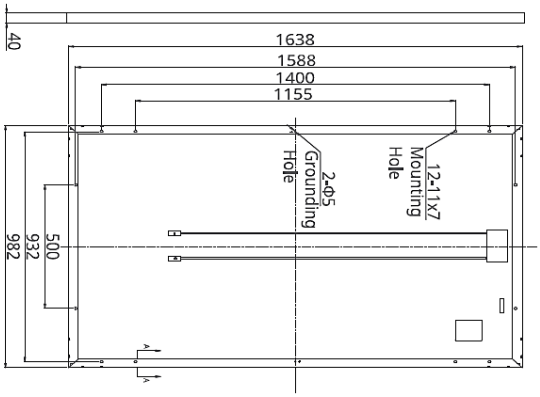
Geographic latitude of the location	Determined inclination angle
0º a 10º	a = 10º
11º a 20º	a = latitude
21º a 30º	a = latitude + 5º
31º a 40º	a = latitude + 10º
41º or more	a = latitude + 15º

Source: Villalva and Gazoli (2012).

Table 1 - Angle of inclination

Thus, following the data in Table 2 regarding the angle of inclination, considering that the latitude of the city of Rio de Janeiro is 22 °, the value used is with latitudes between 21 and 30 and the angle of inclination is obtained by latitude + 5 °, resulting in a = 27 °. With this information, the project is continued and the photovoltaic module is determined.

Photovoltaic Module: The dimensioning of the solar system implies the choice of a module, the type considered as determined was the Canadian CSI CS6K-270P, it has a maximum rated power of 270W, with dimensions of 1638 x 982 x 40mm, having an area of 1.61 m² (Figure 2), and the reason for his choice was because it originated from a poly-crystalline material, with a yield of 16.79%, in addition to the fact that this manufacturer has one of the most affordable prices in the Brazilian market.



Source: Canadian Solar (2018).

Figure 1 - Geometric and dimensional detail of the CSI CS6K-270P module.

With the module determined, it is possible to calculate, based on your data, the number of modules that will be needed to supply the company's energy consumption, as shown by the calculations below.

$$NUMBER\ OF\ MODULES = \frac{3562\ W}{270\ W}$$

$$NUMBER\ OF\ MODULES = 13{,}19 \sim 14\ modules$$

$$TOTAL\ PLATES\ AREA = \ 13{,}19 * 1{,}61\ m^2$$

$$TOTAL\ PLATES\ AREA = \ 21{,}24\ m^2$$

Then, it is possible to have an area of 21.24 m² to result in the supply of the initially determined power of 3.562 kW, and a total of 14 modules will be used to supply your energy demand.

Sizing: With the geographic data and from the chosen solar module, it is possible to perform the sizing of the photovoltaic system, following the guidelines of Rosa and Santos (2016), it is possible to obtain the energy produced daily per module and the total power to be installed through the system.

First, the energy produced by the equation was found:

$$Em = A * \ \eta * Es$$

Where: is the energy produced daily by the module in kWh / day; is the area of the module determined in m²; is the efficiency of the module in decimal; it is the sunstroke of the determined place.$EmA\eta Es$

Reproducing the values obtained so far in the equation it is possible to arrive at the result:

$$Em = 1{,}61 * 0{,}1679 * 5{,}07$$

$$Em = 1{,}37\ kWh/dia$$

Therefore, from the data obtained and presented in the previous topics and solving the calculation, the daily energy production is 1.37 kWh / day.

The power of the system can be determined by the following equation:

$$Pt = Nm * Pm$$

Where: is the total power of the system to be installed in kW; is the number of modules used; is the power of a module in kW.$PtNmPm$

Reproducing the values obtained so far in the equation it is possible to arrive at the result:

$$Pt = 14 * 0{,}27$$
$$Pt = 3{,}78\ kW$$

Thus, based on the module manufacturer's specifications, the total system power is 3.78 kW.Pt

Therefore, it is possible to observe in Table 3 the main data obtained in the design of the photovoltaic system.

Description	Results
Solar radiation from Rio de Janeiro	5,07 kWh/m²day
Installation angle of the plates	27°
Photovoltaic Module	Canadian CSI CS6K-270P
Module power	270 W
System efficiency	16,79%
Energy produced daily by each module	1,37 kWh/day
Total system power	3,78 kW

Source: Own Author (2020).

Table2 - Data of the dimensioned photovoltaic system.

In addition to the calculations performed and the determination of the parameters related to the project, it is necessary to detail some equipment that is essential for the operation of the photovoltaic system such as the inverter and the support structure.

Inverter: The inverter was chosen based on the determination of the power of the photovoltaic system, being 3.78 kW. Thus, from the options presented by the company WEG, being one of the strongest companies nationally in the market for electronic products for power generation and transmission, the SIW 600 ST020-44 solar inverter was chosen, which supports up to 5 kW. Figure 3 shows the chosen model.

Source: WEG (2018).

Figure 2 - SIW600 inverter model.

Supporting Structure of Photovoltaic Plates: The structure to support the solar panels is also relevant in its determination, even though it is a disregarded factor in making a budget, its cost is considerable for the project in question. Therefore, contact was made with a company specialized in this type of structure, Sonnen Energies, and the support for plates was indicated, which is shown in Figure 4.

Source: Sonnen Energies (2017).

Figure 3 - Support structure for solar panels.

With the developed project it is possible to present the question of the budget and costs of the developed project and thus analyze the return time so that it is paid for.

BUDGET AND PROJECT COST ANALYSIS

Having collected all the information regarding the system, contact was made with the companies or third parties regarding the equipment provided for the budget and cost survey of the entire photovoltaic system. A third party responsible for selling the products of the Canadian Solar company, presented the costs for installing the system based on the dimensioning and the determined module, even presenting the auxiliary equipment necessary for its installation. Table 4 illustrates the data received.

Material	Unit price	Amount	Total price
Canadian Solar 60 Cells 270Wp Poly-SI	R$ 486,61	14	R$ 6.812,54
Female / Male Connectors	R$ 12,55	4	R$ 50,20
Cable 6mm, 1000V	R$ 3,22	240	R$ 772,80
Schneider 1000DC 25A Photovoltaic Circuit Breaker	R$ 319,00	1	R$ 319,00
Surge Protector DPS 40 KA 275C Steck	R$ 120,90	1	R$ 120,90
DPS Schneider PRD-DC40r 1000PV Photovoltaic	R$ 569,00	2	R$ 1.138,00
Flexible Cable 10mm 100m 750 V SIL	R$ 416,90	2	R$ 833,80
Total			**R$ 10.047,24**

Source: Canadian Solar (2018)

Table3 - Budget for the photovoltaic system.

Making contact with the company WEG, it was possible to obtain the costs related to the inverter raised for application in the energy system, according to the company, the cost of the inverter with a capacity of 5 kW, being the SIW 600 ST020-44 model , is R $ 4,765.52.

The company responsible for the support structure for the photovoltaic plate system, also presented costs related to materials and services, with a total value of material and labor of R $ 6,104.17.

Therefore, adding all the necessary components for the proposal presented, the entire project will have a total cost of R $ 20,916.96.

Payback: Payback is the period necessary to obtain the return on investment made on a given project, therefore, in this case study, it will be presented together with the budget raised the time it takes to obtain the costs spent on the project of the photovoltaic system for an area of 21.24 m² of solar panels.

To determine the payback, it is necessary to determine some prior information. First, it is necessary to obtain the value of the electricity tariff according to the energy distributor and according to the current legislation, following the regulations of ANEEL (National Electric Energy Agency) updated in 2019, the tariff referred to in question is R $ 0.56 / kWh.

Following the calculation of the payback, it is also necessary to survey the monthly energy generation of the dimensioned electrical system. Bearing in mind that 1.37 kWh / day is generated by each module and having 14 modules, the system presented is responsible for generating 575.4 kWh / month.

With the previous data, it is then possible to determine the return on investment in the project, the payback for this case according to Solar (2016), will be based on the following equation:

$$Payback\ [months] = \frac{Investment\ (R\$)}{Generated\ Energy\ \left(\frac{kWh}{mes}\right) x\ Fare\ amount\ \left(\frac{R\$}{kWh}\right)}$$

$$Payback\ [months] = \frac{20916{,}96\ (R\$)}{575{,}4\ \left(\frac{kWh}{month}\right) x\ 0{,}56\ \left(\frac{R\$}{kWh}\right)}$$

$$Payback\ [meses] = 64{,}9\ months \sim 5\ years\ e\ 5\ months$$

Therefore, using the presented equation, the return time for investment in the photovoltaic system for an area of 21.24 m², generating 3.78 kW of power, is 65 months or 5 years and 5 months.

According to Câmara (2011), photovoltaic plates have a durability of 20 to 25 years, and it becomes a viable alternative in the long term, depending on the case in question (CÂMARA, 2011). Thus, based on the return time of the payment of the solar energy project it becomes viable.

CONCLUSION

The case study for demonstration of the solar system was applied to the city of Rio de Janeiro - RJ, the purpose of the survey was to determine a renewable energy system that can be used and that makes possible the supply of self-sustainable energy for a given time. company concerned. Thus, considering an area of 21.24 m², a system was determined to meet the energy consumption needs of the proposed company, which is at least 3.562 kW of power.

Firstly, the method of development of the solar energy project had as a process the use of bibliography and regulated standards for survey and analysis of data and documents related to geographic information and insolation of the city in question, where based on these factors the dimensioning was carried out , and thus arrive at the conclusion that under the conditions it was possible to generate a total of 1.37 kWh / day for each solar module, having a total of 14 modules, generating a power of 3.78 kW. With the calculated photovoltaic system, it was possible to determine the inverter based on the manufacturer's data and also the bearing structure of the plates.

Therefore, from all the detailed and designated components, the total cost of expenses was assessed to make the initial objective of the research possible, the total amount is R $ 20,916.96. And with the necessary budget for investment in the detailed solar energy project, there was a payback of 5 years and 5 months, which is the period necessary for the solar system to be able to pay for itself. From the evaluated information, it appears that the feasibility of a project of this dimension for a company with the energy demand initially assessed at 684 kWh is feasible and can be applied, considering that its useful life of 25 years, in addition to which brings many economic benefits through the application of sustainable practices.

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Mobile App for the Prediction of Bananas Harvest

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Abstract

This study had the objective to use mathematical modeling of existing functional relationships between meteorological factors and the gestation time of 'Nanicão' banana bunches to develop a model capable of predicting the harvest time, through multiple linear regression and apply this theory in a mobile application on the Android platform, in order to assisting producers in decision making.

Keywords: *Agriculture 4.0, Musa acuminata 'Dwarf Cavendish', mathematical modeling, harvest time.*

1. Introduction

Brazil has been consolidating itself on the world stage as a promising fruit producer with a world production of 114 million tons of bananas in 2019 (Zafalon and Kastner, 2019), according to FAO data (2017), with total production in that year of6,675,100 million tons. Banana tree is characterized by being adaptable to tropical and subtropical climates, with an ideal temperature for production between 15º C and 35º C and average annual rainfall of 1200 mm (Coelho et al., 2016).

Thus, to achieve maximum crop yields and minimize costs and cultivated area, edaphoclimatic adaptation can help achieve these goals. Early detection and management of problems associated with yield due to climatic and weather variables, pest attacks and the occurrence of diseases can help to increase yield and subsequent profit and thus assist in decision-making about harvesting, storage and other cultural tracts.

In 2015, Brazil participated in all sessions of the intergovernmental negotiation related to the consolidation of the Sustainable Development Goals (SDGs) on the occasion of the United Nations Summit for Sustainable Development. At that time, an agreement was reached that contemplates 17 Objectives and 169 targets, involving diverse themes, such as poverty eradication; food security and agriculture; health; education; gender equality; water and sanitation; energy; sustainable economic growth; infrastructure ; reducing inequalities; sustainable cities; sustainable consumption and production patterns; climate change; protection and sustainable use of the oceans and terrestrial ecosystems; peaceful, righteous and inclusive societies and means of implementation (Mundo, 2016).

The present research has insertion and accession in 3 of these global objectives, namely: objective 2 that proposes to end hunger, achieve food security and improve nutrition and promote sustainable agriculture, with agriculture being the largest employer in the world , providing livelihoods for 40% of the current global population and fruit cultivation and banana farming in turn inserted in this context; objective 9, which proposes to build resilient infrastructures, promote inclusive and sustainable industrialization and promote innovation, since according to this objective, in developing countries only 30% of agricultural production goes through industrial processing, and in developed countries 98% is processed. This suggests the existence of a great opportunity for business in the agricultural area in developing countries; and objective 12, which aims to ensure sustainable production and consumption patterns, such as better crop planning and thereby reducing food wasted daily. (Mundo, 2016).

This study aims to investigate the functional relationships between meteorological factors and the gestation time of 'Nanicão' banana bunch, in order to develop a model capable of predicting the harvest time, through multiple linear regression. (Montgomery and Runger, 2016) and to use the mathematical function in the development of an application for Android phones, to assist rural producer in carrying out the harvest planning.

2. Material and Methods

2.1 Description of the experimental area

The data related to this study were collected at Fazenda Rancho Mama located in the municipality of Itaí-SP, which has geographical coordinates, 23°31'44.7"south latitude and 49°04'04.8" west of Greenwich

and an altitude of 630m, Cwa specific variety climate - according to Köeppen climate classification - humid subtropical with hot summer, hot temperate climate (mesothermal) with rain in the summer and drought in the winter with average warmer temperature over 22ºC, average atmospheric pressure during the period of the evaluations of 928.5 hPa, predominant winds in the directions South-Southeast, South and Southeast, respectively with an average speed of 1.9 m s-1.

The soil in the area was considered as Red Nitosol according to the classification performed (Santos et al., 2018). All cultural treatments related to fertilization, irrigation, pest and disease control were realized in the area whenever necessary.

2.2 Weather data

The meteorological data referring to the maximum, average and minimum temperatures, relative humidity and precipitation were obtained by the National Institute of Meteorology (Instituto Nacional de Meteorologia - INMET), through the Observation and Applied Meteorology Section (Seção de Observação e Meteorologia Aplicada - SEOMA), from an Automatic Meteorological Information System of Surface, comprising the following subsystems: data collection, through sensors that measure environmental variables; of control and local storage in data-logger; of power; of communications; of database and data dissemination to users. Data relating to photoperiods were obtained by means of specific calculations from the geographic location of the banana crop carried out by the Meteorological Station located at FCA-Unesp, Botucatu Campus.

For full development and adequate production, the banana tree, a typically tropical plant, requires a constant temperature around 28ºC, but the range of 15 to 34ºC is considered as the extreme limits for satisfactory exploration of the crop, in addition to well-distributed rainfall and high humidity (Borges & Souza, 2012).

Satisfactory banana production is associated with a total annual rainfall of 1,900 mm distributed throughout the year, that is, representing an average of 160 mm month^{-1} and 5 mm day^{-1}. Brazil has favorable conditions for banana cultivation in almost all of its territorial area, with emphasis on the North, Northeast, Midwest regions, much of the Southeast region and some microclimates of the South region, however the climatic factors directly or indirectly delimit the producing zones, placing them in apt, marginal or inapt (Borges & Souza, 2012).

Ballestero, in (Soto Ballestero, 1992) argues that the luminosity directly affects the banana cycle both in terms of the size of the bunches and in the quality and time of their emission until the harvest. Therefore, a time greater than 2000 hours of sunshine/year is considered as ideal, and as the limit, 1000 hours of sunshine/year. The author shows that for 'Valery', 'Grand Naine' and 'Giant Cavendish' cultivars - in conditions of high light - the average time for fruit development is 80 to 90 days and, in low light regions, the observed values were between 85 and 112 days.

Photoperiodism is the organism's ability to respond to a specific photoperiod, this being the period between sunrise and sunset, in a specific place and date. In vegetables, in general, photoperiodism influences the flowering phenomenon and, consequently, in the reproductive process and fruit formation. Throughout the year, in regions where the seasons are well defined, there is variation in the length of days compared to nights, with many plants sensitive to these changes. Researches that analyzed the influence of

the photoperiod on the different phases of the banana phenological cycle are old and present incipient data. Soto Ballestero (2000) reports that the banana tree does not respond to the photoperiod, being classified as a neutral day plant. However, new approaches have been given by different authors, citing the hypothesis that the plant responds to long days optionally, in the inflorescence emission phase.

It is necessary to know the sun's declination to determine the photoperiod, in other words, the angle formed between the equator plane and the sun's rays reaching a certain location, which, although it varies continuously with time from the meteorological point of view, is considered as a discrete function, that is, unchanged along the day, making the calculation more simplified than the one required for astronomical purposes.

Varejão-Silva (2006), from the study of T. Won in *The Simulation of Hourly Global Radiation from Fourly Reported Meteorological Parameters – Canadian Prairie Area,* recommends the use of Equation 1, for the approximate calculation of the declination of the sun (δ) in degrees:

$$\delta = 0.3964 + 3.631sin\left(\frac{360D}{365}\right) - 22.97cos\left(\frac{360D}{365}\right) + 0.03838sin\left(2\frac{360D}{365}\right) - 0.3885cos\left(2\frac{360D}{365}\right) + 0.07659sin\left(3\frac{360D}{365}\right) - 0.1587cos\left(3\frac{360D}{365}\right) - 0.01021cos\left(4\frac{360D}{365}\right) \quad (1)$$

Where:

δ: declination of the sun (degrees)

D: number of the day in the year (D = 1,2,3...365)

From sunrise to sunset, and due to the slope inherent to the sun, the earth rotates at a certain angle and, for a given latitude and specific date, the hour angle is determined by Equation 2:

$$H = arc.cos\,(tan\,\phi\delta) \quad (2)$$

Where:

H: hour angle (degrees)

Φ: latitude (degrees)

Briefly, 2H represents the value of the hour angle that the Earth must travel from sunrise to its culmination and, from culmination to sunset. We know that the photoperiod corresponds to that time interval and that the Earth has an angular velocity of 15°/ h, the elapsed time is given by:

$$P = \frac{2H}{15} \quad (3)$$

Where:

P: Photoperiod (hours and hours decimals)

The moment set as the sunrise and the sunset is established by certain conditions of tangent of the edges of the solar discs with the horizon plane the considered local. For reasons that are outside the scope of this study, it is necessary to apply a correction to the formula for calculating the photoperiod, changing

it as follows, as explained in (Varejão-Silva , 2006).

$$P_c = \frac{2(0.83° + H)}{15} \quad (4)$$

Where:

Pc: Corrected photoperiod (hours)

2.3 Banana Culture

The cultivar analyzed in this research was the 'Nanicão' triploid of Musa acuminata (AAA) from the Cavendish subgroup, chosen because of the following factors: i) because it is a little more tolerant to cold (about 2°C less) and to the lack of water, its hibernation does not occur at the common 15° C; ii) the emission of the inflorescence occurs naturally, with fewer occurrences of interruptions iii) the symptoms of "chilling" in the plant and in the fruits are less than the other cultivars of the Cavendish subgroup.

2.4 Running the experiment

Data were collected in a six-year-old banana crop, established in November 2005 in an area of 50 ha, with a spacing of 2.40m x 2.10m, under a central pivot irrigated system. Data were collected among the harvests of the years 2011 and 2017/2018.

In the developing of the banana tree, all necessary preparations were made in the soil for correction and fertilization, according to its chemical analysis. Throughout the cycles, all the essential cultural treatments were applied, such as periodic thinning of shoots, cleaning of leaves and management of pests and diseases. In the period of data collected, the control of Yellow Sigatoka (*Mycosphaerella musicola*) stands out by carrying out seven (7) fungicide sprays per year (from October to April), intercalating products belonging to different chemical groups.

In order to analyze the performance of the banana bunches, 50 banana trees were signaled and numbered - divided into one per plot - and the emission data was recorded until the bunches were harvested through personal inspections.

2.5 Multiple Linear Regression Model

From 2011 to 2017/2018, 364 samples of banana gestation (difference between the bagging date and the harvest date) were recorded, as well as a set of meteorological information registered on the bagging day, such as temperature, precipitation, relative humidity and photoperiod, as partially shown in Table 1 (Complete table in Appendix 1).

Table 1 – Banana gestation, harvest and meteorological data.

No.	Gestation (days)	Bagging date	Harvest Date	Temperature (ºC)	Precipitation (mm)	Humidity (%)	Photoperiod (h)
1	96	01/03/2011	04/09/2011	22.7	9.3	83	13.562
2	92	01/10/2011	04/12/2011	23.4	13.5	81	13.502
3	91	01/17/2011	04/18/2011	22.9	18.9	84	13.421
4	114	01/24/2011	05/18/2011	24.8	0.6	72	13.32

5	99	02/01/2011	05/11/2011	22.8	21.7	82	13.199
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
360	85	11/20/2017	02/13/2018	21.6	7	74	13.343
361	82	11/27/2017	02/17/2018	20.9	9.4	76.3	13.44
362	75	12/04/2017	02/17/2018	23.4	0	70	13.517
363	70	12/11/2017	02/19/2018	23.8	0.7	64	13.572
364	63	12/18/2017	02/19/2018	22.2	17.1	83	13.604

Source: Authors.

A mathematical model is of regression when it connects the behavior of a variable in function of another. A regression model that contains more than one regressor variable is called multiple, and is widely used to adjust the tabulated data in a linear form with the unknown coefficients that follow the regressor variables. In these models, the second degree polynomial regression class and interactions between two regressor variables are included, as shown in Equation 5:

$$G = \beta_0 + \beta_1 D + \beta_2 M + \beta_3 T + \beta_4 Pr + \beta_5 H + \beta_6 Ph + \beta_7 D^2 + \beta_8 DM + \beta_9 DT + \beta_{10} DPr + \beta_{11} DH + \beta_{12} DPh + \beta_{13} M^2 + \beta_{14} MT + \beta_{15} MPr + \beta_{16} MH + \beta_{17} MPh + \beta_{18} T^2 + \beta_{19} TPr + \beta_{20} TH + \beta_{21} TPh + \beta_{22} Pr^2 + \beta_{23} PrH + \beta_{24} PrPh + \beta_{25} H^2 + \beta_{26} HPh + \beta_{27} Ph^2 + \epsilon \quad (5)$$

Where:

G: Gestation of bananas (in days)

β_0, β_1… β_27: Regression coefficients

D: Bagging Day

M: Bagging Month

T: Temperature (° C)

Pr: Precipitation (mm)

H: Humidity (%)

Ph: Photoperiod (h)

ϵ: Random error term

In addition, it is necessary to select an appropriate set of regressors, based on a model that includes all variables, and not all regressors are necessary. Therefore, an analysis should be performed to choose an appropriate model that contains sufficient regression variables for prediction, of low maintenance cost and easy to use.

Several criteria can be used to evaluate and compare the different regression models obtained, we used in this article the analysis of the coefficient of multiple determination (R^2), adjusted coefficient of determination (adjusted R^2), quadratic sum of errors (SQ_E), Mallows' CP and P value.

To adjust the models, the significance level of the regressive variables was used at 5% and concomitant to the P value, which refers to the lowest level of significance for acceptance of the model adopted.

For the resolution of the regression coefficients values, the choice of the best model, and the determination of the aforementioned selection criteria; the Minitab 19 software was used.

In order to have a general idea of the accuracy of the predictions of the adopted model, it is necessary to determine the confidence intervals (CI), which provides the probable values for the average response and also the prediction intervals (PI) that results in the probable values for an answer to an x not belonging to the analyzed data, but which belong to the range of variation studied.

2.6 Agriculture 4.0

Agriculture 4.0 or Digital Agriculture refers to the set of integrated and connected technologies that allow the automation of agricultural processes through applications for cell phones and tablets, software and equipment in order to optimize agricultural production, reduce costs, streamline operations and enable greater food security.

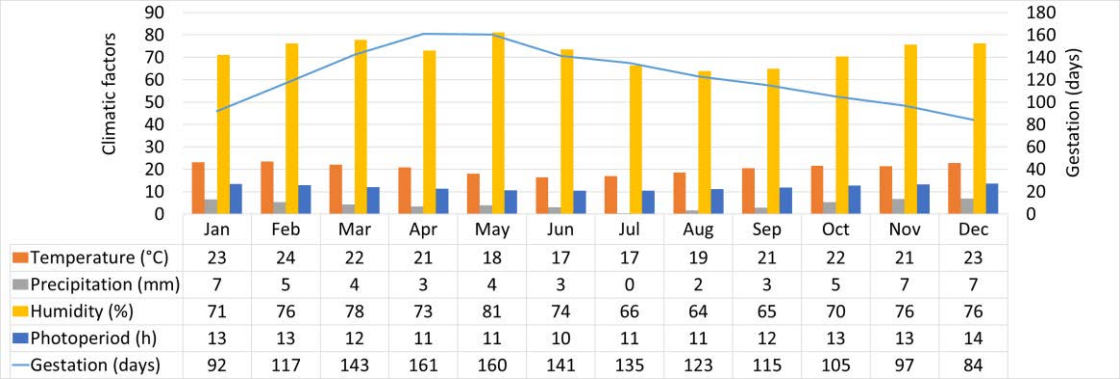
The connectivity of mobile devices is directly related to the concept of IoT (Internet of Things), which adopts computational resources of high technological level, sensors and analysis techniques to generate and process various data that will serve as a basis for rural producers to make strategic decisions more efficiently, due to access to data and tools for daily operations with predictability and harvest planning.

In the present study, an application for mobile device with Android system was developed, on the MIT App Inventor 2 platform, with the GPS (Global Positioning System) location feature applied in the property to collect information about latitude and longitude, being the latitude used for the basis of calculations of the photoperiod, which applied to the mathematical model aims to predict the gestation of bananas and consequently the harvest date.

3. Results and Discussions

3.1 Climatic data and gestation of banana bunches

The behavior of the bunches gestation as a function of climatic factors - such as temperature (ºC), relative humidity (RH%), precipitation (mm) and photoperiod (hours) - can be seen in Figure 1, from the average of 7 years of data collections. It is possible to analyze that in periods of lower temperature, low precipitation and photoperiod, there is an increase in the gestation time of the bunches. Unlike, when the aforementioned climatic factors increase their levels, there is a decrease in the gestation time and, consequently, a reduction of the time of the fruits on the banana trees and optimization of the maintenance costs of the banana crop.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)	23	24	22	21	18	17	17	19	21	22	21	23
Precipitation (mm)	7	5	4	3	4	3	0	2	3	5	7	7
Humidity (%)	71	76	78	73	81	74	66	64	65	70	76	76
Photoperiod (h)	13	13	12	11	11	10	11	11	12	13	13	14
Gestation (days)	92	117	143	161	160	141	135	123	115	105	97	84

Figure 1: Average gestation of banana bunches (secondary axis) according to the average values of climatic factors (main axis). Source: Authors.

In the present study, the average temperature calculated over the 7 years of study was 20.3ºC, with peaks in January of 30.2ºC and minimum in July of 12.5ºC. When calculating the average of monthly temperatures, throughout the year, the temperatures found are within the range of limits for their production showing that the place is ideal for the production of these fruits.

In the region where the samples were measured, the average precipitation over the evaluation period varied from 0.4 mm in July; and values greater than 6.6 to 6.9 mm in the months from November to January. As the banana crop has a central pivot irrigation system, the necessary water demand was supplied when desired.

In this research, relative humidity measurements were calculated varying from 63.8% in May to 81.1% in July. Monthly humidity averages above the recommended were only observed in July, however the lack of humidity and precipitation were supplied by irrigation of the banana crop, making this variable less significant for the study.

As shown in Figure 1, the average monthly photoperiod ranged from 10.4 hours in June to 13.6 hours in December. Likewise, it is observed that under high light conditions (Dec-Jan) the average fruit development time was about 80 days and under low light conditions (May-Jul) the average time was approximately 150 days.

3.2 Mathematical model to predict gestation of banana bunches

Having a model that uses a single linear regression function, in contrast to one developed under the techniques of neural networks (with a much higher number of regressive functions) is interesting and computationally lighter, however studies of mathematical modeling applied to agriculture are still incipient.

From the existing regression models, there are those classified as linear and non-linear models, the last being useful for describing the growth of biological materials over time, as they use parameters of biological interpretation that facilitate analysis (Lúcio et al., 2015).

In the agricultural area, these studies usually assess the entire cycle of a species or growth model according to the application of crop management techniques or comparison between genotypes, as can be seen in Hernández et al. (2007), who studied characteristics of the quality of 'araçá' fruit during growth, development and ripening; Barrera et al. (2008) who studied the physiological development of accessions of different pepper varieties grown in the Amazon; Tarara et al. (2009) who established a dynamic seasonal modeling of canopy and fruit growth in grapevine under different management conditions; Akpo et al. (2014) who studied the dynamics of oil palm growth; and Carson et al. (2014) who analyzed the effect of nitrogen application on tomato production.

A survey of banana fruits was carried out by Etienne et al. (2013) in order to establish a model of the relationship between the acidity of the fruits and their composition during growth and post-harvest maturation from the measurement of the evolution of the organic acids present and found that process-based simulation models are powerful tools for study genotype-environment interactions and design models adapted to the producer / consumer demand.

To assist in the application of multiple linear regression to the analyzed gestation data of banana bunches, the Minitab 19 software was used, in the following steps:

i) Initially, the evaluation of the best subsets to compose the model was evaluated, using the Assistant tool, enabling the obtaining of a mathematical model composed of the variables Day, Month and Photoperiod, as well as the iterations of every two between these variables and also the variable raised to the second power, thus composing a polynomial of order 2;

ii) Then, through an analysis of the normal probability of the residues graphs, (residues of x adjusted values and residues x order of observation), two outliers were found, that is, data that were outside normality and that were causing losses in the interpretation of results of the statistical tests applied to the samples.

iii) Finally, a new modeling was performed, resulting in the equation presented in Equation 18 (rewritten based on Equation 1) with the results obtained from the prediction coefficients.

$$G = -312,6 - 1,996D - 55,04M + 126,1Ph + 0,1426DPh + 4,081MPh - 7,133Ph^2 \quad (18)$$

In terms of model adequacy, R2 was 84.3%, R2aj was 84.03% and R2predict was 83.66%, which represents how well the model can predict responses to new observations.

From the pareto's chart of the effects it was possible to compare the relative magnitude and statistical significance of the terms, in decreasing order of the absolute values, as shown in Figure 2, with the reference line highlighted in red indicating the significant terms for the model (with a significance level of 5%, i.e. $\boldsymbol{\alpha} = 0.05$), whose t value ($t\boldsymbol{\alpha}/2$) - used to determine the confidence and prediction intervals - was 1.97.

According to the results shown in Figure 2, the variables selected for the model are statistically significant, considering that they present values above the reference value, with the month (B) being the most prominent (18.5232), due to the variation the sun declination over the days of the year that affect the necessary photoperiod for banana trees in realizing photosynthesis; the iteration month and photoperiod (E) was the second most important factor (17.8005); and the photoperiod raised to the second power (F) was the third highlighted (11.3096).

Furthermore, it is noteworthy that the model presented S values equal to 10.808, Mallows' Cp of 7.0 and p-values less than 5%, as the level of significance used in this project was $\alpha = 5\%$ and with respect to Evans rule (n/k be at least 10), we have that n=362 and k=6, whose relationship resulted in 60.33, that is, the values found are satisfactory for the use of the regression equation.

In order to verify if the model suggested in this study meets the assumptions of the analysis, the graphs of normal probability of the residues, residues x order, histogram of residues and residues x adjustments were verified, as shown in Figure 3.

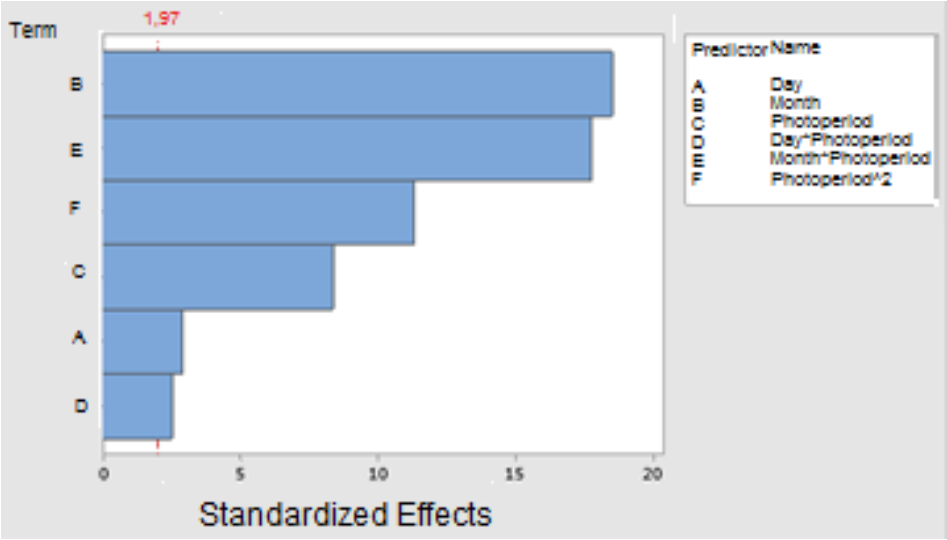


Figure 2: Pareto chart of standardized effects.Source: Authors.

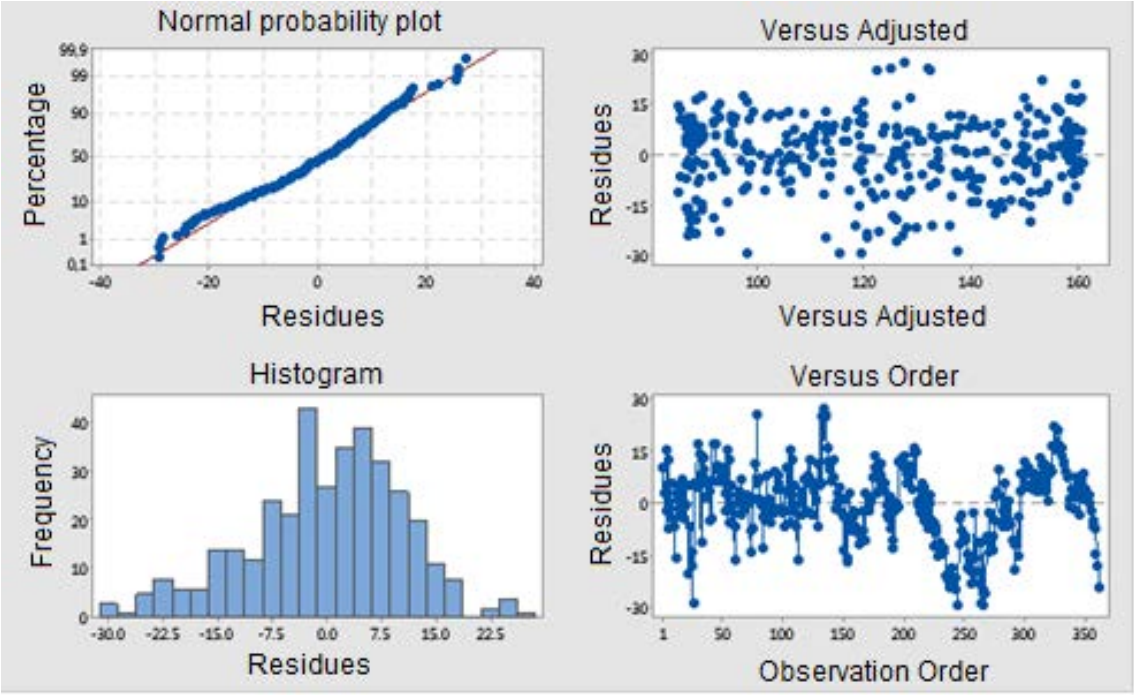


Figure 3: Graphs of Gestation residue. Source: Authors.

The normal probability plot of the residues (upper left side of Figure 3) was used to verify the assumption of distribution of these in order to follow approximately a straight line, thus verifying that there is no evidence of abnormality, outliers or unidentified variables.

Due to the large number of data points (n = 362), the residues histogram (lower left side of Figure 3) proved to be effective, where each bar contained enough points to reliably illustrate the asymmetry.

As for the graph of residues x adjusted values (upper right side of Figure 3), it was found that the residues were randomly distributed on both sides along line 0, with no recognized patterns in the points.

However, in a detailed analysis, it was found that 22 points had large residues and were not ideally adjusted, which are marked in red in the graph in Figure 4, which possibly are given due to the delay in the collection of bunches, without significant losses for the explanation of the model.

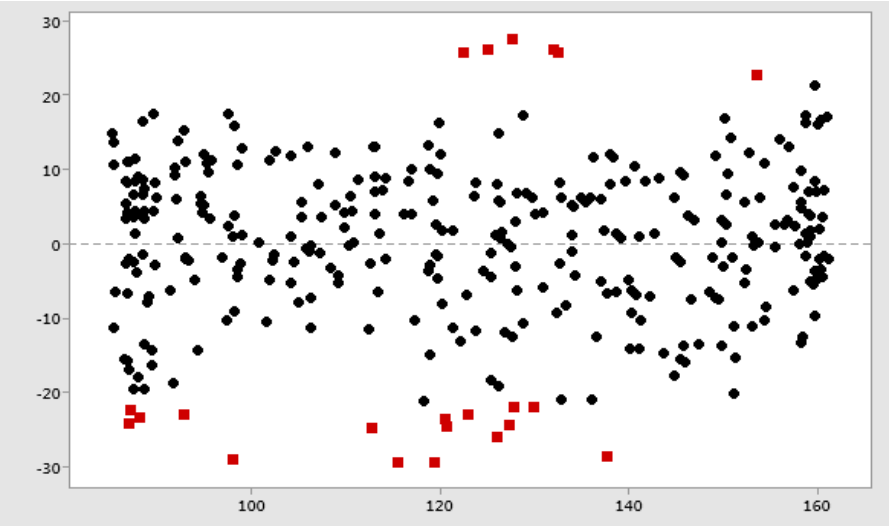


Figure 4: Graph of Adjusted Values x Waste. Source: Authors.

Finally, the graph of residues x order of collection (lower right side of Figure 3), indicates that the residues have satisfactory independence from each other, by presenting themselves randomly around the central line.

With a significance level of 5%, i.e. α=0.05 and t value ($t_{\alpha/2}$) of 1.97, the confidence and prediction intervals were respectively ± 4.88 and ± 21.30, and the results presented in the application are related to the prediction.

3.3 Mobiles Application

The mobile application developed on the MIT App Inventor 2 platform, was developed with 6 screens for use, where:

i) Screen 1: Home screen of the application, as shown in Figure 5 (a).

ii) Screen 2: The second screen was used - together with the TinyDB database feature - to store the bagging date, entered by the user, as shown in Figures 5 (b) and (c), and at the bottom the user has the button to calculate the prediction of gestation and harvest of bananas bunches. For that, the location sensor of the mobile device must be connected.

iii) Screen 3: The third screen shows the results calculated from the predicted lower limit of gestation and harvest, the predicted values of gestation and harvest and also the predicted upper limit of gestation and harvest of banana bunches. For that, the TinyDB database resources were used in order to use the bagging date information from the previous screen, in addition to using the location sensor to use the latitude data to calculate the photoperiod; and also the DateTools extension that enables to add the gestation values to the bagging date, to present the results, as shown in Figure 5 (d).

At the bottom, the user has the possibility to return to the second screen and perform a new calculation or check the additional information of the application, as shown in Figure 5 (e).

The application was tested on devices with Android operating system version 9, and presented excellent functioning, as shown in Figure 5 with a print of the aforementioned screens.

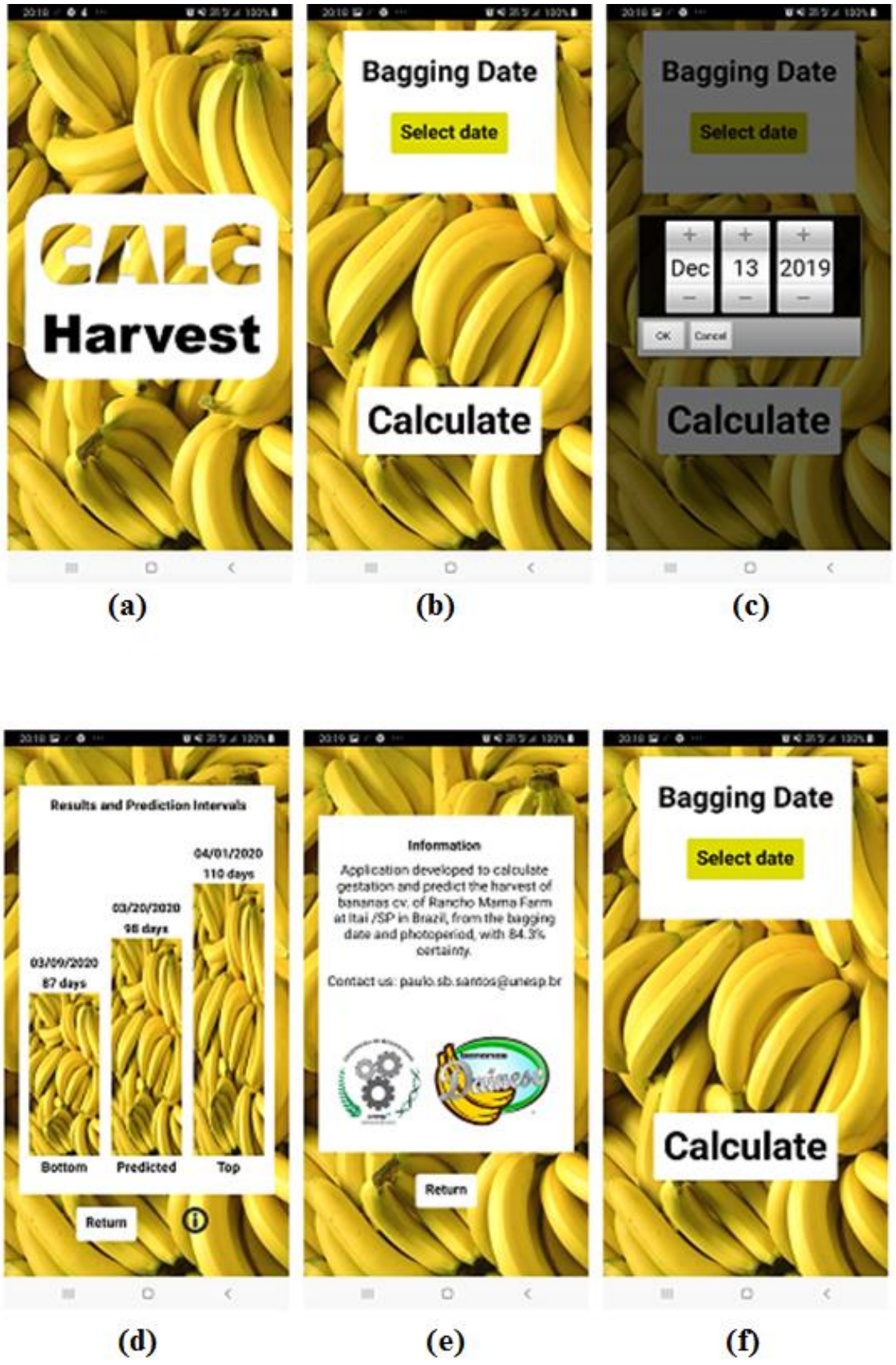


Figure 6: Banana Calc application screens. Source: Authors.

4. Conclusion

The mathematical model proposed in this article obtained a high R2 (84.3%) showing, in percentage,

the variation explained by the model and its effectiveness in predicting responses for future observations. The variations that orbit around the exact prediction may occur due to seasonal climatic variations that have occurred over the observed years, or also due to other climatic characteristics not evaluated in this study, such as light intensity, direction and intensity of the winds, atmospheric pressure, individual characteristics of the plants, aging of the banana plantation, the appearance of pests and diseases or the use of pesticides that may delay or advance the fruit harvest, among others.

Another important factor to be considered is the method used to determine the bagging and harvest of the fruits, being in both subjective episodes. As it is a climacteric fruit, which ripens even after harvest, the criteria used in Brazil to predict the time of harvest are empirical and they are based on some morphological aspects such as the disappearance of the corners and angles of the surface of the fruits or on the measurement of the caliber of a fruit from the central bunch, the physiological degree regarding to fruit maturation related to fruit color or in the distinction of fruit by age through markings in the banana plant, as performed in this study.

Taking these criteria into account, some opportunities may open, forcing the producer to harvest the fruits before the ideal point and accelerating their ripening in cold chambers with the addition of ethylene, for example.

In a complementary study using the modeling of artificial neural networks to evaluate banana gestation data, the authors verified that this model presented unprecedented results, with a low error in the average gestation time of the bunch, thus becoming a tool for producers to manage their production. This complementary study obtained a good performance in the training process (Wi weights all adjusted) with an error (MSE) of 0.00397 and an R value of 0.8998, resulting in a strongly positive linear correlation (Souza et al., 2019).

The 4.0 technologies are tools that try to solve some issues and difficulties of adjustments found, and provide the persons improvements in their daily life, becoming something indispensable as new needs arise and, consequently, the search for new techniques to supply them. Having a method for predicting banana gestation time in a less subjective and effective way, in terms of errors and inaccuracies, has been accessible and necessary since the advent of IoT.

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Appendix

Appendix 1. Banana gestation, harvest and meteorological data.

No.	Gestation (days)	Bagging date	Harvest Date	Temperature (ºC)	Precipitation (mm)	Humidity (%)	Photoperiod (h)
1	96	03/01/2011	09/04/2011	22,7	9,3	83	13,562
2	92	10/01/2011	12/04/2011	23,4	13,5	81	13,502
3	91	17/01/2011	18/04/2011	22,9	18,9	84	13,421
4	114	24/01/2011	18/05/2011	24,8	0,6	72	13,32
5	99	01/02/2011	11/05/2011	22,8	21,7	82	13,199
6	126	07/02/2011	13/06/2011	23,8	5,5	78	13,06
7	118	14/02/2011	12/06/2011	22,6	12,3	80	12,905
8	132	21/02/2011	03/07/2011	23,6	5,1	77	12,736
9	130	01/03/2011	09/07/2011	19,2	0,5	88	12,555
10	134	07/03/2011	19/07/2011	21,3	1,5	84	12,365
11	130	14/03/2011	22/07/2011	21,1	0,3	81	12,17
12	153	21/03/2011	21/08/2011	22,5	0,1	78	11,972
13	154	28/03/2011	29/08/2011	21,3	0,03	85	11,774
14	164	04/04/2011	15/09/2011	20,5	0	77	11,58
15	156	11/04/2011	14/09/2011	21,6	0	80	11,392
16	167	18/04/2011	02/10/2011	22,8	0	71	11,215
17	163	25/04/2011	05/10/2011	18,3	0	82	11,049
18	156	02/05/2011	05/10/2011	18,1	0	73	10,899
19	163	09/05/2011	19/10/2011	18,7	0	80	10,765
20	155	16/05/2011	18/10/2011	15,6	0	76	10,649
21	158	23/05/2011	28/10/2011	16,3	0	71	10,553
22	131	01/06/2011	10/10/2011	15	0	70	10,479
23	142	06/06/2011	26/10/2011	13,9	0,7	78	10,425
24	127	13/06/2011	18/10/2011	16,5	0,1	69	10,394
25	127	20/06/2011	25/10/2011	18,4	0	76	10,385
26	109	27/06/2011	14/10/2011	15,2	0	69,4	10,399
27	143	04/07/2011	24/11/2011	14	0	73	10,435
28	139	11/07/2011	27/11/2011	20,5	0	53	10,493

29	177	18/07/2011	11/01/2012	18,2	0,3	76	10,572
30	135	25/07/2011	07/12/2011	18,5	0	76	10,672
31	146	01/08/2011	25/12/2011	14,8	0	68	10,792
32	141	08/08/2011	27/12/2011	19,5	0	67	10,929
33	132	15/08/2011	25/12/2011	18,5	0,5	67	11,083
34	110	22/08/2011	10/12/2011	18,4	0	67	11,252
35	132	29/08/2011	08/01/2012	17,8	0	72	11,432
36	129	05/09/2011	12/01/2012	20,3	0	62	11,621
37	155	12/09/2011	14/02/2012	18	0	69	11,816
38	120	19/09/2011	17/01/2012	19,1	0,4	66	12,014
39	112	26/09/2011	16/01/2012	20,9	0,7	58	12,212
40	114	03/10/2011	25/01/2012	20,9	3,8	71	12,407
41	109	10/10/2011	27/01/2012	20,3	16,8	88	12,595
42	97	17/10/2011	22/01/2012	17,8	0,2	70	12,773
43	94	24/10/2011	26/01/2012	21	6,3	71	12,939
44	115	01/11/2011	24/02/2012	17,7	0	69	13,091
45	101	07/11/2011	16/02/2012	22,3	2,6	68	13,226
46	102	14/11/2011	24/02/2012	17,8	4,1	78	13,343
47	107	21/11/2011	07/03/2012	22,1	2,8	66	13,44
48	99	28/11/2011	06/03/2012	21,2	0,6	74	13,517
49	95	05/12/2011	09/03/2012	21,5	12,5	79	13,572
50	94	12/12/2011	15/03/2012	23,3	2,5	60	13,604
51	95	19/12/2011	23/03/2012	24,8	2,8	58	13,615
52	95	26/12/2011	30/03/2012	21,5	3,8	76	13,603
53	96	02/01/2012	07/04/2012	22,3	10,4	72	13,562
54	92	09/01/2012	10/04/2012	20,8	2,4	81	13,502
55	91	16/01/2012	16/04/2012	21,2	13,2	84	13,421
56	114	23/01/2012	16/05/2012	20,5	14,9	82	13,32
57	99	30/01/2012	08/05/2012	24,1	0	55	13,199
58	126	06/02/2012	11/06/2012	24,9	1,2	65	13,06
59	118	13/02/2012	10/06/2012	22,5	14,6	79	12,905
60	132	20/02/2012	01/07/2012	22,8	9,7	80	12,736
61	130	27/02/2012	06/07/2012	24,5	4,4	72	12,555
62	134	05/03/2012	17/07/2012	22,9	0,8	70	12,365
63	130	12/03/2012	20/07/2012	22,1	3,3	75	12,17
64	153	19/03/2012	19/08/2012	22	0	73	11,972
65	154	26/03/2012	27/08/2012	20,9	1,4	77	11,774
66	163	02/04/2012	12/09/2012	22,4	1,7	74	11,58
67	157	09/04/2012	13/09/2012	21,6	3	74	11,392

68	168	16/04/2012	01/10/2012	19,8	0	80	11,215
69	158	23/04/2012	28/09/2012	19,4	6,5	84	11,049
70	160	30/04/2012	07/10/2012	14,9	5,5	81,5	10,899
71	159	04/05/2012	10/10/2012	18,7	3,2	78	10,765
72	159	14/05/2012	20/10/2012	16,1	0,1	80	10,649
73	153	21/05/2012	21/10/2012	17,4	3,6	81	10,553
74	150	28/05/2012	25/10/2012	18,8	1,6	84	10,479
75	142	04/06/2012	24/10/2012	15,9	10,3	92	10,425
76	132	11/06/2012	21/10/2012	17	0,4	86	10,394
77	135	18/06/2012	31/10/2012	16,4	26,9	88	10,385
78	140	25/06/2012	12/11/2012	17,6	0,05	73,4	10,399
79	150	02/07/2012	29/11/2012	18	5,9	72	10,435
80	141	09/07/2012	27/11/2012	14,4	0,8	72	10,493
81	158	16/07/2012	21/12/2012	13,8	0,3	76	10,572
82	136	23/07/2012	06/12/2012	17,4	0	61	10,672
83	128	30/07/2012	05/12/2012	18,2	0	68	10,792
84	127	06/08/2012	11/12/2012	18,4	0	64	10,929
85	121	13/08/2012	12/12/2012	20	0	61	11,083
86	109	20/08/2012	07/12/2012	20,5	0	54	11,252
87	118	27/08/2012	23/12/2012	17,1	0,1	69	11,432
88	115	03/09/2012	27/12/2012	22	0	54	11,621
89	125	10/09/2012	13/01/2013	22,6	0	64	11,816
90	115	17/09/2012	10/01/2013	20,9	10,6	70	12,014
91	110	24/09/2012	12/01/2013	16,3	0,4	71	12,212
92	104	01/10/2012	13/01/2013	23,6	0,1	60	12,407
93	105	08/10/2012	21/01/2013	20,1	4,7	72	12,595
94	100	15/10/2012	23/01/2013	20,3	1,4	71	12,773
95	96	22/10/2012	26/01/2013	23,8	6,9	76	12,939
96	105	29/10/2012	11/02/2013	23,1	1,9	70,5	13,091
97	99	05/11/2012	12/02/2013	22,3	5,3	77	13,226
98	98	12/11/2012	18/02/2013	19,3	0,1	74	13,343
99	98	19/11/2012	25/02/2013	23	0,9	65	13,44
100	92	26/11/2012	26/02/2013	22,7	0	69,6	13,517
101	87	03/12/2012	28/02/2013	25	11,9	73	13,572
102	85	10/12/2012	05/03/2013	23,4	13,7	82	13,604
103	85	17/12/2012	12/03/2013	23,9	3,5	77	13,615
104	80	24/12/2012	14/03/2013	23,7	7,4	78	13,603
105	96	02/01/2013	08/04/2013	22,5	7,9	81	13,562
106	92	09/01/2013	11/04/2013	20,3	10,7	84	13,502

107	91	16/01/2013	17/04/2013	21,12	17,6	78	13,421
108	114	23/01/2013	17/05/2013	22,2	1,6	79	13,32
109	99	30/01/2013	09/05/2013	22	23,3	83,7	13,199
110	126	06/02/2013	12/06/2013	21,3	6,7	84	13,06
111	118	13/02/2013	11/06/2013	24,3	2,5	74	12,905
112	132	20/02/2013	02/07/2013	23,2	10,5	77	12,736
113	130	27/02/2013	07/07/2013	20	3,8	72,8	12,555
114	134	05/03/2013	17/07/2013	23,8	19,4	80	12,365
115	130	12/03/2013	20/07/2013	20,7	7,3	88	12,17
116	153	19/03/2013	19/08/2013	20,1	1,7	86	11,972
117	154	26/03/2013	27/08/2013	20,6	6,2	80,4	11,774
118	163	02/04/2013	12/09/2013	20,9	0,1	83	11,58
119	157	09/04/2013	13/09/2013	20,1	0	72	11,392
120	168	16/04/2013	01/10/2013	22,2	0	64,1	11,215
121	158	23/04/2013	28/09/2013	20,2	0	63	11,049
122	166	29/04/2013	12/10/2013	17,8	0	60,5	10,899
123	168	06/05/2013	20/10/2013	20	0	49,1	10,765
124	170	13/05/2013	30/10/2013	20	0,3	74	10,649
125	160	20/05/2013	26/10/2013	19,7	0,7	75	10,553
126	157	27/05/2013	30/10/2013	15,6	3,3	75,2	10,479
127	147	03/06/2013	27/10/2013	17	1	79	10,425
128	150	10/06/2013	06/11/2013	17,1	5,1	87	10,394
129	144	17/06/2013	08/11/2013	17,2	3,5	84	10,385
130	140	24/06/2013	11/11/2013	17,3	6,6	90	10,399
131	132	01/07/2013	10/11/2013	15,3	8,4	98	10,435
132	150	02/07/2013	29/11/2013	17,5	0,7	78	10,493
133	141	09/07/2013	27/11/2013	17,1	0	77	10,572
134	158	16/07/2013	21/12/2013	17,7	6	81	10,672
135	136	23/07/2013	06/12/2013	15,3	0,3	66,8	10,792
136	155	05/08/2013	06/01/2014	18,6	0	64	10,929
137	151	12/08/2013	10/01/2014	15,7	0	69	11,083
138	148	19/08/2013	13/01/2014	20	0	60	11,252
139	136	26/08/2013	09/01/2014	16,4	0,2	61,8	11,432
140	132	02/09/2013	11/01/2014	19,2	0,5	69	11,621
141	127	09/09/2013	13/01/2014	22,7	0	45	11,816
142	121	16/09/2013	15/01/2014	22,1	4,2	76	12,014
143	117	23/09/2013	17/01/2014	20,7	2,9	77	12,212
144	115	30/09/2013	23/01/2014	20,5	8,6	82,3	12,407
145	119	07/10/2013	02/02/2014	21,3	0	62	12,595

146	101	14/10/2013	28/01/2014	22,3	3,9	70	12,773
147	100	21/10/2013	28/01/2014	20,4	3	65	12,939
148	99	28/10/2013	03/02/2014	21,8	0	63,4	13,091
149	100	04/11/2013	11/02/2014	22	6,7	68	13,226
150	93	11/11/2013	12/02/2014	20	0,9	61	13,343
151	87	18/11/2013	12/02/2014	21	10,1	76	13,44
152	84	25/11/2013	16/02/2014	21,5	1,8	68,6	13,517
153	75	02/12/2013	14/02/2014	22,5	3,1	64	13,572
154	89	09/12/2013	07/03/2014	22,4	2,3	69	13,604
155	70	16/12/2013	23/02/2014	21,3	0	62	13,615
156	71	23/12/2013	03/03/2014	25,3	0,1	69	13,603
157	90	30/12/2013	29/03/2014	24,1	2,2	77,7	13,584
158	79	01/01/2014	21/03/2014	21,8	1,7	73	13,562
159	81	06/01/2014	28/03/2014	22,2	1,9	61	13,502
160	91	13/01/2014	14/04/2014	21,2	5,5	70	13,421
161	95	20/01/2014	25/04/2014	22,5	0,8	62	13,32
162	102	27/01/2014	09/05/2014	23,2	3,5	51,1	13,199
163	107	03/02/2014	21/05/2014	23,5	0,4	44	13,06
164	112	10/02/2014	02/06/2014	23,7	3,5	69	12,905
165	115	17/02/2014	12/06/2014	23,7	0,7	66	12,736
166	125	24/02/2014	29/06/2014	21,6	6,8	73,4	12,555
167	131	03/03/2014	12/07/2014	19,3	5,4	75	12,365
168	139	10/03/2014	27/07/2014	21,9	1,2	69	12,17
169	149	17/03/2014	13/08/2014	20,8	6,4	73	11,972
170	144	24/03/2014	15/08/2014	22,6	0	72	11,774
171	160	31/03/2014	07/09/2014	21,6	9	74,3	11,58
172	159	07/04/2014	13/09/2014	20,8	5,6	74	11,392
173	157	21/04/2014	25/09/2014	22,5	0,7	74	11,215
174	158	28/04/2014	03/10/2014	15,5	0	64,5	11,049
175	160	05/05/2014	12/10/2014	18,6	0	57	10,899
176	162	05/05/2014	14/10/2014	19,8	0	65	10,765
177	165	12/05/2014	24/10/2014	20,4	0	65	10,649
178	165	19/05/2014	31/10/2014	17,1	5,3	77	10,553
179	165	26/05/2014	07/11/2014	16,5	0,7	74,7	10,479
180	160	02/06/2014	09/11/2014	15	2,3	57	10,425
181	150	09/06/2014	06/11/2014	15,8	0	68	10,394
182	152	16/06/2014	15/11/2014	16,1	0	74	10,385
183	148	23/06/2014	18/11/2014	15,9	0	61	10,399
184	148	30/06/2014	25/11/2014	16,3	0	45,7	10,435

185	142	07/07/2014	26/11/2014	15,2	0,6	73	10,493
186	139	14/07/2014	30/11/2014	17,7	0	60	10,572
187	134	21/07/2014	02/12/2014	17	1,4	62	10,672
188	127	28/07/2014	02/12/2014	14,6	0	60,4	10,792
189	125	04/08/2014	07/12/2014	17,7	0	53,9	10,929
190	121	11/08/2014	10/12/2014	15	0,3	56	11,083
191	116	18/08/2014	12/12/2014	19,6	0,6	50	11,252
192	122	25/08/2014	25/12/2014	18,3	2,8	62	11,432
193	115	02/08/2014	25/11/2014	18,9	4,8	70	11,621
194	107	08/09/2014	24/12/2014	22,9	0	51	11,816
195	112	15/09/2014	05/01/2015	19,7	3,5	73	12,014
196	111	22/09/2014	11/01/2015	19,3	10,4	78	12,212
197	106	29/09/2014	13/01/2015	18,6	1,05	71,7	12,407
198	105	06/10/2014	19/01/2015	23,9	0	47	12,595
199	115	13/10/2014	05/02/2015	25,8	0	56	12,773
200	112	20/10/2014	09/02/2015	20,3	3,2	75	12,939
201	107	27/10/2014	11/02/2015	22,1	0,3	59,6	13,091
202	107	03/11/2014	18/02/2015	22,4	3,6	77	13,226
203	106	10/11/2014	24/02/2015	20,7	0,3	67	13,343
204	96	17/11/2014	21/02/2015	21,1	5,2	72	13,44
205	97	24/11/2014	01/03/2015	21,8	6,9	79,5	13,517
206	96	01/12/2014	07/03/2015	22,3	0,5	71	13,572
207	96	08/12/2014	14/03/2015	22,2	14,1	82	13,604
208	98	15/12/2014	23/03/2015	22,8	4,2	70	13,615
209	98	22/12/2014	30/03/2015	22,9	12,8	79	13,603
210	91	29/12/2014	30/03/2015	24,1	2,2	76,1	13,584
211	100	05/01/2015	15/04/2015	25,4	6,7	67	13,562
212	105	12/01/2015	27/04/2015	27,3	0	60	13,502
213	108	19/01/2015	07/05/2015	24,6	4,9	67	13,421
214	99	26/01/2015	05/05/2015	22,2	13	81	13,32
215	106	02/02/2015	19/05/2015	22,2	8	77	13,199
216	110	09/02/2015	30/05/2015	23	14,5	83	13,06
217	125	16/02/2015	21/06/2015	22,3	15,5	84	12,905
218	127	23/02/2015	30/06/2015	23,1	1,6	74,3	12,736
219	139	02/03/2015	19/07/2015	22,9	11,8	79	12,555
220	135	09/03/2015	22/07/2015	21,6	5,7	84	12,365
221	143	16/03/2015	06/08/2015	21,2	4	83	12,17
222	142	23/03/2015	12/08/2015	22	3,1	77	11,972
223	149	30/03/2015	26/08/2015	21,8	2,6	77	11,774

224	160	06/04/2015	13/09/2015	19,8	0,4	76	11,58
225	159	13/04/2015	19/09/2015	21,4	4,1	79	11,392
226	154	20/04/2015	21/09/2015	21,2	9,6	81	11,215
227	146	27/04/2015	20/09/2015	18,8	0	74,7	11,049
228	154	04/05/2015	05/10/2015	18,2	0,5	79	10,899
229	151	11/05/2015	09/10/2015	16,8	3,4	83	10,765
230	146	18/05/2015	11/10/2015	19,2	10,3	81	10,649
231	136	25/05/2015	08/10/2015	17,8	0	85	10,553
232	140	01/06/2015	19/10/2015	17,9	3,7	80	10,479
233	134	08/06/2015	20/10/2015	20,2	2,1	68	10,425
234	129	15/06/2015	22/10/2015	16,1	1,8	81	10,394
235	126	22/06/2015	26/10/2015	16,2	0,8	73	10,385
236	124	29/06/2015	31/10/2015	16	3,6	83	10,399
237	115	06/07/2015	29/10/2015	16,7	0	86	10,435
238	112	13/07/2015	02/11/2015	20	0,7	72	10,493
239	108	20/07/2015	05/11/2015	16,8	0,1	80	10,572
240	103	27/07/2015	07/11/2015	18,2	0	56,2	10,672
241	106	03/08/2015	17/11/2015	21,7	0	47	10,792
242	107	10/08/2015	25/11/2015	21	0	55	10,929
243	100	17/08/2015	25/11/2015	19,2	0	62	11,083
244	97	24/08/2015	29/11/2015	18,8	4,2	71	11,252
245	96	01/09/2015	06/12/2015	18,5	0	73	11,432
246	97	07/09/2015	13/12/2015	17,4	17,3	85	11,621
247	86	14/09/2015	09/12/2015	23,7	0,3	59	11,816
248	101	21/09/2015	31/12/2015	25,2	3,1	52	12,014
249	105	28/09/2015	11/01/2016	20,7	4,2	82	12,212
250	105	05/10/2015	18/01/2016	21,7	3,7	75	12,407
251	97	12/10/2015	17/01/2016	22,6	0,8	69	12,595
252	91	19/10/2015	18/01/2016	22,2	0,5	72	12,773
253	89	26/10/2015	23/01/2016	21,5	8	81	12,939
254	87	02/11/2015	28/01/2016	20,2	16,2	88	13,091
255	80	09/11/2015	28/01/2016	24	15,7	76	13,226
256	73	16/11/2015	28/01/2016	22,2	3,7	80	13,343
257	73	23/11/2015	04/02/2016	21,5	19,3	84	13,44
258	68	30/11/2015	06/02/2016	21,9	3,3	80,8	13,517
259	65	07/12/2015	10/02/2016	22,4	5,6	80	13,572
260	65	14/12/2015	17/02/2016	23,5	6,9	77	13,604
261	84	21/12/2015	14/03/2016	21,1	13,6	79	13,615
262	71	28/12/2015	08/03/2016	22,2	12,8	87,7	13,603

263	74	04/01/2016	18/03/2016	23,5	3	77	13,562
264	69	11/01/2016	20/03/2016	21,8	23,3	85	13,502
265	70	18/01/2016	28/03/2016	21,5	0	71	13,421
266	69	25/01/2016	03/04/2016	23,9	4,5	77	13,32
267	95	01/02/2016	06/05/2016	24,9	2,4	71	13,199
268	88	08/02/2016	06/05/2016	24,9	0,7	70	13,06
269	90	15/02/2016	15/05/2016	24,3	11,9	79	12,905
270	100	22/02/2016	01/06/2016	22,4	8,9	85	12,736
271	123	29/02/2016	01/07/2016	21,4	5	81,6	12,555
272	131	07/03/2016	16/07/2016	23,1	2,7	77	12,365
273	143	14/03/2016	04/08/2016	22,9	3,4	76	12,17
274	136	21/03/2016	04/08/2016	22,6	4,2	80	11,972
275	142	28/03/2016	17/08/2016	24,4	0,2	72	11,774
276	145	04/04/2016	27/08/2016	25	0	66	11,58
277	150	11/04/2016	08/09/2016	25	1,6	66	11,392
278	155	18/04/2016	20/09/2016	25,1	0	64	11,215
279	161	25/04/2016	03/10/2016	16,4	3,6	57	11,049
280	164	02/05/2016	13/10/2016	18,3	0,2	72,9	10,899
281	168	09/05/2016	24/10/2016	18	1,3	83	10,765
282	158	16/05/2016	21/10/2016	17,7	12,1	87	10,649
283	147	23/05/2016	17/10/2016	15,6	5,4	83	10,553
284	147	30/05/2016	24/10/2016	17,6	14	91,4	10,479
285	142	06/06/2016	26/10/2016	12,9	9	74	10,425
286	151	13/06/2016	11/11/2016	15,5	0	71	10,394
287	142	20/06/2016	09/11/2016	14,3	0	83	10,385
288	131	27/06/2016	05/11/2016	18,3	0	64,6	10,399
289	132	04/07/2016	13/11/2016	17,4	0	61	10,435
290	135	11/07/2016	23/11/2016	19,6	1,8	60	10,493
291	125	18/07/2016	20/11/2016	13,4	0	76	10,572
292	122	25/07/2016	24/11/2016	17,7	0	68	10,672
293	118	01/08/2016	27/11/2016	19,2	0	64	10,792
294	107	08/08/2016	23/11/2016	15,9	0	69	10,929
295	112	15/08/2016	05/12/2016	19,1	7,3	73	11,083
296	110	22/08/2016	10/12/2016	17,9	0,1	62	11,252
297	115	29/08/2016	22/12/2016	18,5	6,4	77,6	11,432
298	104	05/09/2016	18/12/2016	17,1	2,8	75	11,621
299	120	12/09/2016	10/01/2017	20,9	0	55	11,816
300	122	19/09/2016	19/01/2017	17,8	0,7	70	12,014
301	114	26/09/2016	18/01/2017	17,7	0	64,1	12,212

302	121	03/10/2016	01/02/2017	17,7	5,1	73	12,407
303	111	10/10/2016	29/01/2017	21,1	8,8	76	12,595
304	113	17/10/2016	07/02/2017	23,8	1,4	70	12,773
305	109	24/10/2016	10/02/2017	19,5	2,9	76	12,939
306	106	31/10/2016	14/02/2017	20,5	5,5	76,4	13,091
307	100	07/11/2016	15/02/2017	21,7	2,1	74	13,226
308	101	14/11/2016	23/02/2017	20,2	1,6	71	13,343
309	94	21/11/2016	23/02/2017	22,9	0,9	69	13,44
310	92	28/11/2016	28/02/2017	21,4	5,3	77,1	13,517
311	97	05/12/2016	12/03/2017	22,9	11,2	76	13,572
312	91	12/12/2016	13/03/2017	21,7	0,3	76	13,604
313	91	19/12/2016	20/03/2017	23,1	4,6	72	13,615
314	92	26/12/2016	28/03/2017	24,5	7,3	72,3	13,603
315	99	02/01/2017	11/04/2017	24	1,9	74	13,562
316	93	09/01/2017	12/04/2017	23,8	6	77	13,502
317	104	16/01/2017	30/04/2017	21,4	15,7	86	13,421
318	102	23/01/2017	05/05/2017	21,9	17,8	84	13,32
319	116	30/01/2017	26/05/2017	22,6	13,4	80,4	13,199
320	117	06/02/2017	03/06/2017	24,2	1,9	72	13,06
321	129	13/02/2017	22/06/2017	25,7	1,2	66	12,905
322	127	20/02/2017	27/06/2017	23,8	3,4	72	12,736
323	141	27/02/2017	18/07/2017	23,2	3,4	81,1	12,555
324	151	06/03/2017	04/08/2017	24,5	9,5	75	12,365
325	155	13/03/2017	15/08/2017	21,8	8,1	81	12,17
326	167	20/03/2017	03/09/2017	21,3	0	72	11,972
327	176	27/03/2017	19/09/2017	19,7	0	73	11,774
328	176	03/04/2017	26/09/2017	22	8,9	76	11,58
329	176	10/04/2017	03/10/2017	21,6	0	75	11,392
330	177	17/04/2017	11/10/2017	19,2	11,8	79	11,215
331	181	24/04/2017	22/10/2017	18,5	2,7	80	11,049
332	178	01/05/2017	26/10/2017	18,6	4,2	81	10,899
333	175	08/05/2017	30/10/2017	19,2	0,5	75	10,765
334	170	15/05/2017	01/11/2017	17,7	14,5	84	10,649
335	165	22/05/2017	03/11/2017	18,6	4,7	79,6	10,553
336	161	05/06/2017	13/11/2017	18,6	12	78	10,479
337	155	12/06/2017	14/11/2017	16,4	7,6	78	10,425
338	150	19/06/2017	16/11/2017	17	0	77	10,394
339	146	26/06/2017	19/11/2017	16,9	0	71,7	10,385
340	139	03/07/2017	19/11/2017	15,1	0,1	67	10,399

341	133	10/07/2017	20/11/2017	18,5	0	61	10,435
342	135	17/07/2017	29/11/2017	15,3	0	69	10,493
343	131	24/07/2017	02/12/2017	18,7	0	56	10,572
344	124	31/07/2017	02/12/2017	16,2	0	64,5	10,672
345	134	07/08/2017	19/12/2017	19,7	0	60	10,792
346	130	14/08/2017	22/12/2017	16,1	0	87	10,929
347	123	21/08/2017	22/12/2017	17,7	5,3	70	11,083
348	116	28/08/2017	22/12/2017	19,6	0	65,1	11,252
349	122	04/09/2017	04/01/2018	22,4	0	44	11,432
350	121	11/09/2017	10/01/2018	24,7	0	41	11,621
351	123	18/09/2017	19/01/2018	22,6	0	56	11,816
352	120	25/09/2017	23/01/2018	20,2	2,7	70,4	12,014
353	115	02/10/2017	25/01/2018	20,4	13,2	68	12,212
354	111	09/10/2017	28/01/2018	24,4	7,1	65	12,407
355	105	16/10/2017	29/01/2018	21,4	1,6	71	12,595
356	101	23/10/2017	01/02/2018	19	7,7	84	12,773
357	100	30/10/2017	07/02/2018	19	26,6	80	12,939
358	95	06/11/2017	09/02/2018	20	1,7	77	13,091
359	89	13/11/2017	10/02/2018	22,6	2	63	13,226
360	85	20/11/2017	13/02/2018	21,6	7	74	13,343
361	82	27/11/2017	17/02/2018	20,9	9,4	76,3	13,44
362	75	04/12/2017	17/02/2018	23,4	0	70	13,517
363	70	11/12/2017	19/02/2018	23,8	0,7	64	13,572
364	63	18/12/2017	19/02/2018	22,2	17,1	83	13,604

Nernst equation applied to electrochemical systems and centenary of his Nobel Prize in chemistry

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Abstract

Walther Hermann Nernst received the Nobel Prize in Chemistry in 1920 for the formulation of the third law of thermodynamics, thus celebrating a century in this 2020 year. His work helped the establishment of modern physical chemistry, since he researched into fields, such as thermodynamics and electrochemistry, in which the Nernst equation is included. This paper reports on several experiments that used a Daniell galvanic cell working in different electrolyte concentrations for comparing results with the theoretical values calculated by the Nernst equation. The concentration and activity coefficients values employed for zinc sulfate and copper electrolytes showed activity can replaces concentrations in thermodynamic functions, and the results are entirely consistent with experimental data. The experimental electromotive force from standard Daniell cell, for $ZnSO_4$ and $CuSO_4$, with unitary activity and in different concentrations at room temperature is in agreement with those from theoretical calculations. Cu^{2+} ion concentrations and temperature were simultaneously varied; however, the cell potential cannot be included in calculations of Nernst equation for different temperatures than 25 °C because the standard potential value was set at 25 °C. The cell potential decreases drastically when the Cu^{2+} concentration was reduced and the temperature was above 80 °C.

Keywords: Thermodynamic; Electrochemistry; Nernst Equation; Galvanic Cell; Standard cell potential; Electrolyte Concentrations;

1. Introduction

The first electrochemical studies date from 1786 and were performed by Luigi Galvani, who observed a frog´s leg moved when a potential difference was applied to it (GALLONE, 1986; TICIANELLI, 2013; LINDEN, 1995). In 1799, Alessandro Volta developed the voltaic cell, i.e., the first

electrochemical cell comprised of two metal discs - zinc and copper - called electrodes, connected by cardboard soaked with sulfuric acid or saltwater brine as electrolyte (FABBRIZZI, 2019). Those were the first studies of storage and electrochemical energy conversion, and several others on batteries and fuel cell have been currently developed (HWANG, 2015; SOUZA, 2006; LACINA, 2018) .

In 1836, John Frederic Daniell designed a galvanic cell using two different compartments (called half-cells) where happens semi-reactions, oxidation (in anode) and reduction (in cathode). Anode and cathode are composed of two metallic plates, respectively, i.e., zinc in a zinc sulfate solution (1.0 mol L^{-1}) and copper in a copper sulfate solution (1.0 mol L^{-1}). Such two compartments are interconnected by an ionic conductor, called salt bridge (FATIBELLO-FILHO, 2019; MARTINS, 1990; MCSWINEY, 1982). A schematic representation of the Daniell galvanic cell is provided in Figure 1 and follows are the halves and overall reactions that occur in the cell.

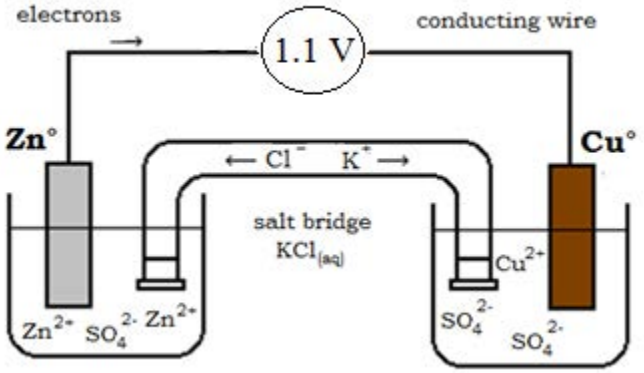

Figure 1. Schematic representation of Daniell galvanic cell.

Anodic semi-reaction	Zn°	$\rightarrow$	$Zn^{2+} + 2e^-$	E° = 0.76 V	(1)
Cathodic semi-reaction	$Cu^{2+} + 2e^-$	$\rightarrow$	Cu°	E° = 0.34 V	(2)
Global reaction	$Zn^{\circ} + Cu^{2+}$	$\rightarrow$	$Zn^{2+} + Cu^{\circ}$	E° = 1.10 V	(3)

The standard potential (E°) values are tabulated (WOLYNEC, 2003; MOORE, 1976) for the electrodes as follows: copper (couple (Cu^{2+}/Cu)) reduction = 0.34 V and zinc (couple (Zn^{2+}/Zn)) = 0.76 V, both relative to hydrogen potential at 25 °C and 1 atm pressure.

A historical analysis of the Daniell cell teaching was reported by Boulabiar et al. (2004), and a detailed discussion on the reason why it works was conducted by George F. Martins (1990). Buckbee et al.(1969) investigated the dependence of standard cell potential, E^{o}, of the Daniel cell on the temperature; they observed E^{o} decreased when the temperature increased, and designed a quadratic equation that showed E varied in function of temperature.

The cell potential depict the electrical work of the cell is able to do. The dependence of the cell potential with temperature are applied to other galvanic cells, like Li-ion batteries (WANG, 2018; ROSCHER, 2011; MA, 2018) and nickel–metal hydride battery (SOUZA, 2003, SOUZA 2006, PIEROZYNSKI, 2011) also reported by Li et al. (2015) for Na-$FeCl_2$ ZEBRA advanced Battery. Additionally, Austin et al. (2018) carried a study on the density function theory (DFT) whose accuracy enabled the obtaining of energy from a zinc/copper voltaic cell and the Daniell cell. All of this electrochemical system presents

spontaneous and exothermic reaction thus, the system heats up with working.

1.1 Thermodynamics and Electrochemical Studies: The Nernst Equation

Walther Hermann Nernst (1864 - 1941), a German chemist, worked in several knowledge areas, including physical chemistry, solid state physics, photochemistry, theory of solutions, and the link between thermodynamics and electrochemistry, which includes Nernst equation, that was developed in 1887 (TICIANELLI, 2013; FATIBELLO-FILHO, 2019; NASCIMENTO, 2019). His studies helped the establishment of modern physical chemistry, researching in theoretical and experimental fields, and the formulation of the Nernst heat theorem, known as the third law of thermodynamics. In 1920, he was awarded The Nobel Prize for Chemistry, thus celebrating a century in this 2020 year (NASCIMENTO, 2019). The Nernst equation has several applications as, it can also be used for oxidation-reduction titration, pH dependence redox couple; determination of equilibrium constants, (THOMPSON, 1999; LU, 2015; WALCZAK, 1997) among others (DANILEWICZ, 2019; RODRIGUES, 2018; NASCIMENTO 2013; SOUZA, 2018).

W.H. Nernst attended the Universities of Zurich, Berlin and Graz, where he studied Physics and Mathematics with Ludwig Boltzmann and Albert Von Ettinghausen. He later obtained his Ph.D. in Würzburg (1887), under the guidance of physicist Friedrich Kohlrausch. After working for some time in Leipzig, he held the position of professor of Physics and Chemistry at the Universities of Göttingen (1891-1905), where he founded the Institute of Chemistry, Physics and Electrochemistry (1895), and Berlin, where he was also director of the Physical-technical Institute of Physical Chemistry (1905-1925). He was appointed President of the Institute of Berlin-Charlottenburg (1922-1933), and from then on, focused on studies of acoustics and astrophysics (NASCIMENTO, 2019; VOGEL, 1979).

The equation developed by W.H. Nernst relates the electromotive force of an electrochemical cell (electrode potential) to the solution concentrations and temperature. In brief, the electrochemical cell potential is determined by cathodic and anodic electrodes, in which happens each reduction semi reaction and oxidation semi reaction as shown in equations 1 and 2, and on the global electrochemical reaction, as showed in equation 3. The electrochemical reactions are carried out often at constant pressure and temperature, and the maximum electrical work (We) is the same of the Gibbs free energy change (ΔG), $We,max = \Delta G$, for reversible transformation. The ΔG of any reaction and standard free energy change, ΔG°, is given by the following relationship:

$$\Delta G = \Delta G^\circ + RT\ln Q \quad (4)$$

where Q is the law of mass action of a reaction. For a redox reaction, additionally, the galvanic cell requests a spontaneous global electrochemical reaction, thus, from thermodynamic the variation of Gibbs (ΔG) is negative for a positive cell potential as descripted by equation 5:

$$\Delta G = -nFE \quad ; \quad G^\circ = -nFE^\circ \quad (5)$$

where: E° is the standard cell potential and E is the cell potential for an electrochemical system; F is the Faraday constant, F = 96485 C mol^{-1}; and n is an amount in mol of electrons transferred.

The combination of the two equations (4) and (5) gives

$$-nFE = -nFE° + RT\ lnQ \quad (6)$$

This equation can be rearranged, so that the Nernst (7) is obtained:

$$E = E° - \left(\frac{RT}{nF}\right) \ln Q \quad (7)$$

where: R = 8.314 J mol^{-1} K^{-1} is the universal gas constant; F is the Faraday constant, F = 96485 C mol^{-1}; n is an amount in mol of electrons transferred; T is the absolute Kelvin scale temperature (T = 298.15 K); and Q is the reaction quotient.

The Nernst equation, is the quantitative relationship that enables the calculation of the cell potential, E, in different ion concentrations of a unit; therefore, the cell potential can be easily calculated by Nernst equation and applied to Daniell galvanic cell at 25 ºC, furthermore, at the standard conditions, i.e, ions unitary concentration, the Daniell cell potential is E=E°, because the second thermo of Nernst equation become zero. Moreover, thermodynamics functions can be accessed from electrochemical experiments also (MOORE, 1976; RODRIGUES, 2018; VOGEL, 1979) as will be shown follows.

1.2 Entropy and enthalpy of cell reactions

The application of the Gibbs-Helmholtz equation to equation (5) enables the calculation of the enthalpy change (ΔH) and the entropy change (ΔS) of the cell reaction from the temperature coefficient of the reversible electromotive force. In equation (8), the Gibbs free energy change is equal to the heat reaction corrected for the amount of energy (it cannot be converted to work) (COFEY, 2006).

$$\Delta G = \Delta H - T\Delta S \quad (8)$$

where TΔS denotes the heat amount that can be generated in a reversible process.

At constant pressure and according to the preferred representation of Nernst and van't Hoff, equation 8 becomes:

$$\Delta S = -\left(\frac{\partial \Delta G}{\partial T}\right)_P = zF\left(\frac{\partial E}{\partial T}\right)_P \quad (9)$$

$$\Delta H = \Delta G + T\Delta S \quad (10)$$

$$\Delta H = -|z|FE + |z|FT\left(\frac{\partial E}{\partial T}\right)_P \quad (11)$$

$$\Delta G = \Delta H + T\left(\frac{\partial \Delta G}{\partial T}\right)_P \quad (12)$$

which is the Gibbs-Helmholtz equation. ΔH can be calculated if ΔG is known for all temperatures; however, the reverse is not possible, since it involves an arbitrary integration constant (COFFEY). This technical fact was at the core of the problems faced in the development of the third law of thermodynamics.

Since 1888, scientists have attempted to integrate the differential form of equation (8). Le Chatelier,

Lewis, Theodore Richards, van't Hoff, Fritz Haber, and Nernst (1906), in this chronological order. They aimed to obtain absolute values for the entropy, for the determination of free energy change from thermometric measurements.

T. Richards conducted some reactions in a dilute aqueous solution, such as

$$Zn + CuSO_4 \quad ZnSO_4 + Cu \tag{13}$$

in which the exchange of sulfate ion between metals did not refer to temperatures below the water freezing point. Figure 2 shows energy vs. temperature graphs based on Richard´s diagram for metal pairs Zn-Cu, Fe-Cu, and Zn-Fe. The points below 0 °C (273.15 K) were obtained by thermodynamic relations, and above 0 °C, free energies and heats of reaction were measured galvanically and calorimetrically, respectively (COFFEY, 2006).

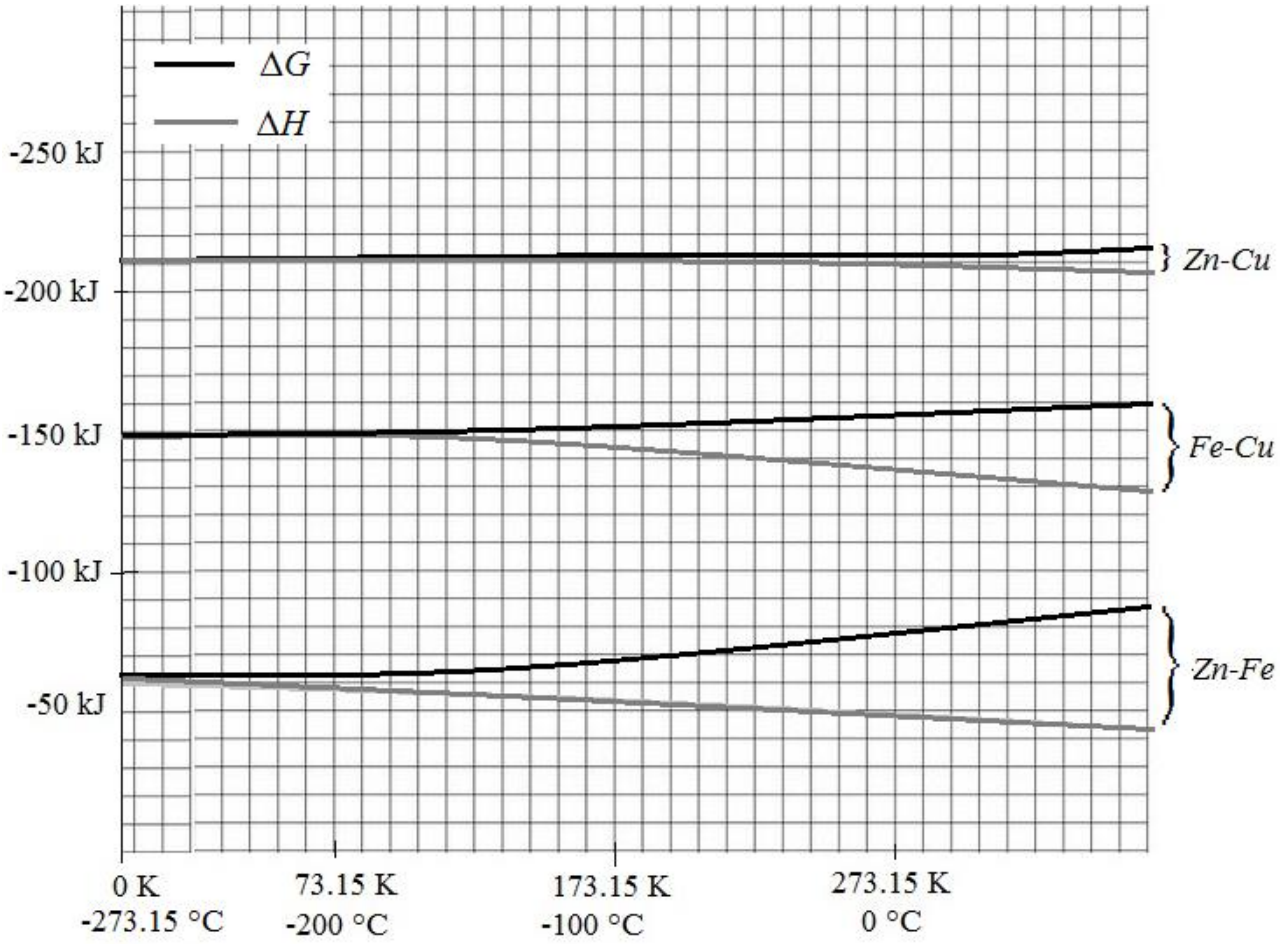

Figure 2 Gibbs free energy (black line – ΔG) and enthalpy (gray line – ΔH) as a function of temperature.

According to the diagram in Figure 2, at 25 ° C for metallic pair Zn/Cu (reactions in equations 1-3), the value of ΔG is slightly higher than –210 kJ, and can be compared with that calculated by equation 5 (ΔG° = -2 x 96485 x 1.1), thus resulting in ΔG = –212.3 kJ mol-1.

Figure 2 shows diagrams with behaviors very similar to those obtained by Richard for some metal pairs. Such behaviors are interesting when ΔG and ΔH are equal in extrapolations to zero Kelvin (absolute zero). W.H. Nernst built a diagram showing the two curves are together when T→0, which agrees with condition ΔG = ΔH at absolute zero. Lewis then constructed a diagram general pattern in Richards' data.

Lewis had deep knowledge of physics, mathematics, and especially thermodynamics, and had read Gibbs and knew what European scientists had been studying and developing in thermodynamics (COFFEY, 2006). Such a way of measuring free energies also has limited applications. Therefore, Lewis wrote: "*Of all the chemical reactions which we meet in our thermodynamic calculations, comparatively few may be studied by the simple measurement of [voltage]. This is due to the difficulty of finding a galvanic cell in which a given reaction occurs, and occurs with such ease as to permit an approach to complete reversibility*" (COFFEY, 2006).

This study investigates the experimental behavior of Daniel's galvanic cell for measurements of the cell potential (or electromotive force) in different concentrations of electrolytes and compares Nernst equation calculations at room temperature, considering the electrolyte concentrations and molar ions activity. Experiments conducted at different temperatures in Daniel's galvanic cell analyzed the dependence on the ions concentration of electrolytes and temperature, although the thermodynamic parameters of the reactions cannot be determined by simple voltage measurements for further theoretical calculations by the Nernst equation.

Additionally, some simple experiments with Daniell cell may be able to demonstrate different chemical concepts such as electrolyte conductivity, electrolyte dissociation, Kohlrausch law, preparation of the Daniell cell preparation, and electromotive force measurements and when the Nernst equation can be applied to galvanic cells. This paper features the Daniel cell working at different electrolytes concentrations and temperatures, the expected cell potential of these conditions were calculated by Nernst equation and a comparison between experimental and theoretical results are shown.

2. Experimental

The Daniell galvanic cell, used in all electrochemical experiments, is basically constituted by two electrodes and two beakers, electrolytic solutions and one salt bridge, cables and one multimeter (Minipa ET-1002).

The electrodes consist of high purity metal sheets (99.9%) zinc (Zn°) and copper (Cu°). Both metal sheets presents 4x25x80 mm (thickness x width x length), totaling a $4.8x10^{-3}$ m^2 surface area. The electrolytes solution were prepared with distilled water (Quimis, Q341) and $ZnSO_4$ (>99.5%, Dinâmica) and $CuSO_4$ (>99.5%, Nox Lab Solutions). The Agar-Agar KCl saturated salt bridge in U-shaped tubes was prepared also.

2.1 Daniel cell preparation

Previous each any measurement the electrodes were cleaned with sandpaper (Norton 320, Agua T223) afterward it was immersed in HCl solution toward removes surface oxides. The electrode were cleaned with paper tower and immediately inserted in electrolyte.

50 mL of each electrolyte solution was transferred to beakers, the electrodes were connected to a multimeter and the salt bridge was inserted to connect the electrolytes.

2.2 Daniel cell potential measurements

The electrodes were immersed in electrolytes, with $3.2x10^{-3}$ m^2, the piece out of electrolyte are non-electrochemical active and has no influences in electrochemical data. The salt bridge and the multimeter were connected and the cell was registered after stable value. The solutions were replaced and the electrodes were cleaned before new potential registration.

For cell potential at different temperatures (25, 40, 60, 75 and 80 ° C), the electrochemical system was inserted into a water thermal bath heated by a heating plate with a controller (Fisaton 752A) and whose temperature was measured by a thermometer. The open circuit potential was measured at different temperatures, waiting 10 min for galvanic cell to reach thermal equilibrium.

3. Results and Discussion

3.1 Experimental cell potential and Nernst equation applied as a function of Cu2+ and Zn2+ concentrations and activity for zinc sulfate and copper electrolytes

Figure 3 shows cell potential measured experimentally (EM) and cell potential calculated (EC) by Nernst equation, at room temperature, i.e. 25ºC (298.15 K), for different Cu^{2+} concentrations and fixed 1.0 mol L^{-1} Zn^{2+} concentration.

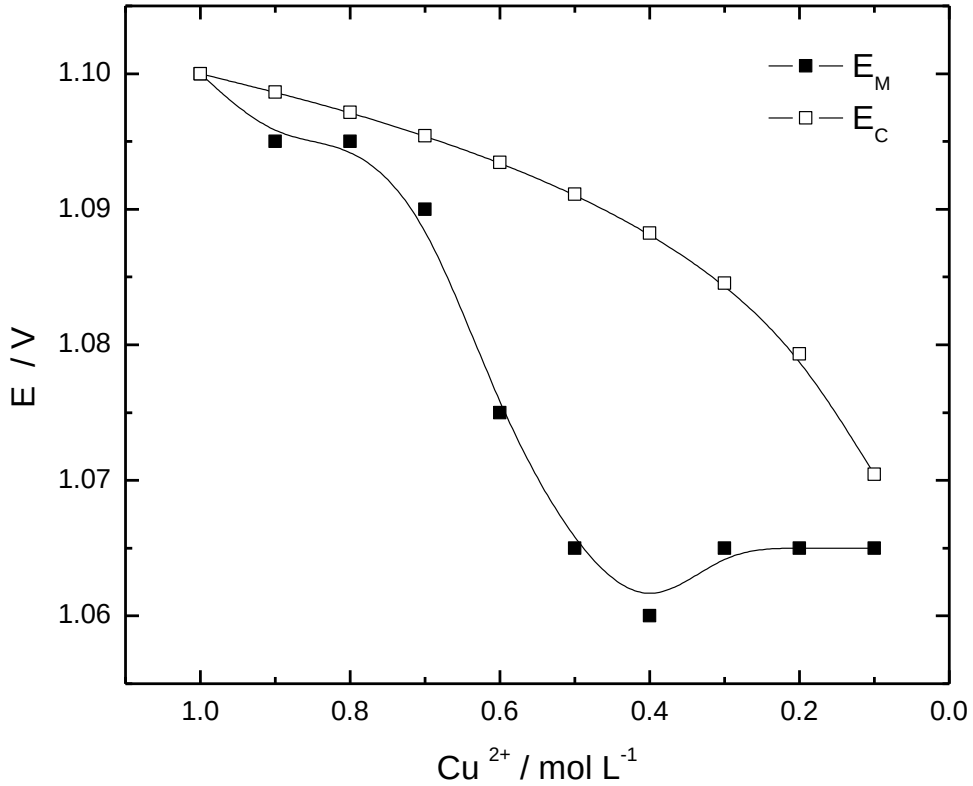

Figure 3. Cell potential calculated (EC) by Nernst equation and measured experimentally (EM) for Daniell cell in different Cu^{2+} concentrations. Zn^{2+} concentration fixed in 1.0 mol L^{-1}. T = 25 ºC.

As knew the cell potential of the cell is a contribution of both electrodes, if one electrode has low activity, the cell shown low performance. The Figure 3 shows discrepancies between theoretical (calculated by Nernst equation) and experimental Daniell cell with different Cu^{2+} ions concentrations. The Nernst equation can be applied at different Cu^{2+} ions concentrations for theoretical calculations of cell potential

at 25ºC. Moreover, the operation mechanism of Daniell cell is Zn oxidation and Cu reduction, as shown by the reactions in equations (1-3). Thus the Zn° from electrode became Zn^{2+} in electrolyte at anode and at cathode the Cu^{2+} from electrolyte became Cu°. The experimental results in Figure 3 show the cell potential measured different from theoretical. It is expected the experimental cell potential is lower than theoretical and this differences can be assigned to experimental random error instead of the accuracy toward minimize then. The salt bridge saturated in KCl was used to minimize the junction potential, measurement was carried out after cell potential stabilization and triplicate measure were registered, the cell potential drifted 2 mV among the each experiments.

Additionally, the $CuSO_4$ concentration at room temperature showed little changed to smaller values when $Cu^{2+} \leq 0.7$. Such changes can be assigned to others physical-chemistry properties as ion diffusion from bulk to interface electrode/electrolyte; the electrolyte dissociation, and the electrode polarization by mass transfer. According to the Nernst equation, the cell potential behavior is weakly dependent on Cu^{2+} concentration electrolyte in all range calculated because it is an Neperian logarithm mathematical equation, but it do not become the Nernst Equation wrong, the values are close to the Nernst model. Furthermore, at standard conditions i.e. both ions in electrolyte is unitary, e.g. 1.0 mol L^{-1} of Zn^{2+} and 1.0 mol L^{-1} of Cu^{2+}, or at nonstandard but the second member of eq. 7 become zero, i.e 0.1 mol L^{-1} Zn^{2+} and 0.1 mol L^{-1} Cu^{2+}, the calculated and measured cell potential convert to same value when second member of Nernst equation become zero and the large discrepancies on cell potential measured and calculated were observed between $0.7 < [Cu^{2+}] < 0.3$ (CIRIBELLI, 2018).

3.2 Experimental cell potential as a function of Zn^{2+} and Cu^{2+} concentrations and theoretical results of the Nernst equation (ion concentrations and activity for electrolytes)

According to the law of mass action, the concentration of chemical species is used as variables; therefore the equilibrium constant is independent of such concentrations(MOORE, 1976; NASCIMENTO, 2019). Subsequent studies have shown such a concept is only approximately valid for diluted solutions (the greater the dilution, the greater the approximation of the results) and can be incorrect for more concentrated solutions. Similar discrepancies are large when other thermodynamic quantities, such as electrode potential and free chemical energy are involved. To overcome these difficulties and still retain simple derivative expressions for such quantities, G.N. Lewis introduced a new thermodynamic concept, called activity, which, replacing concentrations in thermodynamic functions, offers results that are perfectly consistent with experimental data. The dimension of this greatness is the same of that of concentration. The activity of a component A ,(a_A), is proportional to its effective concentration [A], and can be expressed by:

$$a_A = f_A.[A] \quad (15)$$

where f_A is activity coefficient, dimensionless quantity, which varies according to the concentration. Table 1 shows the activity coefficients for zinc sulfate and copper electrolytes (MOORE, 1976; VOGEL, 2006) at different concentrations.

Table 1. Molar activity coefficients (f_A) for zinc sulfate and copper sulfate electrolytes (VOGEL, 2006)31.

Molar Concentration (C)	0.001	0.01	0.05	0.1	0.2	0.5	1.0	2.0
$CuSO_4$	0.74	0.41	0.21	0.16	0.11	0.07	0.05	-
$ZnSO_4$	0.70	0.39	-	0.15	0.11	0.07	0.05	0.04

Additional calculation of the cell potential were theoretically calculated at 25 °C for the galvanic cells using the activity and the concentration of the electrolytes and a comparison are shown in Table 2. The comparison among activity and concentration were calculated with the cells:

$Zn/ZnSO_4(1.0M)||CuSO_4(1.0M)|Cu$ $Zn/ZnSO_4(0.1M)||CuSO_4(1.0M)|Cu$

$Zn/ZnSO_4(1.0M)||CuSO_4(0.1M)|Cu$ $Zn/ZnSO_4(0.1M)||CuSO_4(0.1M)|Cu$

The Nernst´s equation becomes:

$$E = E° - \frac{RT}{2F} \ln \frac{a_{(ZnSO_4)}.a_{(Cu)}}{a_{(CuSO_4)}.a_{(Zn)}} \quad (16)$$

Table 2 shows the potential cells at four combinations of concentrations of Zn^{2+} and Cu^{2+} obtained experimentally and calculated by the Nernst equation (theoretical) with concentrations and activity for zinc and copper ions.

Table 2 – Experimental potential cells (E) and calculates by Nernst Equation applying molar ion concentrations (equation 14) and activity (equations 15 and 16) for zinc and copper sulfates electrolytes, at 298.15K.

E (V) – Experimental							
Zn^{2+} 1.0 mol L^{-1} Cu^{2+} 1.0 mol L^{-1}		Zn^{2+} 0.1 mol L^{-1} Cu^{2+} 1.0 mol L^{-1}		Zn^{2+} 1.0 mol L^{-1} Cu^{2+} 0.1 mol L^{-1}		Zn^{2+} 0.1 mol L^{-1} Cu^{2+} 0.1 mol L^{-1}	
1.095		1.095		1.065		1.085	
E (V) – Theoretical							
$a_{Zn} = f_{Zn}.[Zn^{2+}]=0.05$ $a_{Cu} = f_{Cu}.[Cu^{2+}]=0.05$		$a_{Zn} = f_{Zn}.[Zn^{2+}]= 0.015$ $a_{Cu} = f_{Cu}.[Cu^{2+}]= 0.160$		$a_{Zn} = f_{Zn}.[Zn^{2+}]= 0.150$ $a_{Cu} = f_{Cu}.[Cu^{2+}]= 0.016$		$a_{Zn} = f_{Zn}.[Zn^{2+}]= 0.015$ $a_{Cu} = f_{Cu}.[Cu^{2+}]= 0.016$	
Nernst [C]	Nernst *a*	Nernst [C]	Nernst *a*	Nernst [C]	Nernst *a*	Nernst [C]	Nernst *a*
1.100	1.100	1.130	1.130	1.070	1.071	1.100	1.100

The data presented in Table 2 shows close values of cell potential calculated with Nernst equation using concentration or activity of the electrolytes, the values shift only after four decimal places (data not shown here).

3.3Cell potential as a function of cell temperature and Zn^{2+} and Cu^{2+} concentrations

Additional investigations of cell potentials were carried out at different temperatures in different $CuSO_4$ concentrations (fixed $ZnSO_4$ concentration), and at different temperatures and in different $CuSO_4$ and

$ZnSO_4$ concentrations. Figure 4 shows the variation of the cell potential obtained in electrochemical experiments as a function of temperature for the same $CuSO_4$ and $ZnSO_4$ concentrations and $CuSO_4$ concentration lower than those of $CuSO_4$ and $ZnSO_4$.

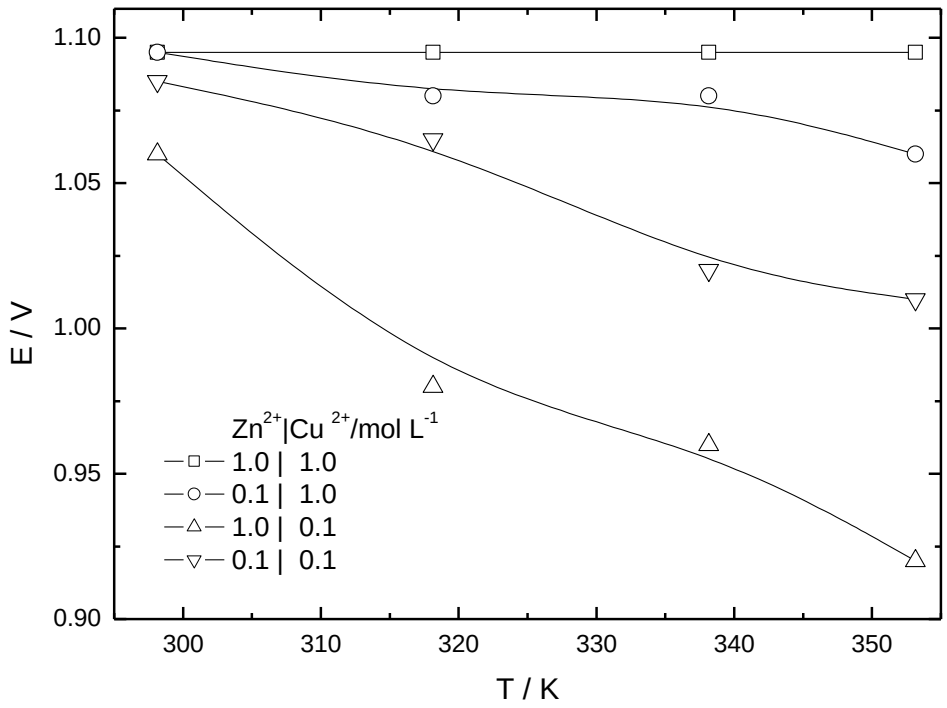

Figure 4. Cell potential obtained experimentally as a function of temperature increase and with variation in Zn^{2+} and Cu^{+2} concentrations.

The cell potential decreased with increases in the temperature for concentrations different from unity. An important concept shown here and often wrongly used is the use of Nernst equation at temperature different from 25 ºC. It is not possible to include in the Nernst equation calculates because the value of the standard potential (E°) that appears in this equation is valid only at 25 °C; for application of the Nernst equation at temperatures different from 25 ºC, the standard cell potential must be determined (MOORE, 1976) as discussed by Whittemore and Langmuir (1972) on standard electrode potential from 5 to 35 ºC using the Fe^{3+}/Fe^{2+}. Bratsch (1989) presented several standard electrode potential and temperature coefficients. At the same way, Letowsky et al. (1981) showed the $Pb/PbSO_4/H_2SO_4$ cell potential at 240 ºC.

Instead the Nernst equation cannot be directly applied to different temperatures Daniel cell, a qualitative discussion can be done. It was observed from Figure 4, the cell potential is almost independent from temperature when the electrolyte concentrations is high i.e. both are 1 mol L^{-1}. As discussed previews and showed by Buckbee et al. (1969), the standard cell potential decreases with cell temperature increases. Thus, qualitatively the second thermo of Nernst equation increases with temperature at the same intensity of the standard cell potential decreases, for high ion concentration in both electrolytes.

The reduction of the Zn^{2+} concentration has low influences in the cell potential, when the temperature increases, the cell potential present low decreases in comparison with standard cell potential. On the other hand, when the Cu^{2+} concentration is low, the cell potential decreases drastically in comparison with

standard cell potential. The interesting data is low concentration of both electrolytes; of cell potential do not decreases drastically and is not independent from temperature as standard cell potential.

Figure 5 shows the cell potential to the Daniell cell at different temperatures as a function of only Cu^{2+} concentration.

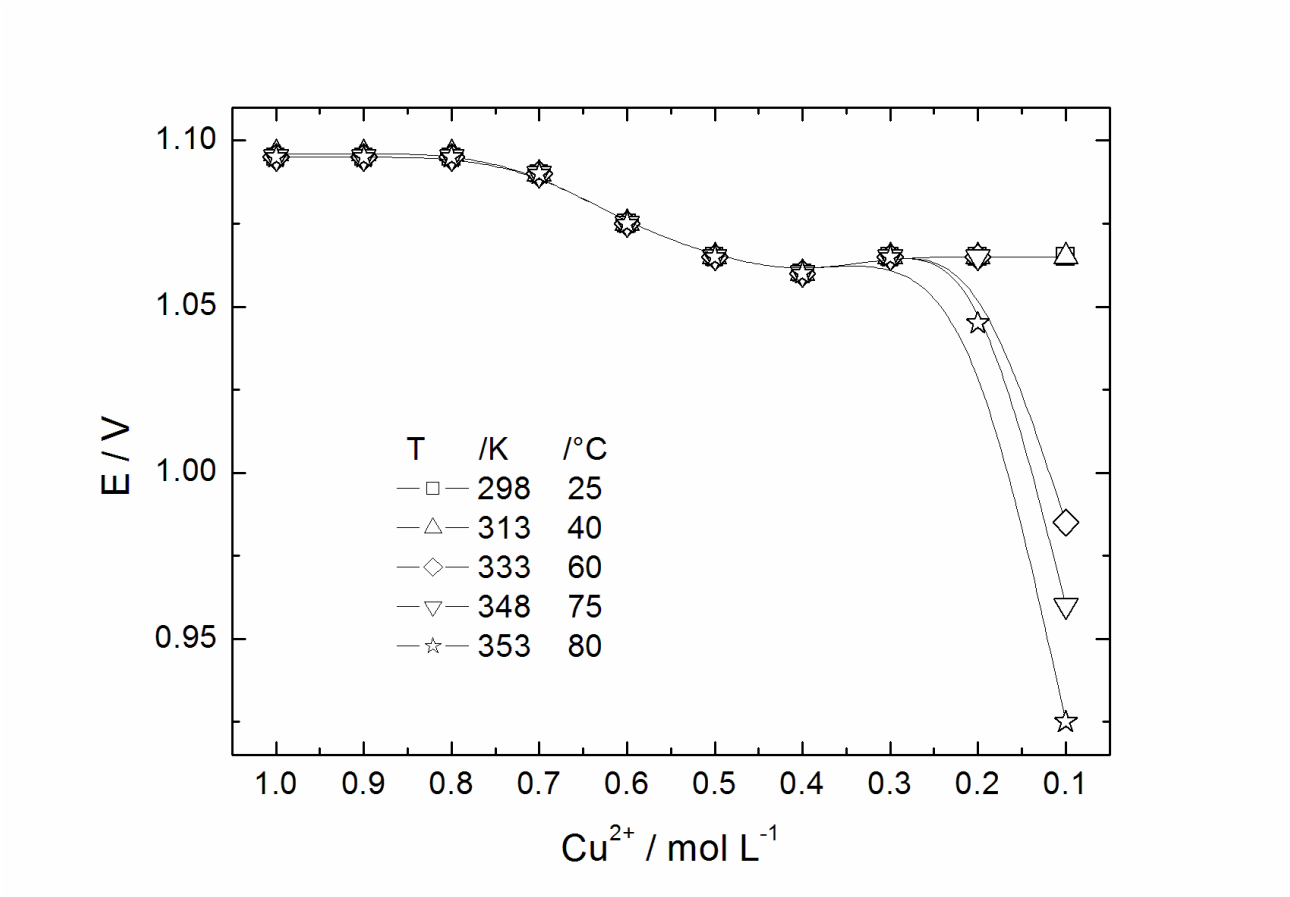

Figure 5. Potential vs. concentration of Cu^{2+} as a function of temperature. $[Zn^{2+}] = 1.0$ mol L^{-1}.

According to Figure 5, the cell potential shows three well-marked regions of concentration relative for all temperatures. The first, from 1.0 to 0.8 mol L^{-1}, shows no variation in the cell potential, regardless of temperature. The second, from 0.8 to 0.4 mol L^{-1}, shows an approximately 4% decrease in the cell potential with a $CuSO_4$ concentration decrease, all independent from cell temperature. Finally, the third region comprises a Cu^{2+} concentration lower than 0.4 mol L^{-1}, where the cell potential drastically mainly for high temperatures.

As discussed from Figure 4, the Daniel cell potential is more sensitive to Cu^{2+} when the temperature of the cell increases; Figure 5 suggest this cell potential susceptibility is main at lower than Cu^{2+} concentration. Such a different behavior can be assigned to $CuSO_4$ dissociation. $CuSO_4$ is a moderate electrolyte, i.e., it is not completely dissociated at high concentrations, and the dissociation increases when get infinitive solubility as Kohlrausch law.

4. Conclusions

The cell potential obtained experimentally for electrolyte solutions of Zn^{2+} and Cu^{2+} investigated at

different concentrations at room temperature are in agreement with those calculated by the Nernst equation (theoretical). Moreover, the calculation of cell potential with using concentrations and the activities of the Zn^{2+} and Cu^{2+} ions in the Nernst equation result close values in all the investigated concentration ranges.

Experimental results showed decrease the cell potential, especially when [Cu^{2+}] is below 0.2 mol L^{-1}. For temperatures above 25 ºC the Daniel cell potential is more susceptibility to Cu^{2+} concentration.

The study of electromotive force of batteries also led Nernst, this renowned scientist, a century ago (1920-2020) to the discovery of the third law of thermodynamics, thus earning, the Nobel Prize in Chemistry.

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Science and Technology Park Management Implanted in the Missions Region (RS), a regional vision of scientific and technological development.

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Abstract

Innovation and technology, which are part of the debate in the knowledge society, are linked to the creation of a prosperous environment that benefits them, the result of multiple and coordinated action of three factors: government, productive structure and technological and scientific infrastructure. The investigation starts from the following question: What is the best methodology for managing the structures known as Science and Technology Parks? The objective of the research is to develop a management model for the Scientific and Technological Park of the Missions Region in order to optimize its economic and financial self-sufficiency so that it does not depend exclusively on resources from the University or from public notices. In methodological terms, the research is a qualitative one, of an applied nature since its results will be used in practice to solve a specific problem. As preliminary results, a self-sustainable management model for the Scientific and Technological Park of the Missions is presented, considering its specificities and peculiarities. This model was developed from the investigation of the main methodologies used in PCTs in different regions of the world and in Brazil, with the purpose of indicating the most appropriate strategies for the implantation of PCTs in a farming region, as well as, identifying the regional base actors technology to understand the operation of the Triple Helix.

Keywords: Innovation Environments; Management model; Scientific and Technological Park; Triple Helix.

1. Introduction

The theme of innovation and technology has been a recurring issue over the years, both in the debate of theoreticians and researchers in the area of knowledge, and in the public sphere as well as among civil society itself, who share the idea of creating prosperous environments, capable of providing innovation and technology transfer. Such environments result from the multiple and coordinated action of three factors: government, productive structure and technological and scientific infrastructure, called Science and Technology Parks: innovation environments that integrate the three elements, and have their contribution to the scientific and technological development of the region in which they are implemented.

The literature presents discussions about Science and Technology Parks over time, such as the article (ROBLEK et. Al, 2013) that studies the participation of STPs in the creation and development of knowledge-based organizations, associated with centers of technological excellence, especially universities and the impacts of employee turnover on the management of activities and performance in STP member organizations in Slovenia. Another study analyzes elements of added value to new technology-based firms

(NTBCs), identifying differences between companies that operate inside and outside Science Parks in Sweden (LÖFSTEN; LINDELÖF, 2002).

In the most populous country in the world the success of technology parks was already studied in 2006, more specifically, the Zhongguancun Technology Park in Beijing, as it was understood that promoting technology transfer and attracting highly innovative groups of companies was essential for regional development, which motivated countries around the world to try to promote regional development through STPs (TAN, 2006).

In this way, the study is justified by the relevance and contribution that STPs of a regional nature have in adding value to organizations, society and regional development. In the specific case of the study, the Scientific and Technological Park of the Missões region aims to provide diversification and added value in the region's production matrix, in joint work with the Regional Development Council - COREDE Missões, Municipal Development Councils - COMUDES , class entities, businessmen, politicians, regional coordinators, educational institutions, among others.

According to Aswegen & Retief (2020), the main agent of economic change in a community is the knowledge transfer, which will generate technological development, so innovation becomes a factor of transformation by reducing the time to use knowledge to unorthodoxly generate economic and social development in a region, starting to pinpoint the best minds, produced in the region so that they are the transforming agent of local values.

The regional capacity to create science and transform it into technological innovation, is associated with some regional actors such as universities, companies and government, forming the Triple Helix (MÄENPÄÄ & VIRKKALA, 2020).

Thus, the main objective of the study is to develop a Management Model for the Missions STP, in order to optimize its economic and financial self-sufficiency so that it does not depend exclusively on resources from the University or public notices. It is also intended that the built model is adaptable to the reality of other regions and other STPs, to generate research and development of new products, services and processes.

In view of this contextualization, the understanding that the Scientific and Technological Parks (STPs) are inserted as instruments and inducers of sustainable and innovative development is established. In this sense, the research question in this study is: What is the best methodology for managing the structures known as Science and Technology Parks?

The main objective of the research is to develop a management model for the Scientific and Technological Park of the Missions Region as to optimize its economic and financial self-sufficiency so that it does not depend exclusively on resources from the University or from public notices. Thus, when developing a management model for the Missions STP, it is intended that the model can be used by other STPs in Brazil, in view of their adaptation to the reality of each region, generating research for the development of new processes, products and services.

Understanding the new management methodologies developed for regional STPs that converge so that these organizations support the advances in science, technology and innovation, is of fundamental importance. In this attempt, ANPROTEC (National Association of Entities Promoting Innovative Enterprises) spared no efforts in its actions, presenting an unprecedented survey of technological parks in

Brazil, evidencing growth since the 1990s. According to collected data (BRASIL, 2019), technology park initiatives have multiplied in Brazil, over time, from 10 in the year 2000 to 103 in 2017, 37 of which are in the design phase, 23 are in the implementation phase and 43 in operation phase. It is worth highlighting the South and Southeast regions, with greater concentration.

In view of the perspectives of the Brazilian government at its different scales, the implementation of public policies, such as the Sectorial Funds, the Law on Informatics, the Law on Innovation, the Law on Good and tax incentives, stands out. Associated with these policies, mechanisms for transforming knowledge into goods and services are encouraged and supported, such as Incubators, Local Productive Arrangements, Technological Modernization Poles and Science and Technology Parks, considered innovation environments or innovation habitats.

In Rio Grande do Sul, the state government has encouraged such enterprises through the Secretariat for Economic Development, Science and Technology (SDECT), promoting Higher Education Institutions, through agreements and resources from the International Bank for Reconstruction and Development (IBRD) and the National Bank for Economic and Social Development (BNDES) to implement and strengthen innovation environments.

Regarding the Scientific and Technological Parks and according to data from SDECT / RS, more than 20 (twenty) projects have already been registered, of which 12 (twelve) are already accredited, with 03 (three) of those already consolidated, 03 (three) in the consolidation phase and 06 (six) with their works started and in the implementation process (SDECT, 2017).

But how to manage the different regional factors that influence the management of STPs, given that the structures of science and technology are different in different regions and countries, influencing regional actors?

The methodological aspects defined in this part were intended to guide the research's constructive process, from the initial stage of elaboration to its execution. It is based on the formulations and typologies proposed by Silva and Menezes (2005); Vergara (2014) and Gil (2010). In practice, the steps followed were: a) to investigate the main methodologies used in STPs from Brazil and various regions of the world, with the purpose of pointing out the most appropriate strategies for implementing PCT in an agricultural region; b) to identify regional technology-based actors to understand the operation of the Triple Helix; c) to map the management processes used especially in STPs administered by IES Comunitária do RS (RS state community HEI) , in order to assist in the construction of the management model and, d) to elaborate the Management Model for the Scientific and Technological Park of Missões.

The study is structured in five parts: In the first part, it refers to the introduction that discusses the research problem, objectives, the justification and relevance of the study. The second part presents the theoretical framework that supported the construction of the management model. In the third part, the methodological aspects used to achieve the proposed objectives are exposed. The fourth part presents TecnoURI Missões and the management model developed, the result of the main objective of this study. Finally, the final considerations of the referred study are aligned.

2. Knowledge, Innovation and Technology

For quite some time there has been talk of a knowledge society (DRUCKER, 2001, p. 38). This society is strongly influenced by knowledge and should not be treated as a simple factor of production of the new era, as land, labor and capital were previously considered, but rather, as the only resource, "which makes this unique new society "(NONAKA; TAKEUCHI, 1997, p. 32).

Modernly, it can be said that inter-university cooperation is a source of economic growth and competitiveness in all knowledge societies, that refers to the understanding of the university as fundamental in this current system of transition and development of information, which ends up generating the current knowledge society (TETREVOVA & VLCKOVA, 2020)

According to the Oslo Manual, OECD (2005, p. 28), knowledge-based economy "is an expression coined to describe trends in advanced economies towards greater dependence on knowledge, information and high levels of specialization, and the growing need for prompt access to these factors by the private and public sectors.

Innovation is the use of knowledge in an applied way. According to OECD (2005, p. 31), it is considered a "technological innovation of product or process if it has been implemented, that is, if it has been introduced in the market (product innovation) or used in the production process (innovation process) ". In this sense, Giugliani (2012, p. 40) defines innovation as "a process by which companies dominate and implement the development and production of goods and services, which are new to them, regardless of the fact that they are new to their competitors – national or international".

Sabato and Botana (2011), develop a triangle in which three types of relationships are pointed out that can be articulated by Latin American societies enabling them to stop being dependent on the acquisition of patents and royalty payments, to also become producers of technical and scientific knowledge within the complex world economy. In this model, innovation is used as a substitute for the import substitution model. As agents of these relations, Sabato and Botana (2011) understand that the government is the apex element of the triangle and in the other two vertices, on the one hand, the entire productive structure, and on the other, the scientific-technological infrastructure. According to him, the combination of the efforts of these agents, catalysts of the economy, would be the basis of a new way of seeing and thinking about regional development, creating a structure that would be favorable to the emergence of new technologies and, consequently, of new products that could insert Latin American countries in the world technology circuit.

3. Management Models for STPs

Every organization demands a management model that is complete, perfect for the company to be effective and successful in its trajectory, however, it is important to emphasize that it is the people within the organization that keep the wheels turning. In this line of thought, the organization's culture can design or outline the management model. According to Deal and Kennedy (1983, p.501), culture within the organization "is the way we do things around here". Thus, this definition in practice determines how to understand culture from the observation of how things are done. Thus, success or failure may not depend exclusively on the Management Model.

According to Catelli (1997), the greatest influencers of the organizational culture are the founders and the

main leaders of the company. As definers of the management model, because they are in power, these people will influence, through their own way of making things happen.

In the words of Fleury (1987, p.10), "culture, conceived as a set of values and beliefs shared by the members of an organization, must be consistent with other organizational variables such as structure, technology and leadership style". Thus, there are countless factors for an organization to achieve success. Within this concept of organizational culture, aligned with the other concepts presented in this phase, the Triple Helix or Quadruple Helix model is fundamental to enable the exchange of experience among the helices based on the managers' predisposition and, thus, this relationship strengthens and the innovation environment is effective.

Catelli (1997, p. 49) approaches in his theory that "the management model is the set of rules and principles that should guide managers in choosing the best alternatives to lead the company to fulfill its mission effectively".

The success of the first North American experiments contributed decisively to the evolution and construction of the concept of technology parks as well as to the development of emulation experiences in Europe, with emphasis on the implantation of the French and British pioneer parks, in the early 1970s (SCHMITZ; HUPHREY, 2000).

4. Methodological aspects

Regarding the classification of the research, the typology proposed by Vergara (2014) is used, classifying it as for its purposes, in Applied and Descriptive research and, as for the means, in Case Study and Bibliographic research.

Thus, the research was applied in the Missions PCT, as it sought to solve a specific and practical problem, that is, to develop a management model appropriate to its reality and capable of consolidating it into a self-sustainable park. Still, the research was descriptive because, according to Silva and Menezes (2005, p. 20), "descriptive research requires an inductive analysis where the main focus of the approach is the process and its meaning". Describing, therefore, the management methodologies used by science and technology parks in Brazil and the world.

As for the means, the research was outlined in a case study and bibliography. It is a case study, as according to Gil (2010), such a research can be qualified when there is an in-depth and detailed study about a certain unit. In these terms, it was configured in a case study for carrying out a detailed study on STP TecnoURI Missões in order to elaborate a management model applied to its reality. It is bibliographic, because it is based on published works, books, theses, scientific journals, among others. Gil (2010) mentions that bibliographic research is the first step for any scientific research. As for the nature and treatment of the data, the research is qualitative. In the interpretation of Silva and Menezes (2005, p. 20), “the phenomena and the attribution of meanings are basic in the qualitative research process. It does not require the use of statistical methods and techniques. The natural environment is the direct source for data collection and the researcher is the key instrument”.

Data collection took place through bibliographic, documentary research and on-site observation. **Bibliographic:** based on books, articles and essays already published in periodicals, specialized magazines,

websites, newspapers, among other sources. **Documentary:** in STPs regulations and statutes, in Laws, Decrees. **On-site observation:** throughout the research, visits were made to the STPs of Community Institutions of Higher Education (ICES) such as PUC / RS, FEEVALE, UPF, UNISC and UNIVATES, in which the researcher used direct observation to better understand the management process of these innovation environments.

5. Characterization of the Missões region – STP Missões' performance stage

The Missões Region, inserted in the process of this study, is composed of more than 25 municipalities and is located in the Northwest of the State of Rio Grande do Sul. This region borders the Republic of Argentina, and is located between the following geographical coordinates central: 28 ° 18 '1' 'South Latitude and 54 ° 15' 49 " West Longitude. The total area of the Missões Region corresponds to 4.6% of the territory of the State of Rio Grande do Sul. Its altitudes vary from 0 to 360 m distributed predominantly in the geomorphological unit of the Southern Plateau. Its Municipalities are inserted in the Hydrographic Basin of the Uruguay River and belong to the Pampa and Mata Atlântica biomes (COREDE MISSÕES, 2010). This micro-region of the State, composes COREDE Missões (Regional Council for the Development of Missions), linked to SEPLAG / RS (Secretariat of Planning and Management of Rio Grande do Sul), comprising twenty-five (25) municipalities (COREDE MISSÕES, 2010).

Important road routes are located in the region: BR 285, BR 392, RS 168, RS 561, RS 165, RS 536, RS 344 and RS 472 in a total of 342.57 km of state highways, of which 250.97 km are paved. Road links with Argentine territory are also noteworthy. "Air transport, on the other hand, consists of a regional airport, which was deactivated for four years, being reactivated in the first half of 2017 for small non-commercial aircraft transit". It also has a railway network that crosses the region south to north passing through São Luiz Gonzaga and in the west to east direction it goes from Cerro Largo to Santo Ângelo, functioning poorly, and in some sections it is disabled (WBATUBA et al., 2017, p. 91).

The main economic activities present in the COREDE Missões region are temporary crops, especially soybeans, corn and wheat. Another highlight is the ranching activities, especially cattle. The industrial segments that stand out, in terms of the number of establishments installed in the region, in decreasing order, are: Food Products, Clothing, Footwear and Leather, Wood, Metallurgy and Non-Metallic Minerals. These segments are, for the most part, small, with around 55% of industrial workers being linked to an establishment considered small, while 17% of the workforce is linked to a medium-sized company (among 50 and 249 workers). Large establishments (250 workers or more) employ 28% of the total. It is important to note that such companies are strongly concentrated in the main municipalities in the region: Santo Ângelo, São Luiz Gonzaga, Cerro Largo and Guarani das Missões (WBATUBA et al., 2017).

In this space, through a state public policy, the Local Productive Arrangement of Family Agroindustry of the Missões was organized, for the development of the region, with the objective of increasing the aggregation of value in agricultural products, expanding markets and facilitating the growth of family agroindustries, companies and cooperatives, as a way to generate more income for the rural and urban population, and an alternative for the permanence of young people in rural areas. However, the agricultural potential and the strengthening of the food market in the Missões region need to incorporate technology,

innovation and management, in addition to diversifying the production of raw materials and coaloesce to other industries and markets (POLACINSKI et al., 2014).

Another important instrument to support development and research is the Missões Technological Modernization Pole (TMP Missões), fostering the culture of innovation outside major metropolitan centers. In Rio Grande do Sul, consolidated courses and Masters and Doctoral programs in the area of materials only exist in the greater Porto Alegre and in the region of Serra Gaúcha, which, coincidentally, are the most economically and technologically developed.

It is understood that, in order to develop the interior of the state, it is necessary to decentralize investments by the government, to new research centers, to better meet the regional demands of applied research, thus reducing regional inequalities in the state of Rio Grande do Sul, which has been discussed for some time by researchers in the area (SCHULZ, 2020).

Also, the Local Productive Arrangement of the Missões Family Agroindustry (APL - Missões) has been strengthened since 2012, when it was implemented, encouraging the development of agroindustries, fostering the growth of an important vocation in the region, as well as the creation of URINOVA - University-based Technology Incubator to act on the innovation environment that is being established. In 2019, a study published on the territorial activation of rural agroindustries in the Upper and Middle Uruguay region corroborates with the thesis that innovation is inevitable for the development of regions, especially in those regions with a great vocation for agricultural production (ALBARELLO, 2019).

Historically, the Missões Scientific and Technological Park - TecnoURI Missões, takes its first steps in 1968, when the old FUNDAMES, started its activities in Santo Ângelo. It started to gain strength in 1975, with the implementation of engineering and technological courses. In this period, the state of RS was already looking for alternatives to stimulate economic and social development, promoting actions that would facilitate interaction between the public and private sectors (universities and companies). In this sense, the Government of the State of RS, through the State Bureau of Science and Technology, structured in 1989 the Support Program for Technological Modernization Poles and the Research Support Foundation of the State of Rio Grande do Sul - FAPERGS, with the objective to increase the capacity for socioeconomic development and, through its public notices, to finance research projects.

The University is gaining expertise and continues to work on building its innovation habitat, implementing in 2008, the Innovation and Technology Transfer Center - NIT, with the mission of strengthening the relationship between URI, Santo Ângelo campus with the community, involving public agencies, the private sector and other civil society organizations, in order to provide research and extension opportunities to spread the technological development of the region.

In 2012, the URI campus of Santo Ângelo accredited in the State of RS its Incubator of Technology-based Companies, called URINOVA, with the objective of developing actions to promote and support new technology-based enterprises, whose products, processes or services are generated from from the results of applied research, in which technology represents a high added value. Thus, promoting social well-being and contributing to changing the regional economic profile through the dissemination of the culture of entrepreneurship in its area of operation.

Thus, after a long walk, the University obtains the accreditation of the Missões Scientific and Technological Park - TecnoURI Missões, in 2014. The building has a structure with an auditorium for up to 250 people,

equipped with a sound system, air-conditioned environment, multimedia projector, screen and stage. With an area of 300 m² for the installation of laboratories, rooms for the installation of the sectors of research and development of companies, four meeting and training rooms and two rooms for the administration and secretariat of the STP, the building occupies an area of 1475 m², liable to expansion over the years.

6. Management Model for the Missões STP - TecnoURI Missões

Based on the classification of the National Institute of Industrial Property (INPI), which conceptualizes the product, based on a diversity and particularity in relation to each evaluation area, the Management Model developed in the study fits into the AXIS 1- Products and Processes - characterized by the development of a technical or technological product, subject to protection or not, which may generate industrial / intellectual property assets (INPI, 2008).

Based on this definition, the Management Model developed is linked to the Management processes, which according to the INPI (2008), refers to an interdisciplinary approach to identify, design, execute, document, measure, monitor, control and improve business processes, automated or not, to achieve consistent results and aligned with an organization's strategic objectives.

The Management Model for STP Missões is the result of a study based on the Innovation Law, State Decree, Regulations and Statutes, as well as on research in published studies on the subject. It is noteworthy, however, that the proposed research and the management model developed differs from other STP management models that are linked to a specific area or a single production system, such as the management model proposed to the Agency. of Coffee Innovation - INOVACAFÉ (COSTA, et. Al, 2020). Still, based on the bibliographic documentary survey and observation of the innovation environments through on-site visits carried out in some STPs in Brazil, in addition to courses and seminars related to the theme, the necessary strategies for the construction of the Management Model for the STP Missões, whose methodology is described step by step, below:

FIRST STEP: Become acquainted and observe the correct compliance with the legal requirements pertinent to Science and Technology Parks, on a permanent and updated basis. Law No. 13,196 of July 13, 2009; Innovation Law of the State of Rio Grande do Sul, on July 11, 2012; Decree No. 49,355 of July 10, 2012;

SECOND STEP: Know, observe and comply with the University's guiding standards: URI Statute; General Rules of the URI; FuRI Bylaws and Rules; General Norms, Resolutions and Ordinances of the University related to the PCT, Incubators of Technologically Based Companies, Pole of Technological Modernization of Missions and Center for Innovation and Technology Transfer.

THIRD STEP: Knowing, observing and complying, as well as making the necessary changes to the TecnoURI Missões guiding documents: TecnoURI Missões Internal Regulations; Public notices; STP Conduct Manual; Intellectual Property and Royalties Guide; General Standards.

FOURTH STEP: TecnoURI Missões will be linked to URI Santo Ângelo, having as a governance body a Management Committee, directly linked to the campus management, the highest deliberative instance, composed by the Director General of URI -Campus de Santo Ângelo, by the Administrative Manager of the TecnoURI Missões, by the Scientific Manager of TecnoURI Missões, by the Manager of the Center for Innovation and Technological Transfer - NITT, by the Manager of the Technology-Based Business

Incubator - URINOVA, by the Manager of the Technological Modernization Pole of the Missions and by a representative and a representative alternate of each of the entities: Association of Municipalities of Missions - AMM and Regional Council for the Development of Missões.- COREDE MISSÕES, to decide on the actions to be developed within the scope of TecnoURI Missões.

FIFTH STEP: The hiring of TecnoURI Missões managers is exclusive responsibility of the Chairman of the Management Committee - General Directorate of URI, who is also responsible for the administrative and financial function. The members of the Management Committee and their respective alternates will be appointed by an act of the URI Rectory, upon indication of the entities represented.

SIXTH STEP: Creation of the Advisory Partners Council, to be integrated by at least two members of the Steering Committee and, voluntarily, by a representative of each of the TecnoURI Missões Partners. The members of the Partner Council and their respective alternates are appointed by the TecnoURI Missões. Partners and appointed by specific act of the Rector of the URI. The board should provide for the participation of various actors, such as representatives of regional entities and associations, business unions, secretaries, councilors, presidents and directors of other bodies and institutions.

SEVENTH STEP: Another representation to be listed is the Scientific Committee, which must be formed by: TecnoURI Missões Administrative and Scientific Managers; 01 (one) Doctor Professor, from the URI Santo Ângelo career board; 01 (one) PhD Professor, from the career board of the Federal University of the Southern Border - UFFS Cerro Largo; 01 (one) Doctor Professor, from the career board of the Federal Institute Farroupilha Campus Santo Ângelo - IFFAR; 01 (one) PhD Professor, from the career framework of the State University of Rio Grande do Sul - UERGS São Luiz Gonzaga; the Manager of the Missões Technological Modernization Pole - PMT Missões; the Manager of the Innovation and Technological Transfer Center - NITT - URI - Santo Ângelo and the Manager of the Technology-Based Business Incubator - URINOVA. In addition to these, other regional actors may participate, such as teachers from Basic Education Schools (Public and Private) and Technical Schools.

STEP EIGHT: The Missions PCT infrastructure must house the URI - URINOVA Technological Incubator; the Center for Innovation and Technological Transfer - NITT; the Technological Modernization Pole and other actors in this process, together with businessmen, who will be able to take advantage of the space for the development of research related to the innovation of products, processes and / or services, in compliance with the Internal Rules of TecnoURI Missões. Thus, PCT Missões will offer several laboratories in the areas where the Park operates, as shown in Table 1 below. vai oferecer diversos laboratórios nas áreas de atuação do Parque, conforme o Quadro 1 a seguir.

Laboratory	**Área Física (m^2)**
Mathmatics Laboratory	74,03
Physics Laboratory	109,24
Chemistry and Corrosion Laboratory	138,06
Pharmaceutical Chemistry Lab	144,71
Electronic Structure and Simulation Lab	30,00
Chemistry and Toxicology Lab	262,13

Magnetic Materials Lab	28,39
Mechanical Test ans Stress Analysis Lab	50,00
Electromachanic Instrumentation and Automation Lab	50,00
Mechanical conforming Lab	59,56
Heat Treatment and Sutface EngineringLab	113,75
Metrology and Metallography Lab	289,26
Engine, Machines and dWelding Lab	95,00
Thermical Sciences and Fluid Mechanics Lab	80,00
Metalurgy, Machinery and Agricultural implements Lab	50,00
Geoprocessing Nucleus - composed of: Topography, Photointerpretation and Photogrammetry laboratories.	59,56
Laboratório de Mecânica dos SolosSoil Mechanics Laboratory	113,75
Building Materials Laboratory: concrete, asphalt, paving and mortar.	289,26
Electricity and Electrical Installations Laboratory	25,00
Design Laboratory (Civil Engineering and Architecture)	147,00
Mockup Lab-1 - Building 13	82,13
Mockup Lab-2 - Building 15	60,39
Architecture Studio	50,40
Design Laboratory (Architecture) building - 17	82,46
Clinical Analysis (Hematology) Lab	90,00
Clinical Parasitology Lab	65,00
Human Physiology Lab	44,65
Biochemistry and Biophysics Lab	92,13
Biotechnology Lab	35,89
Microbiology Lab	86,80
Farmacotécnica e Cosmetologia Lab	79,00
Pharmacognosy Lab	79,00
Pharmacology, Pharmacodynamics and Pharmacokinetics Lab	36,52
Pharmaceutical Technology and Quality Control Lab	137,36
Pharmacy School	43,02
Metallography Lab	49,50
Distributed Networks and Systems Lab	23,16
Technological Integration Lab - LABINTEC (research)	33,83
Infoaccess	35,00
Digital circuits Lab	70,00
Programming and Accounting Lab	40,00

Computer Graphics and Multimedia Lab	38,93
Computer Lab I, II, III, IV, VI e VIII	367,86
Hardware Lab	46,86
Office of Legal Practice	241,65
URISAN-TRADE, Junior Enterprise Innovation	25,00
Accounting Laboratory (Project Room)	32,00
Botany Lab	67,86
Water and Environmental Sanitation Lab	95,10
Geology Lab	35,8
Herbarium	30,55
Scales Room	16
Support Center for the Development of Products and Processes	200

Sourcee: the authors

The main services that URI laboratories can offer to future companies to be installed in the STP Missões are listed in the main areas of operation, namely:

I) Innovation and Technologies in Engineering, Automation and Socio-Environmental Technologies: Statistical treatment of products and processes; Corrosion analysis of materials; Toxicological analysis; Analysis of chemical structure of elements; Analysis of solid tests, such as magnetic and mechanical formations and surface treatment; High precision machining and welding services; Assistance to agricultural machines with geoprocessing; Analysis of building materials, paving and mortar; Assistance in civil construction projects.

II) Food, Pharmaceutical Innovations and Nutraceuticals: Chemical analysis of medicines; Clinical analysis; Biomechanical analysis; Assistance to pharmacology and cosmetology companies; Quality control of food; Training of pharmacists.

III) Information Technology, Communication and Digital Convergence: Training companies in the use of software; Software production; Production services for the creative industry.

IV) Technology and Innovation in Agribusiness and Agriculture: Irrigation services; Soil analysis; Accounting advice; Legal advice; Administrative assistance.

It is important to note that the companies included in the STPs must be aware of and know the Safety Standards, Equipment Use Manuals and Laboratories use protocols, as well as the price list of materials and equipment used in the laboratories. The main services that URI laboratories can offer to future companies to be installed in the STP Missões are listed in the main areas of operation, namely:

I) Innovation and Technologies in Engineering, Automation and Socio-Environmental Technologies: Statistical treatment of products and processes; Corrosion analysis of materials; Toxicological analysis; Analysis of chemical structure of elements; Analysis of solid tests, such as magnetic and mechanical formations and surface treatment; high precision machining and welding services; Assistance to agricultural machines with geoprocessing; Analysis of building materials, paving and mortar; Assistance in civil construction projects.

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It is important to note that the companies included in the STPs must be aware of and know the Safety Standards, Equipment Use Manuals and Laboratories use protocols, as well as the price list of materials and equipment used in the laboratories.

STEP NINE: The technical and financial feasibility, and the technical feasibility will depend directly on the organizational capacity of the researchers and scholars who will attend the companies. The financial viability of the Missions PCT, on the other hand, is initially prospected by means of promotion notices at different levels (public or private), rent of spaces for companies and laboratory services to be made available, according to the list above.

It is also necessary to invite the institutions or actors who are in charge of the Business Accelerators, Angel Investors and / or Mentors to assist in the development of start-up companies (Startups), in order to promote their exponential growth in the region.

TENTH STEP: Support from other institutions. All other public and private institutions and bodies that are interested and ready to collaborate with research, development and innovation, within this logic of the triple helix, will certainly contribute to this model to be successful and TecnoURI Missões to play the role competes, spreading the culture of entrepreneurship and providing regional development through knowledge, innovation and technological transfer.

Finally, it is worth registering the proposed organizational chart based on the Management Model developed for the Missions PCT - TecnoURI Missões, as shown in Figure 01.

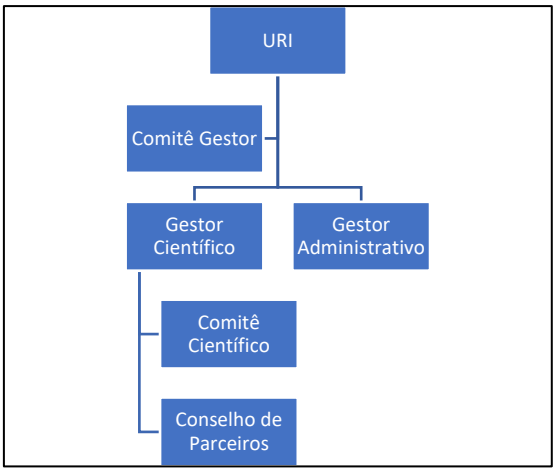

Figure 01 - Organizational Chart of the Missions PCT - TecnoURI Missões

It is noteworthy that the organization chart proposed in the Management Model elaborated for the Angel Investors, although it was based on published studies on STPs, on the methodologies observed in the RS

STPs linked to Higher Education Institutions and on the theory of the Triple Helix, Laws and Decrees (federal and state), considered the specificities and particularities of the missionary region and the need for active participation of qualified regional actors in the Councils and Committees, in order to consolidate and legitimize the performance of the Missions PCT in the socioeconomic development of the region in question. that is inserted.

Future scenarios for the socioeconomic development of regions in the Brazilian territories, in which knowledge, innovation and technological transfer are linked to favorable environments, as in the case of STPs, in a strict connection with Higher Education Institutions, government and companies, is increasingly evident in the results of research and studies already published that involve the theme. As an example, the research carried out by Andrade et. Al. (2020), who reserves similarities with the present study, by inferring the use of technologies, through STPs, in the prospecting of scenarios and development of agribusiness (area of activity, equally relevant for the Missions PCT).

7. Final considerations

This study aimed to offer URI Santo Ângelo, the technical-administrative entity responsible for the Scientific and Technological Park of Missões, a management model, considering the particularities of the Missões Region.

It is understood that the proposed general objective was achieved, as the study intended to elaborate a Management Model for the Scientific and Technological Park of the Missions, in order to optimize its economic-financial self-sufficiency. To achieve the proposed objective, it was necessary to theoretically estabilish the study based on publications in periodicals, books and magazines that dealt with the theme. It was also necessary to research internal documents and observe on the spot STPs linked to Higher Education Institutions in RS, seeking to appropriate the methodologies used by these STPs , compare them with studies of STPs from other regions of the country and the world, in order to identify the most appropriate strategies for the implantation of the STP Missões, considering the particularities inherent to the monoculture region.

In the elaboration of the Management Model for the STP Missões, the regional actors that could be inserted in the process were identified, taking into account the theoretical proposal of the Triple Helix and the mapping of the management processes used especially in STPs administered by ICES.

In this sense, the study sought to characterize, albeit briefly, the Missões region, where the STP Missões operates, describing the political and social aspects of this territory. Equally relevant and necessary, was the temporal description of the institutional and technological trajectory of URI Santo Ângelo, from its foundation to the conquest and implantation of the STP Missões.

The entire theoretical apparatus researched, the documents analyzed, the observations made in other STPs, the understanding and description of the Missões region and the identification of the regional actors who must integrate and assist in the process of consolidating the STP Missões, according to the Triple Helix , culminate in the Management Model elaborated in the study and presented, in a simplified way, through the description of the 10 (ten) sequential steps / steps and the proposed organization chart.

Still, acknowledging the difficulties and limitations encountered during the study, it is understood that for

the success of the Management Model developed, some basic premises must be considered: i) the model cannot be static, its dynamism and flexibility are necessary for the effectiveness of the management; ii) the model must be participatory and its ideas disseminated and shared with all the actors involved in the constituted Committees and Councils, ensuring good governance of the Missions PCT; iii) the regional community must be involved as a protagonist in the process, contributing on legitimating of the Missions PCT; iv) it is essential that all the regional actors involved establish relations of trust and mutual cooperation, in favor of the territorial development of the Missões region. Thus, it is understood that the success of the management model will depend on this relationship of trust and cooperation between the regional actors, the very environment of innovation and the culture of the Missões region.

6. Acknowledgement

TecnoUri - Parque Científico e Tecnológico das **Missões**

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Justifications of Representative Democracy

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Abstract

The totalitarian regimes of the 20th century - Nazism, fascism and Stalinism - in the same way as the dictatorships of South America and Africa, gave the human community a profound reflection on the future. This literature review problematizes the justifications and limits of representative democracy. It discusses the mechanisms of improvement of the democratic process for greater popular participation in the decisive spheres of political life. The lack of popular participation and a possible disbelief with political representation deserve to be addressed in order to continuously actualize democracy as a political regime.

Keywords: democracy; representation; participation; politics

Initial thoughts

Given the totalitarian regimes of the 20th century, the dictatorships of South America and Africa, the configuration of the future has become a central theme for the reflection of the human community. The construction of mechanisms for the protection and promotion of human rights were fundamental in post-war society. Democracy has been recognized as the most propitious political regime to promote a political and social organization to guarantee individual and collective rights. Only with democracy and popular

political power can one prevent the perpetuation of a despot.

This literature review highlights, firstly, different configurations of democracy and, secondly, proposes a discussion about the limits of representative democracy and the reduction of the spaces of the democratic process and the exercise of citizenship. Due to the limits of the system of political representation, one understands that an active popular participation promoted by self-government devices is fundamental for the full exercise of citizenship and for the construction of social justice.

1. Discussions

The origin of the democratic political regime dates back to ancient Greece, at the heyday of Athens as a regional political and cultural center. The word democracy, derived from the Greek language, is composed of the combination of the terms "demo" and "kracia", which means "government of the people". The main principle of democracy, in this way, is the sovereignty of the people in the making of decisions of public interest.

Greek democracy was participatory or direct, guarding the conditions of the time, which excluded most of the population from the right to participate in the city administration. The citizens gathered in the agora, in assemblies, agreed on the future of the polis. In Greek conception, the city is seen as the common good; the exercise of citizenship is an ethos of which the Greek citizen was proud. The strong debate and discursive skills were remarkable among Athenian citizens. Women, children, slaves and foreigners were excluded from public debates. However, citizen participation is the element of legitimacy of politics and democratic regime.

Concerning Roman civilization, Dahl (2001) points out that the patricians called the people's government a republic. The republic, for the great speaker Cícero (1980), represented a congregation of men. The basis of this form of government took place at the meeting that legitimized legal consent and common utility. Freedom was only considered true when exercised by the government of the sovereign people. The right to participate in the public thing, in Roman government, was initially limited to patricians and aristocrats. Only later, the commoner acquired the right to political participation. As in Athens, the right to participate was limited only to men, not unlike what occurred in modern democracies centuries later, which until the 20th century limited women's right to participate.

Unlike the monarchical regimes of his time, Rousseau (1999) proposed a social pact founded on popular participation, which would legitimize the sovereign power. This political power should emanate, for the philosopher, from the general will, which is not confused with the particular wills: "Each one of us puts in common his person and all his authority, under the supreme command of the general will, and we receive together each member as an indivisible part of the whole" (Rousseau, 1999, p. 81).

For the Genevan thinker, the social contract should guarantee citizens the natural rights, including the freedom and equality of associates: "To find a form of association that defends and protects the person and the property of each associate with all common force, and by which each one, uniting with all, obeys only himself, remaining as free as before" (Rousseau, 1999, p. 79). The social pact would be based on a democratic and republican ideal, ensuring the active participation of citizens in the public sphere. The philosopher considered, however, that the size of the population should be taken into account for the functioning of a free society. Therefore, for a larger contingent of citizens, the representative democratic

regime would be more reasonable, as modern societies have become even more complex and populous.

For Mill (1981), there is no difficulty in demonstrating that the ideal of a sovereign government would be one in which, ultimately, control belongs to the people; in which the mass, gathered in community, gives voice to the exercise of supreme power. This does not mean that the people should participate directly in decisions, but that they should be called, at least occasionally, to be part of the exercise of a civil service, whether at the local or general level. Thus, the philosopher advocated a government that, from the ideal point of view, could only take place in a representative system, as circumstances would allow a greater number of beneficial consequences in the social and political constitution of a country:

> [...] it becomes evident that the only government capable of meeting all the demands of the social state is the one in which the whole people participated; that all participation, however small, is useful; whereas participation should be everywhere in proportion to the general degree of community development; and that one cannot desire anything less than the admission of all to a part of the sovereign power of the State. But since, in communities that exceed the proportions of a small village, it is impossible for everyone to participate personally, except in a very small portion of public affairs, the ideal type of perfect government can only be representative (Mill, 1981, p. 38).

In modern society, especially from the 18th century on, after the bourgeois revolutions, new forms of democracy were spread. Representative democracy, as a form of mediation between civil society and government, has become widespread as the only morally accepted model of a country's social and political organization. Thus, a process of dissemination of the democratic ideal was promoted as a safeguard for the justifications that opposed the old regime. With the rise of capitalism and a new form of market relations, there arises the need for a system that allows its unfolding and protection.

Representative democracy, founded on the record of liberalism, has given citizens civil and political rights. Rights such as freedom, equality and private property were considered essential as the State, in its absolutist configuration, did not provide the political and social participation of individuals. On this point, Bobbio (1992, p. 41) maintains that: "[...] the affirmation of human rights within each State was accompanied by the establishment of representative regimes [...]". For this understanding, the recognition and protection of rights would only be possible in a democratic society.

Thus, a legal framework was established, which guarantees, from the legislative power, the management of business and private property. At the same time, a system of national sovereignty was established. From the perspective of a government of laws, constitutions establish the vectors of public administration, the functionality of public institutions and the fundamental rights of citizens. The citizen is understood as a subject of rights and universal suffrage as a condition of legitimacy of the government.

It is observed, nowadays, that there is a tension between the conditions of being a citizen of law and of being a de facto citizen, which has repercussions in the form of political participation. It is understood, next to this, that there is an emptying of public spaces, which directly interferes in the context of citizenship, because its exercise takes place, initially, in the public sphere. It is also noteworthy that nowadays there is

a strain in the perception of citizens in relation to political representation, which has been attached to the figure of the politician, resulting in a feeling of dissatisfaction with politics in general. Given this, it remains to be questioned whether there are alternatives to democratize, so to speak, democracy, and whether there are solutions that allow a more effective participation of citizens directly involved in matters of public interest.

The configurations of representative democratic societies, according to Santos (2007), usually reduce the citizen's participation in the public sphere, making him/her a passive entity of the decision-making process. The author stresses that there is a blockage in the current scenario of democracy that prevents the effective participation of the citizen, observing a simulacrum of participation, which often does not ensure the material conditions for its actualization. The process of democratic participation is trivialized, since it is provided to participate in what is not important:

> The situation from which we start, really very difficult, has these general characteristics: a blocked citizenship, as many people - which is the characteristic of the representative democratic system - have no guarantee of conditions to participate, that is, a citizenship that is based on the idea of participation, but does not guarantee its material conditions [...] It seems to me that, with this citizenship blocked, participation is being trivialized; we participate more and more in less important issues, more and more we are called to have an opinion about things that are increasingly banal for the reproduction of power (Santos, 2007, p. 93).

At the same time, Dahl (2001) considers that there is a dark side to representative democracy. For him, political and bureaucratic elites in democratic countries are more powerful than the average citizen, which represents a problem for the process of political participation. If, on the one hand, the citizen ends up participating little in democratic deliberations, on the other hand, he/she delegates important decisions to the political authority for the population as a whole. Moreover, these delegations, within the framework of public administration, for example, assume even more indirect levels:

> The dark side is this: under a representative government, citizens often delegate immense arbitrary authority to decisions of extraordinary importance. They delegate authority not only to their elected representatives, but, in an even more indirect and tortuous journey, the authority is delegated to administrators, bureaucrats, civil servants, judges and, to an even greater degree, to international organizations (Dahl, 2001, p. 128).

In view of this, it can be inferred that, in representative democracy, the common citizen does not participate in the deliberation process, since the idea of representation delegates a mechanism of indirect action. Today, this phenomenon becomes even more evident.

Bauman (2001) argues that, in liquid modernity, society has acquired new forms of configuration. Safety and assurance in relation to traditions and concepts gradually weaken. If solids largely represented

the fixed postulates that constituted the European industrial civilization, because they lasted for a longer time, in our context this no longer occurs. In liquid modernity there is a deconstruction of the whole idea of solid. One of its consequences, in the political sphere, is the emptying of public space. The citizen no longer argues in the agora. There is a weakening of what is public. In liquid modernity, the citizen became an individual, beyond that, the process of individualization transformed the citizen into a consumer.

Rancière (2014), in the book entitled "Hatred of democracy", analyzes postmodern democracy, presenting the concept of "consumer individuality", according to which the citizen has become a consumer alienated by commercial production. As a result, this process of individualization disintegrates citizenship and raises a serious problem for democracy, as the "[...] de jure individual cannot become a de facto individual without first becoming a citizen" (Bauman, 2001, p. 55).

From this perspective, a "de facto individual", in social interaction, should, before becoming a mere "individual of right", go through a process of formation for the exercise of citizenship. The principle of isonomy, observed only in terms of form, does not guarantee the substantiality of the right. The high rates of social discrepancy attest to the importance of both the guarantees that are constitutionally covered and for the conditions that allow citizens to actively participate in the decisions concerning them. For Bauman (2001), it is in politics that public order issues must be resolved. It is in this sphere that the public interest must be agreed upon. Becoming a "de facto individual" and not just "of right" is a central theme for the scope of life-politics, which causes significant problems when we think of democracy:

> I repeat: there is a great and growing abyss between the condition of de jure individuals and their chances of becoming de facto individuals – that is, of gaining control over their destinies and making the decisions they actually desire [...] This abyss cannot be transposed only by individual efforts: not by the means and resources available within self-administered life-politics (Bauman, 2001, p. 53).

Upon examining one of the problems surrounding representative democracy, Santos (2007) considers that, in this model, the relationship between the authorization of the citizen and the accountability to the population, or what is expected of State power, ends up conflicting. For there is, in fact, no adequate transparency, and there is still great difficulty in the control mechanisms. This model has two dimensions, as the sociologist says:

> [...] representative democracy is, on the one hand, authorization and, on the other, accountability. In the original democratic theory, these two ideas are fundamental: authorization, because with the vote I authorize someone to decide for me, but on the other hand, he has to account to me. What is happening with this model is that there is still an authorization, but there is no accountability in the current democratic game; the more we talk about transparency, the less transparency there is (Santos, 2007, p. 92-93).

As a consequence of this scenario, two decisive concepts for representative democracy come into crisis:

on the one hand, representation, and, on the other, participation through suffrage. For Santos (2002), as citizens do not feel represented by those who should represent them, these voters end up discouraged from political participation to the point of not wanting to exercise the right of suffrage. The high rate of abstentions corroborates this circumstance, which ends up weakening the democratic system.

In an article published on the subject, Jamil (2010) states that the lack of confidence of citizens in their representatives compromises the democratic system towards their political legitimacy, since the representatives do not feel that their interests are included in the political agenda. Added to it is the fact that the high rate of corruption linked to political institutions ends up fostering a feeling of powerlessness and lack of interest in participating in political praxis.

Santos (2002) argues that it is necessary to reinvent democracy, expand the spaces of public participation, enable the citizen to praxis to make decisions in the public interest. For the Portuguese sociologist, there are three necessary conditions for a more forceful participation process to occur, that is: to have survival guaranteed, to have freedom and information. Once these conditions are met, the opening of the public space for new forms of participation is necessary, thereby raising the possibility of exercising citizenship. In this sense, participatory democracy is a system that allows expanding discussions in public spaces, fostering more effective control with involvement and popular participation in the political and social sphere:

> In summary, (social) movements conceive participatory democracy as a parallel policy of social intervention, creating and maintaining new spaces for decision-making (i.e., for self-government) by populations in matters that affect their lives differently. As a form of praxis, participatory democracy is for them a political and social process that is intended to create a new system of government, multiple and overlaid, that works through participation and more direct control of the decision-making of the populations involved (Santos, 2002, p. 128).

It is in the political spaces located in the popular bases that the democracy is actively reached, Santos (2002) points out. In this sense, it is understood that, through the political clashes of everyday life, participatory democracy must be inserted as a form of social and political organization. Thus, three characteristics of democracy are listed below, understood as political practice: a) at the base, at the local level, populations engage in political struggles to establish rights and manage their autonomy; b) at the provincial and national level, participation takes place from alliances and coalitions between popular movements; c) at the global level, it is worth highlighting the construction of international movements, in which activists seek to promote liberating policies.

In Brazil, in cities such as Porto Alegre, community movements have come to fructify the participation of the community in the public sphere. The participatory budget, for example, produced positive results in order to enable the population directly affected to produce proposals, discuss and choose in which areas public resources should be invested. Thus, a closer relationship was developed between the government and the citizens. For Santos (2002), there are three main characteristics of participatory budgeting, namely:

> [...] (1) participation open to all citizens without any special status assigned to any

> organization, including community ones; (2) a combination of direct and representative democracy, whose institutional dynamics attributes to the participants themselves the definition of internal rules; and (3) allocation of investment resources based on the combination of general and technical criteria, i.e., matching the decisions and rules established by participants with the technical and legal requirements of government action, also respecting financial limits (Santos, 2002, p. 64).

Santos (2002) adds to this three elements he considers essential in the process of implementation or application of the participatory budget: first, the budget must be the subject of regional assemblies; secondly, it is necessary to seek space in public policies to reverse existing inequalities; and, finally, there must be a mechanism that would make the process of participation compatible with the public authorities. It is worth noting that, in Brazil, according to estimates of the period between 1997 and 2000, about 140 municipalities, in their management, prepare the budget in a participatory way.

Final thoughts

In view of the previous considerations, it is emphasized that there are several possible configurations of the democratic political regime. It is not easy to conceptualize them. This article aimed to review the literature on the subject and to analyze the democratic system in general terms. Representative democracy has established itself as a predominant form of political regime in the complex societies of modernity. However, it is essential to guarantee and expand the spaces of popular participation, especially in the agendas in which the public interest is directly achieved.

Examples of participation such as those that occur in participatory budgeting, social movements, discussion in local assemblies and even in student associations of basic schools are conditioning factors that affect the sphere of citizenship. Thus, it is encouraged to treat what is public responsibly, because this is the common world in which the life politics are produced. Despite the problems discussed in the text, it is recognized that, throughout the 20th century, and at the beginning of the millennium, some advances were achieved from popular actions, especially when social participation represented the path of defending individual rights and freedoms.

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Emotional indicators associated with bullying behaviors victimization

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Abstract

Bullying is a specific expression of violence in the school environment that has become more relevant in recent decades, due to the appearance of new forms of violence. Experiences of bullying are associated with several social interactions, behavioral adjustment, emotional problems, mainly internalized problems such as anxiety, anxiety and anger.

The purpose of this research was to evaluate the distress, anxiety, the expression of anger and the use of humor and its association with the roles of bullying and victimization in school situations in secondary school students from Mexico City.

406 high school students from Mexico City participated. The Reynolds RBVSS bullying victimization scales, the anger expression inventory and the humor styles questionnaire were applied to them. The data from this research confirm the association of expression of anger, agony, anxiety, and negative use of humor in bullying behaviors, in different ways in both bullies and victims.

Keywords: Bullying distress, anxiety, anger, humor styles

1. Theoretical support.

Violence is an interpersonal process that affects at least two actors: the person who suffers it and the person who exercises it (Castro, 2009); it can have both physical and psychological expressions. The World Health Organization classifies it into three types, according to the characteristics of those who commit the act of violence: self-inflicted violence, such as suicidal behavior and self-harm; Interpersonal violence, that imposed by an individual or a small group of individuals, and collective violence, inflicted by large groups such as the State, troops or terrorists (OMS, 2003).

At the interpersonal level, two subcategories can be located: family or partner, and community violence. The latter is done in unrelated people, usually outside the home. Within community violence, situations of violence that occur in school can be located, specifically acts of violence that students carry out among themselves, which are conceptualized as bullying or bullying.

Aggression between equals at school is a permanent and old phenomenon that has been the subject of systematic research since the 1970s: One or more students intentionally and systematically harass and attack other students, in the face of essential look of the other colleagues, this phenomenon is called Bullying, (Olweus,1996) danish origin concept. In Spanish, the most appropriate term is bullying or bullying between equals. The manifestations of harassment range from insults, harassment to physical

attacks. It contemplates three characteristics: intentionality, persistence over time and abuse of power. It is important to reiterate that, to be conceptualized as bullying, the violence exerted by the bully is fully intentional, it does not refer to a single event but to a series of events that take place over a period of time and the bully is perceived with greater power over the victim, whether physical, psychological or social. This apparent power is used inappropriately to cause harm to others.

The targets of bullies at school are typically other students, consequently the term victim refers to the student who has experienced a relevant amount of bullying by another student or multiple students. While there may be people with typical bullying behaviors or people with typical victim behaviors, sometimes the bullies themselves are the targets of the bullying, thus creating a student who is both a bully and a victim. This creates a circular phenomenon where participants can change roles or be both at the same time, which is why Reynolds (2017) refers to the phenomenon as bully victimization.

This specific expression of violence in the school environment has become more relevant in recent decades, due to the emergence of new forms of violence. Indeed, although bullying is not a new phenomenon, its peculiarity and interest in its study is due to the fact that it constantly presents new forms, expressions and resources, ranging from physical violence, intimidation, to exclusion or segregation, and either in person or even in modalities that involve the use of digital technologies, mainly through social networks (Wade & Beran, 2011).

Provoke fights and videotaping them to upload them to the network, or photographing the privacy of others, sending or receiving offensive and insulting and personalized messages on social networks, are new expressions of violence, which are becoming increasingly harsh, and can even go from one joke, a game, to activities that involve severe physical harm.

Another peculiarity of bullying is its presence worldwide, practically in all schools there are situations of bullying, with negative social and personal consequences, which has implied that it is considered as a public and mental health problem worldwide (Hamburger, Basile & Vivolo 2011) as it is risky behavior that affects the physical, mental and social integrity of those involved in different degrees and forms, with serious consequences at a personal and group level that affects the school community, the family and society in general (Asabey, 2015).

One of the great concerns is that these previously mentioned behaviors can potentiate or be directly associated with physical injuries, psychological conditions and even suicides or death events in adolescents (Srabstein, 2013). A study carried out by the Pan American Health Organization, in all the countries of the American continent, was able to document in 2012, 82 cases of injuries related to bullying in people between 5 and 19 years of age, of which 47 cases were injuries, 17 suicide cases and 18 homicides (Srabstein, 2013).

There are many affectations of a psychological order, as a consequence of the situations of harassment

victimization, Reynolds (2000) indicates that the experiences of intimidation are associated with a series of problems of social interaction, behavioral adjustment, emotional, mainly internalized problems, including anxiety, anxiety and anger.

One of the most damaging effects of bullying is emotional distress on the victim, which often have a significant impact. Internalizing disorders are those psychological disorders and problems that have as primary symptoms of expression, behaviors, affects and thoughts that are directed inward and that are a source of distress for the individual (Romero, Lucio, Duran & Ruiz, 2017).

Both victims and bullies present high levels of distress, with internalizing symptoms such as fear or sadness, even depression, or with externalizing symptoms such as anger and hostility (Reynolds, 2017). Anger and depression are related to a history of bullying victimization (Ruiz, Torres &, Ochoa, 2017). The form the answer can take differs from student to student. In some it can be expressed by fear or sadness, in others by anger or aggression, and in some by both, internalizing and externalizing symptoms of distress.

On the other hand, anxiety is a cognitive assessment that causes an emotional state of uneasiness or very intense restlessness, in the school environment, it is one of the most harmful consequences of bullying (Albores Gallo, Sauceda-García, Ruiz-Velasco & Roque -Santiago (2011). Research has also shown that victims of bullying present greater concern, negative self-evaluations, and rejection of the school, due to fears about their safety (Reynolds, 2017).

For Ruiz-Badillo and Reyes Lagunes, (2007) anger is an emotional state characterized by subjective feelings that vary in intensity, from annoyance or irritation to fury, rage or intense anger, it is a complex reaction, which mixes mental activities and bodily, depends on personal contexts, and even sociocultural. Hostility is a complex apparatus of angry feelings and attitudes that motivates aggressive behavior. Aggression is used to describe negative behavior loaded with anger and hostility that is generally destructive and punitive.

Harassment situations are often started with jokes or games, easily override their humor, and turn into aggression. Humor is a personality trait that can be reinforced from the environment, its use can achieve a balance, by compensating external pressures, mainly humor is used as the ability to joyfully recognize the incongruous, to see the adversity of a benign way and to provoke laughter in others or experience it yourself (Seligman, 2002). On the contrary, the use of humor can be used in a negative context either to disqualify and denounce the attributes of others, or even as a form of aggressiveness to criticize, annoy or manipulate others (Cayssials, Dana, & Pérez, 2006). In a social environment mediated by aggression, young people who are bullies tend to use humor in the negative sense as a resource to victimize others and legitimize their internal anger.

Young people involved in bullying situations, either as bullies or as victims, constitute a risk group among students, in large part due to their significant potential for suffering mental health problems, distress , and

anger, as well as the effects to long-term violence at school. Therefore, it is important to study these states and personality traits in the Mexican school population.

The purpose of this research was to evaluate the distress, anxiety, expression of anger and use of humor and its association with the roles of bullying and victimization in school situations in secondary school students from Mexico City.

2. Method.

2.1 Participants.

Participated in the study, 406 high school students, 207 women (51%) and 199 men (49%), aged 13 to 16 years, median age 14, standard deviation 0.884. Students from public secondary schools in the southern part of Mexico City. The form of selection of the participants was by an intentional non-probability sampling. With the prior agreement of the school authorities, the classrooms were visited and the instruments were administered in a group, covering relatively equal quotas by sex and applied (RBVSS and expression of state trait Anger or RBVSS Humor Styles Questionnaire).

2.2 Materials and Instruments.

The Reynolds Bully Victimization Scales for Schools RBVSS. It is made up of Bully Victimization Scale Scale (BVS), the Bully-Victimization Distress Scale Scale (BVDS) and the School Violence Anxiety Scale (SVAS), with the spanish translation and psychometric adaptation for the Mexican population carried out by Ruiz Badillo (2017).

The EBV Bullying Victimization Scale has 46 items, composed of two dimensions, the first assesses the role of the bully, with a Cronbach's alpha of $\alpha = 0.88$, The second dimension assesses the role of the victim ($\alpha = 0.89$). The BVDS Bully-Victimization Distress Scale measure internal distress because of Bullying Victimization ($\alpha = 0.92$) and external distress because of Bullying Victimization ($\alpha = 0.88$), with 35 items. The third scale is School Violence Anxiety Scale SVAS ($\alpha = 0.94$), composed of 29 items that assesses anxiety towards bullying and school violence. All items are presented in a Likert format with four intervals with response options that indicate the frequency of each indicator in the last month: never, once or twice, three or four times, and five or more times. This instrument was applied to all participants.

A second instrument used was the State-Trait Anger Expression Inventory, adapted to the Mexican population (Ruiz-Badillo and Reyes-Lagunes, 2007). Made up of five factors; Anger State ($\alpha = 0.74$), which evaluates the condition of anger at the moment of answering the instrument; Anger Trait Temperament, which evaluates the anger trait ($\alpha = 0.88$); Manifest Anger, which evaluates the expression of anger ($\alpha = 0.73$); Content Anger, which evaluates the opposite of the previous one, the containment of anger ($\alpha = 0.78$) and Reaction Anger, which evaluates the impulsive reaction when angry ($\alpha = 0.78$). In total 22 items, with a total Cronbach's alpha of $\alpha = 0.82$.

A third instrument to assess humor, the Humor Styles Questionnaire (HSQ) scale was used, by Puhlik-

Doris, Larsen, Gray, & Weir (2003) in the version translated into Spanish by Cayssials, Dana, & Pérez (2006). It consists of 32 items grouped in four dimensions, each with 8 items: affiliative, personal improvement, aggressiveness, and personal disqualification, the first two represent a positive use of humor and the next two indicate a negative use of humor. The Spanish version presents a reliability of the total test with a Cronbach's alpha $\alpha = .79$. For the present investigation, some reagents were modified to adapt them to the way of speaking of Mexicans, for example; the reagent "If someone makes a mistake, I try to spend or charge him" was replaced by the following reagent "If someone makes a mistake, I make fun of him."

Alternately with the base instrument (Reynolds Scales), a measure of expression of anger was applied to 203 participants and another 203 participants a measure of use of humor. Socioeconomic data was applied to all the interviewees.

2.3 Process

With the prior consent of school authorities and secondary school teachers, it was applied to students collectively in natural school groups. Voluntary participation was requested (no student refused to participate) indicating that the study would be anonymous and confidential, and the information obtained would be grouped for statistical purposes. An email address was provided to contact the investigators in case of questions.

The questionnaire consisting of the base instrument and one of the two instruments indicated above was randomly distributed to each student. Thus, 203 responses were obtained from the Reynolds scales and the anger measure and 203 responses from the Reynolds scales and the humor measure.

As an ethical aspect to give back to the population where the study was carried out, a document was offered to the school authorities with the diagnosis of the situation about bullying that occurred in these settings, without specifying names, and actors since the questionnaire was applied with the consent of confidential and anonymous handling.

The responses were processed and analyzed in two databases, one containing the evaluations of bullying, victimization and anger and the other with the evaluations of bullying humor, with them the information was analyzed through the statistical program SPSS see 21®, using frequencies simple, group comparisons and correlations with non-parametric statistics, because the data are not normally distributed and were obtained by non-probability sampling.

3. Results

The socioeconomic characteristics of the participants indicate that they belong to a preferably medium and low social condition, just over half live in rented house. It should be noted that 30% of students live in a single-parent family.

Under the cut-off points set by the Bully Victimization Scale, 104 participants (25.6%) were identified, involved Bullying situations, of which 52 (12.8%) are exclusively Bully or stalker, and 52 (12.8%) are exclusively Victims. 23 students (5.6%) exhibit behaviors such as Bully and victims. For comparison purposes, students be clasified Bully or victims.

By grouping by sex of the interviewees, 28 men and2 4 women were found with the role of Bully, while 20 men and 32 women in the role of victims. It should be noted that there are a higher number of victims of the female sex.

El 46.7% of bullying students, and 59% of female victims use video games, 73% of bullies and 77% of victims use social media. El 53% of bullies refer to frequently watching videos of student fights, while only 22% of victims watch this type of video.

As for coexistence, there are some negative situations; 53% of bullies and 50% of victims refer to having a bad relationship at home. 33% of bullies and 32% of victims refer badly to the father. In school, 26% of bullies and 36% of victims refer to having poor coexistence in their school classroom.

When making comparisons between students identified as bullies and non-Bullies, it was found that there are statistically significant differences in applying Mann-Whitney U Test which shows high levels of Internalized distress, Externalized distress, and total distress (which is the sum of the above markers), and anxiety about school violence, in students identified as bullies, compared to non-harassing students (See Table 1).

Table 1 Comparison of Distress and Anxiety in Bully and Non-Bully

	Bully		**Non-Bully**		**Mann-Whitney U**	**Z**	**Prob.**
Factor	**Mean**	**DE**	**Mean**	**DE**			
Internalized Distress	9.3929	11.855	2.7486	5.696	1387.500	-3.841	. 000
Externalized Distress	13.5000	11.390	2.9600	4.226	679.500	-6.278	. 003
Total Distress	22.8929	21.611	5.7086	8.831	796.500	-5.796	. 000
Anxiety about school violence	12.75	15.255	4.74	8.044	1393.500	-3.711	. 000

Similarly, in comparisons between students identified as victims and non-victims, it was found that there are statistically significant differences in applying Mann's U non-parametric test, which shows high levels of Internalized distress, Externalized distress and total distress (which is the sum of the above markers), and anxiety about school violence, in students identified as victims, compared to non-victim students (See Table 2).

Table 2 Comparison of Distress and Anxiety in Victims and Not Victims

	Victims		No victims		Mann-Whitney U	Z	Prob.
Factor	**Mean**	**SD**	**Mean**	**SD**			
Internalized Distress	14.285	13.249	1.9657	3.477	560.500	-6.831	. 000
Externalized Distress	14.928	10.381	2.7314	4.006	372.000	-7.368	. 000
Total Distress	29.214	20.442	4.6971	6.572	318.000	-7.473	. 000
Anxiety about school violence	17.00	19.909	4.06	4.999	1315.000	-3.984	. 000

Regarding the measure of anger, comparisons were made between students identified as bullying and non-bullying, showing high levels of state anger, temperament trait anger, manifest anger, content anger and reaction trait anger in students identified as bullying, in comparison with non-bullying students. In all these comparisons statistically significant differences were found when applying the non-parametric Mann's U test, (See Table 3).

Table 3 Comparison of Anger Expression in Bully and Not Bully

	Bully		Non-Bully		Mann-Whitney U	Z	Prob.
Factor	**Mean**	**SD**	**Mean**	**SD**			
Anger state	2.2000	. 901	1.5086	. 681	1215.500	-4.373	. 000
Anger temperament trait	2.5286	. 955	1.9771	. 823	1599.000	-2.964	. 003
Manifest anger	2.4357	. 812	1.7211	. 661	1216.500	-4.300	. 000
Contained anger	2.3214	. 957	1.6895	.782	1465.000	-3.490	. 000
Anger trait reaction	2.6607	.773	2.0586	.771	1410.500	-3.621	.000

Likewise, comparisons were made between students identified as victims and non-victims, in the measure of anger, where high levels of state anger, temperament trait anger, manifest anger, content anger and reaction trait anger in students identified as victims were made. compared to non-victimized students. In all these comparisons statistically significant differences were found when applying the non-parametric Mann's U test (See Table 4).

Table 4 Comparison of Anger Expression in Victims and Not Victims

	Victims		No victims		Mann-Whitney U	Z	Prob.
Factor	**Mean**	**SD**	**Mean**	**SD**			
Anger state	2.2286	1.001	1.5040	.654	1430.000	-3.613	. 000
Anger temperament trait	2.6000	. 870	1.9657	. 830	1405.000	-3.639	. 000
Manifest anger	2.4286	. 778	1.7223	. 669	1193.500	-4.380	. 000
Contained anger	2.4286	. 924	1.6724	.773	1268.000	-4.188	. 000
Anger trait reaction	2.6429	.749	2.0614	.776	1435.500	-3.536	.000

Comparisons between students identified as bullies and non-bullies in humor styles, when applying Mann's U nons parametric test, were found to be statistically significant differences in styles of aggression and personal disqualification, where students identified as bullies are shown high levels, compared to non-harassing students (see Table 5). The positive affiliation and personal improvement factors showed no differences between the two groups.

Table 5 Comparison of Humor Styles between Bully and Non-Bully

	Bully		Non-Bully		Mann-Whitney U	Z	Prob.
Factor	**Mean**	**SD**	**Mean**	**SD**			
Affiliate	2.854	. 352	2.861	. 297	2114.500	-.125	. 901
Personal Improvement	2.365	. 578	2.377	. 691	2098.00	-.185	. 853
Aggressiveness	2.432	. 366	2.283	. 369	1571.000	-2.152	.031
Personal disqualification	2.125	. 520	1.733	.426	1142.000	-3.758	. 000

Comparisons between students identified as victims and non-victims in humor styles, when applying Mann's U non-parametric test, were found to be statistically significant differences only in personal disqualification styles, where students identified as victims show high levels, compared to non-victim students (see Table 6). It should be noted that in the affiliation and personal improvement positive factors the scores of non-victim students, have higher averages, which implies a trend and on the contrary the negative factors are most used by the students identified as bullies.

Table 6 Comparison of Victim and Non-Victim Humor Styles

	Victim		No victim		Mann-Whitney U	Z	Prob.
Factor	**Mean**	**SD**	**Mean**	**SD**			
Affiliate	2.776	. 363	2.872	. 293	1789.500	-1.338	. 181
Personal Improvement	2.182	. 644	2.402	. 680	1746.500	-1.489	. 136
Aggressiveness	2.370	. 455	2.291	.359	1733.500	-1.546	. 122
Personal disqualification	1.995	. 572	1.750	.430	1582.500	-2.113	. 035

To identify the impact and strength of these comparisons, non-parametric correlations were made using Spearman's Rho statistic, finding a relationship between the expression of anger and the role assumed in situations of harassment: bullying behavior – manifest anger (Rho= .361, p=0.02), victim – anger content (Rho= .268 p= 0.05). It should be noted that overt anger implies hostile behavior, and therefore an active form. In opposition, contained anger is passively hostile behavior.

There is a relationship between the use of humor and the role of harassment: The bullying behavior correlated positively to the dimension of aggressive humor, (Rho=.305, p= 0.01) and personal disqualification (Rho.243, p=0.01) and in the case of victim role correlates negatively with the mood dimension for personal improvement (Rho=.292, p= 0.05). On the other hand, students who do not participate in this circle of violence use humor in a positive sense, so that as Seligman argues (2002), it allows them to improve their interactions and their own person. The phenomenon of bullying is manifested mainly through the making of jokes, taunts, and insults, that is, in the use of humor in a negative way.

4. Discussion.

In bullying there are mainly two types of protagonists, bullies and victims. In this study, students considered bullies present an externalized distress characterized by a lack of social skills, lack of empathy, with polarized emotional expressions; Their trait is anger, they are aggressive and hostile towards others, according to the data obtained, they use humor to insult and attack others, they usually disguise their condition before adults. Their behavior may be the consequence of a bad family relationship and lack of affection at home, and permissiveness of aggressive behaviors from an early age, lack of limits, or family education based on physical punishment. Due to the above considerations, an inadequate coexistence at home and at school, and the excessive use of digital media in a negative way, are factors that induce aggression between equals.

On the other hand, students considered as victims, present high levels of internalized anguish and anxiety towards school, they can have various personality patterns: some are passive and submissive, and others are anxious and aggressive. They have an expression of contained anger, possibly a consequence of internalized anxiety, and they can even use humor, but as a resource to self-abuse. Victims are often alone and apart from their schoolmates and report a bad family relationship.

The data in this investigation confirm the association of anger expression, anxiety, and negative use of humor in bullying behaviors, in different ways both bullies and victims.

The study, evaluation and intervention of anger in adolescents, is a substantive activity that would provide elements for the future of aggressive behaviors and situations of harassment and promote the regulation and control of anger and thereby strengthen personality in the teens. The scale of the problem downss the capacity of the protagonists, so it has to be worked as a school community, made up of parents, teachers and students. Given the complexity of the phenomenon, it is desirable to make several recommendations for its prevention.

Among them is the increase in the coexistence between parents and children, which has decreased considerably, often because both parents work and have little time to live with children. Maintain an everyday dialogue with children, mainly listen to them, and promote themselves to express the meaning and consequence of their actions, both positive and negative.

Prioritize conversations about the meaning and messages of the information the child receives, as well as responsibility and consequences for the use of means such as the internet and the use of digital networks. Avoid ambiguity between the standards and behaviors of both parents, teachers, and students. That is, to maintain a congruence between what is said and what is done.

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